Proposed changes to

London Luton Airport Arrivals

CAP1616 Stage 4

Step 4A(iii) Final Options Appraisal

Photo © Graham Custance

NATS-LLA Public

Roles

Action	Role	Date
Produced	Airspace Change Expert NATS Airspace and Future Operations	24/06/2021
Reviewed Approved	Airspace and Noise Performance Manager London Luton Airport	24/06/2021
Reviewed Approved	ATC Lead NATS Swanwick Development	24/06/2021
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Drafting and Publication History

Issue	Month/Year	Changes this issue
Issue 1.0	06/21	Published to CAA Portal

References

Ref No	Description	Hyperlinks
1	SAIP AD6 CAA web page – progress through CAP1616	Link to CAA portal Link to consultation site
2	Stage 1 Statement of Need	Link to document
3	Stage 1 Assessment Meeting Minutes	Link to document
4	Stage 1 Design Principles	Link to document
5	Stage 2 Design Options	Link to document
6	Stage 2 Design Principle Evaluation	Link to document
7	Stage 2 Initial Options Appraisal and Safety Assessment	Link to document
8	Stage 3 Consultation Document	Link to document
9	Stage 3 Full Options Appraisal	Link to document
10	Stage 3 Consultation Strategy	Link to document
10A	Stage 3 Step 3D Consultation Feedback Report and Technical Compliance Supplement	Link to report Link to CAA portal
10B	Stage 4 Step 4A(ii) The Final Airspace Design (layered map PDF)	Link to CAA portal
10D	Stage 4 Step 4A(i) Consultation Response Document	Link to CAA portal
11	Airspace change: Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, & on providing airspace information CAP1616	Link to document (Edition 4, March 2021)
12	Environmental requirements technical annex CAP1616A	Link to document
13	Definition of Overflight CAP1498	Link to document
14	Airspace Modernisation Strategy AMS CAP1711	Link to document
15	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. Introduction and Overview

1.1 **This is not a standalone document.** It should be read in conjunction with the following documents:

1.1.1 Stage 3 Step 3's Full Options Appraisal (Ref 9)

1.1.2 Stage 4 Step 4A(i) Consultation Response Document (Ref 10D)

What is the difference between this 4A(iii) Final Options Appraisal document and the Stage 3 Full Options Appraisal document?

1.2 We have made changes to the design based on consultation feedback (see Refs 10B and 10D for full details), which can be summarised as:

1.2.1 The holding pattern has been moved and the lowest normally useable altitude has been raised by 1,000ft.

1.2.2 Some higher-altitude routes have been shortened and kept higher for longer, to reduce the disbenefit in fuel consumption and CO_2, and to reduce noise impacts.

1.2.3 Option 1 Vectoring has progressed, Option 2 PBN Routes with Vectoring, has not.

1.2.4 The holding pattern adjustment and route adjustment has increased the likelihood of controllers building an efficient arrival sequence further away and higher up than in the consulted airspace design.

1.3 This document compares the consulted airspace design from Stage 3 against the final airspace design from Stage 4, in terms of analysis to quantify predicted impacts and to monetise them where possible.

1.4 Its primary purpose is to allow like-for-like comparisons of the same assessment criteria, so the differences can be attributed to design changes made following consultation.

1.5 Naming convention: The comparisons in this document will be made between:

1.5.1 **Option 0** baseline do-nothing (this option is for **comparison purposes** only);

1.5.2 **Option 1** as consulted at Stage 3; and

1.5.3 **Option 1A**, the final airspace design described in the companion Stage 4 documents.

1.5.4 For both Option 1 and Option 1A the results are also shown excluding the air traffic effects of LLA's Development Consent Order (DCO), and including the effects of the DCO, so that all four scenarios are covered.

1.5.5 We will not compare options with Option 2 as this has not progressed.

1.6 The analysis and forecast methodologies remain the same as the Step 3 Full Options Appraisal (Ref 9) and that document should be considered the 'master document' for methodology and sources of data.

1.7 The only exceptions are:

1.7.1 In the cost-benefit calculations, we have included for the first time approximate total costs for this airspace change project, up to implementation day.
These costs would be the same for both Option 1, Option 1A, without, or with, LLA's DCO.

1.7.2 An update to the Government's monetisation calculation method known as WebTAG. The relevant calculations from the original Step 3 Full Options Appraisal were repeated using the updated WebTAG method in order to compare like with like.

1.8 The relevant explanatory sections in the Step 3 Full Options Appraisal (Ref 9) are:

1.8.1 Section 2: Criteria against which the options have been assessed

1.8.2 Section 6: Analysis forecasts and methodology summaries

1.9 The next sections compare Options 0, 1 and 1A, followed by a cost-benefit analysis, a plain English safety assessment, a summary, and conclusions.

2. Option 0 – Baseline do-nothing scenario

2.1 This combined baseline option (do-nothing option) is included for comparison purposes only. It is not an option to be progressed.

<table>
<tr><th>Group</th><th>Impact</th><th>Level of Analysis</th><th>Evidence – see the row below each heading</th></tr>
<tr><td>Communities</td><td>Noise impact on health and quality of life</td><td>Quantitative impacts of LLA traffic
Qualitative (other impacts)</td><td>Noise contour, area covered, population count
Hospitals, places of worship and schools
This includes impacts on tranquillity and visual intrusion (Chilterns AONB).</td></tr>
<tr><td colspan="4">Noise Metric Images (contours) and Data Tables are provided in the consultation document. Annex D for 2022, Annex E for 2032 without DCO, and Annex F for 2032 with DCO. See Ref 9 Section 6 for the analysis forecasts and methodology summaries.
Data types:
Contours and summary tables
LAeq16hr Day, LAeq8hr Night N65 Day N60 Night CAP1498 Overflight 48.5° angle Day CAP1498 Overflight 48.5° angle Night
Numbers of hospitals, places of worship and schools

Data info:
Summer arrivals and departures (16 June to 15 Sept, forecast for the scenario years and types), average runway split (30% rwy 07, 70% rwy 25).
Fleet analysis assumptions: retire older/noisier aircraft and replace with equivalent newer quieter aircraft over the 10-year period (Fleet change is not due to this proposal, would happen regardless, and is common between analyses)
Population forecasts are from CACI[1], for 2021 and ten years later, 2031. Analysis using this population data was performed before the coronavirus pandemic caused a nine month delay to the planned implementation, to 2022. The population data for 2021 is a valid illustration for 2022, likewise 2031 for 2032, and it would be disproportionate to perform a new noise analysis.
WebTAG 10-year adverse impact cost data is based on differences from this baseline no-change option.

Tranquillity (quantitative estimate, qualitative discussion)
A 7-day sample of aircraft trajectories based on radar data was analysed (one 7-day sample per runway) from June 2019, to see how many aircraft overflew the Chilterns AONB below 7,000ft (see Consultation Document Annex G for illustrations).

The northern part of the AONB is overflown by some Rwy 07 arrivals below 7,000ft, mostly level at 5,000ft.
Number of overflights <5,000ft: 1+12=13
Number of overflights level 5,000ft: 705
Number of overflights 5,000ft-7,000ft: 30
Total overflights <7,000ft: 13+705+30=748

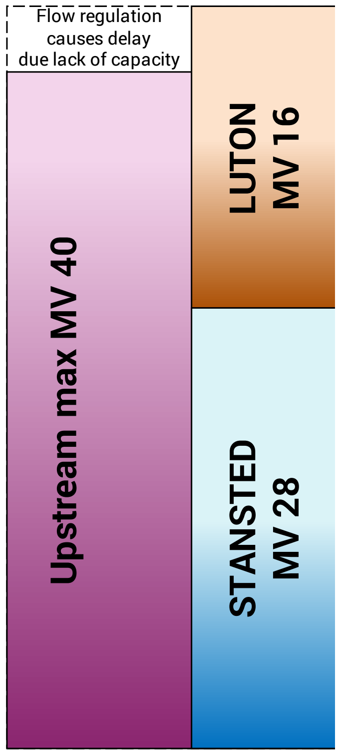
The southern part of the AONB is overflown by all Rwy 07 arrivals below 7,000ft and cannot be avoided by the final approach track.
Number of overflights <4,000ft: 11+211+720=942
Number of overflights 4,000ft-7,000ft: 447
Total overflights <7,000ft: 942+447=1,389

The southern part of the AONB is overflown by some Rwy 25 arrivals below 7,000ft, generally those shortcutting from the west direct to downwind right hand.
Number of overflights <4,000ft: 1
Number of overflights 4,000ft-7,000ft: 70
Total overflights <7,000ft: 1+70=71

This sets an estimated baseline for tranquillity, to allow for qualitative comparison.</td></tr>
<tr><td>Communities</td><td>Air quality</td><td>Qualitative</td><td>See also Government guidance Air Navigation Guidance 2017 (ANG 2017).</td></tr>
<tr><td colspan="4">Government guidance (ANG 2017) says that aircraft flying higher than 1,000ft are unlikely to have a significant impact on local air quality.
Today, arriving aircraft descend through 1,000ft between 4 and 2 nautical miles (about 7-4km) from touchdown at either end of the runway. This is close to landing, in the very final stages of the approach.</td></tr>
</table>

[1] CACI is the company that supplied the population and household data for the analysis

Option 0 Baseline Continued…

<table>
<tr><td>Communities</td><td>Historic environment</td><td>Quantitative estimate, qualitative discussion</td><td colspan="2">Overflight of registered historic parks and gardens below 4,000ft</td></tr>
<tr><td colspan="5">A 7-day sample of aircraft tracks based on radar data (one 7-day sample per runway) was analysed from June 2019, to see how many aircraft overflew historic parks and gardens below 4,000ft (see Consultation Document Annex H for illustrations).
Easterly arrivals:
Mentmore Towers: 481 overflights, of which 47+1=48 were below 4,000ft
10% of flights over this place were below 4,000ft, for this data sample
Luton Hoo (northern edge): 1,440 overflights, all but one of which was below 4,000ft
99.9% of flights over this place were below 4,000ft, for this data sample (indeed, were below 1,000ft)
This place is directly adjacent to final approach about 1-2nm from the runway
Westerly arrivals:
Julians: 394 overflights of which 68+8+2=78 were below 4,000ft
20% of flights over 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 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 sets an estimated baseline for overflight of the historic environment below 4,000ft, to allow for qualitative comparison.</td></tr>
<tr><td colspan="2">Wider society</td><td>Greenhouse gas impact</td><td>Quantitative</td><td>Fuel simulation analysis</td></tr>
<tr><td colspan="5">The options described later on use the NATS recognised fuel analysis tool to compare the differences from this baseline, which is the no-change option. From this, the greenhouse gas impacts can be estimated because the differences in aviation fuel burnt are proportional to the CO_2 equivalent emitted (for each kg of aviation fuel burnt, 3.18kg of CO_2 equivalent is emitted).</td></tr>
<tr><td colspan="2">Wider society</td><td>Capacity/ resilience</td><td>Quantitative/ qualitative</td><td>Monitoring value (MV)
Minutes of delay avoided due to improved traffic flows
Changes in number of radio exchanges</td></tr>
<tr><td colspan="5">Capacity (quantified)
All arrivals to LLA are entwined with arrivals to Stansted for most of their time in UK airspace, until they reach the holds. Only after leaving the holds are they separated into their respective arrival flows.
This means that LLA arrivals are highly dependent on Stansted arrivals and vice-versa.
For example, if a Stansted flight is at the lowest level in the hold and LLA aircraft are holding in the levels above, then any delay at Stansted Airport (like a temporarily closed runway) means the LLA arrivals are stuck and Air Traffic Controllers will find it difficult to extract them from the holds. This applies the other way around, should Stansted traffic get stuck above LLA traffic. The dependencies on each other cause capacity and resilience issues which we intend to solve through this airspace change proposal. So the main comparison will be, do the other options improve the situation compared to this baseline do-nothing scenario.
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.

Option 0 Baseline do-nothing flow management illustration (see Consultation Document Annex I)</td></tr>
</table>

Option 0 Baseline Continued…

Under this baseline no-change option, the MVs could not change, the intertwining of LLA arrivals with Stansted arrivals would continue, and there would be no opportunity to rebalance the workload. As traffic increases, it is more likely that the upstream MV would be breached, leading to flow regulations more often and for longer periods, causing extra complexity and workload for controllers and pilots. This is predicted to have a potential latent safety impact (unsustainable periods of over-demand) if the airspace design is not changed, hence this proposal's planned implementation before the main summer period of 2022.

See this section in each option for the forecast benefits.

Capacity (qualitatively assessed)

The broader impact of delay to the travelling public, businesses and local communities would not improve. The forecast increase in air traffic is likely to increase this impact in the future.

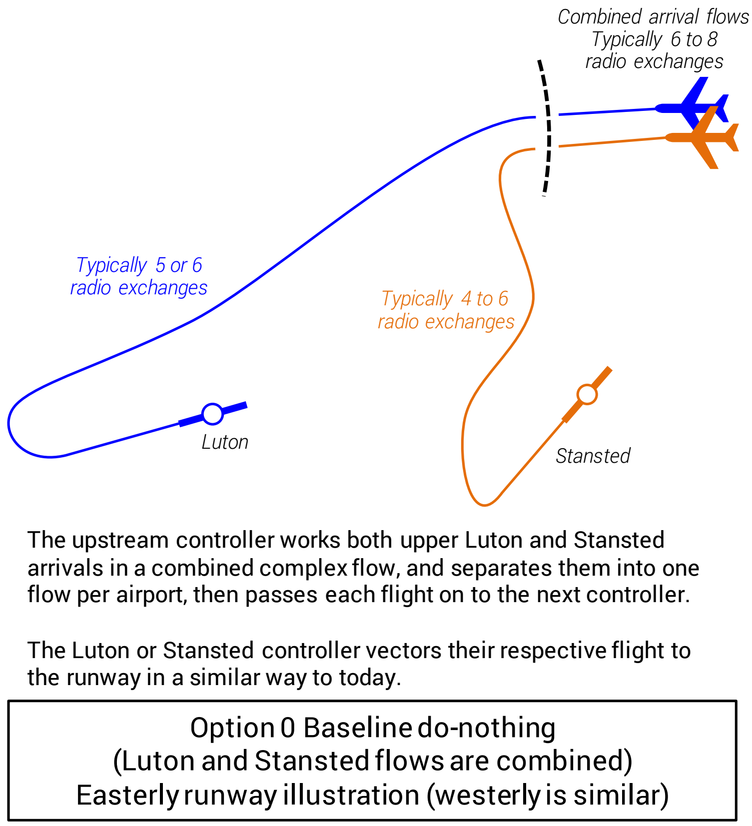
Resilience (quantified estimates, qualitatively discussed)

As described above, complexity for air traffic controllers builds rapidly for arrivals heading to LLA and Stansted as the arrival traffic increases.

Air traffic controllers can manage aircraft by providing heading and level instructions, which is referred to as vectoring. Vectoring is highly manual, tactical and intense because each instruction to the pilot must be read back by the pilot to the controller to ensure accuracy. Therefore, a single radio exchange to an aircraft involves at least two radio transmissions (one call, one response), or at least four if an error needs to be corrected (call, incorrect response, correction call, correct response).

The lower the need for radio exchanges per flight, the more resilient the airspace system because controllers can spend more time managing the overall flows and less time making constant adjustments to individual flights. Should there be any disruption, the lower the complexity, the easier it is to recover.

The illustration below is an extract from the consultation document Annex I (the full diagram shows all three options side by side).



The typical number of radio exchanges per flight for this scenario would be **12-16** (upper, 6-8 x2), **5-6** (LLA) and **4-6** (Stansted).

Under this Option 0 baseline, controllers working with arrivals in the complex do-nothing system would typically require **21-28 radio exchanges.** The number of radio exchanges for the westerly runways would be comparable.

General Aviation	Access	Qualitative	
The options described later on will estimate the differences from this baseline, which is the no-change option.			
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantified, monetised estimate	Cost per minute of delay avoided
The options described later on will estimate the differences from this baseline, which is the no-change option.			

Option 0 Baseline Continued...

General Aviation/ commercial airlines	Fuel Burn	Quantified, monetised estimate
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Commercial airlines	Training costs	Qualitative
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Commercial airlines	Other costs	Qualitative
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Airport/ ANSP	Infrastructure costs	Qualitative
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Airport/ ANSP	Operational costs	Qualitative
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Airport/ ANSP	Deployment costs	Qualitative
The options described later on will estimate the differences from this baseline, which is the no-change option.		
Government policy	Alignment with AMS	Qualitative
This baseline Option 0 is not aligned with the AMS.		

End of Baseline Option 0 table

3. Option 1 – As per consultation

This is the unmodified Option 1 as consulted on between 19th October 2020 and 5th February 2021.
The only differences in this document are due to an updated Government monetisation method (WebTAG) to ensure like for like comparison with Option 1A.

Group	Impact	Level of Analysis	Evidence – see the row below each heading
Communities	Noise impact on health and quality of life	Quantitative impacts of LLA traffic Qualitative (other impacts)	Noise contour, area covered, population count Hospitals, places of worship and schools This includes impacts on tranquillity and visual intrusion (Chilterns AONB). (Biodiversity is covered on p. 5 of Ref 9 para 2.30).

Noise Metric Images (contours) and Data Tables are provided in the consultation document. Annex D for 2022, Annex E for 2032 without DCO, and Annex F for 2032 with DCO. See Ref 9 Section 6 for the analysis forecasts and methodology summaries.

Data types:

Contours, overflight areas and summary tables

LAeq16hr Day, LAeq8hr Night N65 Day N60 Night CAP1498 Overflight 48.5° angle Day CAP1498 Overflight 48.5° angle Night

Numbers of hospitals, places of worship and schools

Data info:

Summer arrivals & departures (16 June-15 Sept, forecast for the scenario years and types), average runway split (30% rwy 07, 70% rwy 25).

Fleet analysis assumptions: retire older/noisier aircraft and replace with equivalent newer quieter aircraft over the 10-year period (Fleet change is not due to this proposal, would happen regardless, and is common between analyses)

Population forecasts are from CACI, for 2021 and ten years later, 2031. Analysis using this population data was performed before the coronavirus pandemic caused a nine month delay to the planned implementation, to 2022. The population data for 2021 is a valid illustration for 2022, likewise 2031 for 2032, and it would be disproportionate to perform a new noise analysis.

WebTAG 10-year adverse impact cost data is based on differences from the baseline no-change option and the comparison is made using 2021-2031 analyses which we contend are valid illustrations for 2022-2032.

The base year has been set to 2010 because it aligns with the most recent official valuations of health impacts on environmental noise exposure and is consistent with the example used in CAP1616a.

The full updated Excel WebTAG sheets will be supplied directly to the CAA.

Description *positive value reflects a **net benefit** (i.e. a reduction in noise)	2032 No DCO Option 1		2032 With DCO Option 1	
	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£471,306	-£30,221	£572,196	£402,581
Net present value of impact on sleep disturbance (£, 2010 prices):	£236,442	£98,896	-£105,328	£122,790
Net present value of impact on amenity (£, 2010 prices):	£282,335	-£81,645	£603,711	£205,978
Net present value of impact on AMI (£, 2010 prices):	£4,844	£4,844	£11,836	£11,836
Net present value of impact on stroke (£, 2010 prices):	-£20,793	-£20,793	£24,776	£24,776
Net present value of impact on dementia (£, 2010 prices):	-£31,521	-£31,521	£37,202	£37,202
Households experiencing increased daytime noise in forecast year:	2252		2798	
Households experiencing reduced daytime noise in forecast year:	2959		3858	
Households experiencing increased night time noise in forecast year:	872		979	
Households experiencing reduced night time noise in forecast year:	1156		934	

(These monetised numbers are slightly different compared with Ref 9's Option 1 because the WebTAG methodology has been updated. The number of households are unchanged.)

Tranquillity (quantitative estimate, qualitative discussion)

This Option 1 would not change the likelihood of overflight of the Chilterns AONB by LLA arrivals, compared with the quantified estimates provided in baseline Option 0. The proportions would be broadly similar, and at similar altitudes. (See Consultation Document Annex G for illustrations).

Group	Impact	Level of Analysis	Evidence
Communities	Air quality	Qualitative	See also Government guidance ANG2017 (Ref 15)

Government guidance says that aircraft flying higher than 1,000ft are unlikely to have a significant impact on local air quality.

Arriving aircraft would still descend through 1,000ft between 4 and 2 nautical miles (about 7-4km) from touchdown at either end of the runway. This is close to landing, in the very final stages of the approach, and there are no proposed changes this close to touchdown.

Option 1 As consulted - Continued…

<table>
<tr><th>Group</th><th>Impact</th><th>Level of Analysis</th><th>Evidence – see the row below each heading</th></tr>
<tr><td>Communities</td><td>Historic environment</td><td>Quantitative estimate, qualitative discussion</td><td>Overflight of registered historic parks and gardens below 4,000ft</td></tr>
<tr><td colspan="4">See Consultation Document Annex H for illustrations. Vectoring is unlikely to change significantly below 4,000ft, compared with Option 0.
The proportions would be broadly similar, and at similar altitudes.
For Runway 07:
Mentmore Towers is still likely to be overflown by c.10% of LLA arrivals below 4,000ft
The northern edge of Luton Hoo is still likely to be overflown by all arrivals below 4,000ft, indeed below 1,000ft, due to its location directly adjacent to final approach.
For Runway 25:
Julians Gardens is still likely to be overflown by c.20% of LLA arrivals below 4,000ft
Garden House is still likely to be overflown by c.87% of LLA arrivals below 4,000ft
St Paul’s Walden Bury would continue to be overflown by all LLA arrivals below 2,000ft.</td></tr>
<tr><td>Wider society</td><td>Greenhouse gas impact</td><td>Quantitative</td><td>Fuel simulation analysis</td></tr>
<tr><td colspan="4">In 2022, the changes would apply to a total of 172,459 combined LLA and Stansted arrivals, resulting in a net increase of 18,574 tonnes of CO_2e. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 20,129t, combined with forecast 101,719 Stansted arrivals, total benefit of 1,555t.

In 2032 without LLAL’s DCO, the changes would apply to a total of 173,150 combined LLA and Stansted arrivals, resulting in a net increase of 16,596 tonnes of CO_2e. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 20,129t, combined with forecast 102,410 Stansted arrivals, total benefit of 3,533t.

In 2032 with LLAL’s DCO, the changes would apply to a total of 193,910 combined LLA and Stansted arrivals, resulting in a net increase of 19,687 tonnes of CO_2e. These figures are the sum of forecast 91,500 LLA arrivals, total increase of 23,220t, combined with forecast 102,410 Stansted arrivals, total benefit of 3,533t.

WebTAG was used to assess the greenhouse gas impact over time from the proposed changes. Both options would yield a negative Net Present Value which reflects a disbenefit, i.e. a CO_2e increase.
Without LLAL’s DCO, there would be an increase of CO_2e in the opening year (2022) of 18,574t which would, over a 60 year appraisal period, total 193,441t.
WebTAG was also used to calculate the overall Net Present Value of CO_2e emissions increase for the non-traded sector at £1,368,665.
(This number is slightly different compared with Ref 9’s Option 1 because the WebTAG methodology has been updated.)

With LLAL’s DCO, there would be an increase of CO_2e in the opening year (2022) of 18,574t which would, over a 60 year appraisal period, total 210,425t.
WebTAG was also used to calculate the overall Net Present Value of CO_2e emissions increase for the non-traded sector at £1,473,211.
(This number is slightly different compared with Ref 9’s Option 1 because the WebTAG methodology has been updated.)
Traded and non-traded flights were categorised as intra-EU for traded (82.1% for LLA, 86.1% for Stansted) and all other flights as non-traded (17.9% for LLA, 13.9% for Stansted). These figures were calculated by analysing the origins and destinations for LLA and Stansted flights for 2019 and factored into the calculations, assuming the ratios remain constant for the WebTAG period.
The disbenefit primarily arises from the longer tracks flown by LLA arrivals, partially offset by the arrivals remaining higher for longer and less likely to enter the hold. Also there is some benefit to Stansted arrivals due to the separation from LLA arrivals at an early, higher stage of flight.</td></tr>
</table>

Option 1 As consulted - Continued…

Wider society	Capacity/ resilience	Quantitative/ qualitative	Monitoring value (MV) Minutes of delay avoided due to improved traffic flows Changes in number of radio exchanges

Capacity (quantified)

All arrivals to LLA are entwined with arrivals to Stansted for most of their time in UK airspace, until they reach the holds. Only after leaving the holds are they separated into their respective arrival flows. This means that LLA arrivals are highly dependent on Stansted arrivals and vice-versa. For example, if a Stansted flight is at the lowest level in the hold and LLA aircraft are holding in the levels above, then any delay at Stansted Airport (like a temporarily closed runway) means the LLA arrivals are stuck and Air Traffic Controllers will find it difficult to extract them from the holds. This applies the other way around, should Stansted traffic get stuck above LLA traffic. The dependencies on each other cause capacity and resilience issues which we intend to solve through this airspace change proposal. So the main comparison will be, do the other options improve the situation compared to this baseline do-nothing scenario. 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.

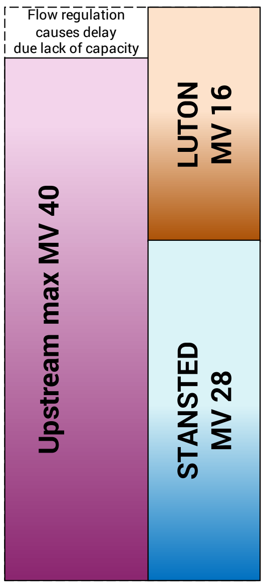
When the actual number of upstream movements per hour approaches the MV (known as over-demand), safety is highest priority, so the air traffic control supervisor considers applying flow regulations.

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.

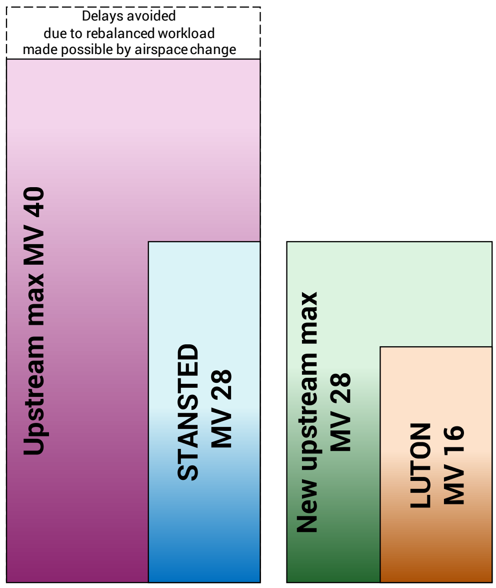
The LUTON arrival flow has an MV of 16, STANSTED an MV of 28, totalling 44, which is greater than the upstream MV. This means flow regulation is more likely to be applied when both LUTON and STANSTED are busy.

The LUTON and STANSTED arrival flows cannot be separated without changing the airspace design.

Under Option 1 and Option 1A 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.



Option 0 Baseline do-nothing flow management illustration (left)



Option 1 and Option 1A flow management illustration (right)

(See also see Consultation Document Annex I). The extra capacity created by separating the LLA flow from the Stansted upstream flow removes the probability of upstream delay.

In 2022 the forecast shows an estimated net delay avoidance (reduction) of c.10,200 minutes given either Option 1 or Option 1A.

In 2032 this forecast rises to an estimated saving of c.11,200 minutes (with or without LLAL's DCO).

Capacity (qualitatively assessed)

The broader impact of delay to the travelling public, businesses and local communities would reduce. There would be additional capacity to absorb delay to cater for the forecast return and allow for an increase in air traffic.

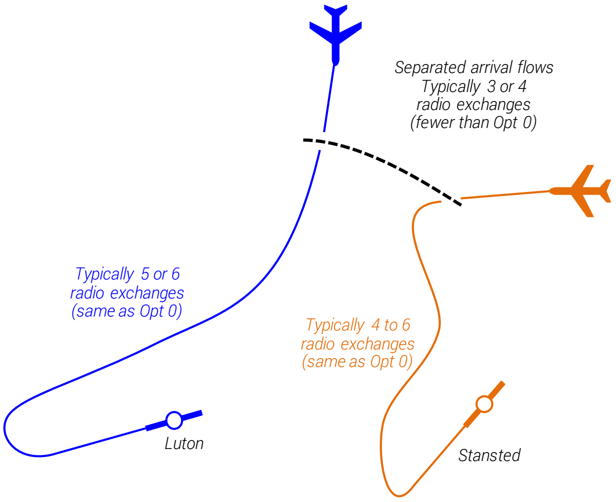
Resilience (quantified estimates, qualitatively discussed)

Air traffic controllers can manage aircraft by providing heading and level instructions, which is referred to as vectoring. Vectoring is highly manual, tactical and intense because each instruction to the pilot must be read back by the pilot to the controller to ensure accuracy. Therefore, a single radio exchange to an aircraft involves at least two radio transmissions (one call, one response), or at least four if an error needs to be corrected (call, incorrect response, correction call, correct response).

Option 1 As consulted - Continued…

Radio exchanges are an indicator for resilience. The lower the need for radio exchanges per flight, the more resilient the airspace system because controllers can spend more time managing the overall flows and less time making constant adjustments to individual flights. Should there be any disruption, the lower the complexity, the easier it is to recover.

The illustration below is an extract from the consultation document Annex I.



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

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

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

The typical number of radio exchanges per flight for this scenario would be **6-8** (upper, 3-4 x2), **5-6** (Luton) and **4-6** (Stansted).

Under this Option 1, controllers working with arrivals from the simplified upper system would typically require **15-20** radio exchanges which is **6-8 fewer** than Option 0's 21-28 radio exchanges.

This makes Option 1 more resilient than Option 0 by the predicted removal of 6-8 radio exchanges from the controllers' workloads.

The number of radio exchanges for the westerly runway configurations would be comparable.

The lower the need for radio exchanges per flight, the more resilient the airspace system because controllers can spend more time managing the overall flows and recovering from the disruptive event, and less time making constant adjustments to individual flights.

Should there be any disruption, the lower the complexity, the easier it is to recover.

General Aviation (GA)	Access	Qualitative	

This Option 1 requires an increase in the volume of controlled airspace – see the consultation document's aviation technical section 7 for full details, summarised as four new volumes of CAS with bases FL75, FL85, FL105, FL125 and the raising of two low-altitude CAS bases southeast of Stansted Airport.

Qualitatively this impact would be a potential increased access restriction on GA who fly FL75 and above in the region, compared with the baseline do-nothing upper Option 0, but a reduced restriction at lower altitudes near Stansted.

Although not a requirement under CAP1616, this section of the table considers impacts on military aviation. Qualitatively this impact would be a potential increased access restriction on the MoD, specifically USAFE operating from RAF Lakenheath and RAF Mildenhall who fly FL75 and above in the region, compared with the baseline do-nothing upper Option 0.

General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantified, monetised estimate	Cost per minute of delay avoided

Earlier in this table, capacity was discussed and quantified. Since April 2018, NATS monetises airline delay costs at £3.68/min where delay ≤ 15 mins and £53.50/min where delay > 15 mins.

In both Option 1 and Option 1A we presume the individual delays avoided are ≤ 15 mins, at £3.68/min, and the costs shown here assume no change year on year.

In 2022 the forecast shows an estimated net delay avoidance (reduction) of c.10,200 minutes given either Option 1 or Option 1A.

This monetises at 10,200x£3.68=£37,500pa

In 2032 this forecast rises to an estimated saving of c.11,200 minutes (with or without LLAL's DCO).

This monetises at 11,200x£3.68=£41,200pa

Option 1 As consulted - Continued…

General Aviation/ commercial airlines	Fuel Burn	Quantified, monetised estimate

This section provides data applicable to each Option using the no-DCO and with-DCO traffic forecasts and is calculated using the same data as the Greenhouse Gas section earlier in this table. The ratio of 1kg fuel burnt emits 3.18kg of CO_2e. Each tonne of jet fuel in Europe cost 356.76GBP based on IATA jet fuel website, at 457.38USD converted to GBP at 0.78 using XE.com's rate (both as of 28 Feb 2020#).

The overall fuel cost disbenefit would be c.£2.1m in 2022, £1.9m in 2032 (no DCO) or £2.2m in 2032 (with DCO) – see left panel of table below. This would be apportioned as per the forecasts described in the Greenhouse Gas section earlier, duplicated here.

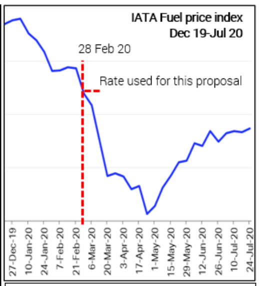
In 2022, the changes would apply to a total of 172,459 combined LLA and Stansted arrivals, resulting in a net increase of 5,841 tonnes of fuel. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 6,330t, combined with forecast 101,719 Stansted arrivals, total benefit of 489t.

In 2032 without LLAL's DCO, the changes would apply to a total of 173,150 combined LLA and Stansted arrivals, resulting in a net increase of 5,219 tonnes of fuel. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 6,330t, combined with forecast 102,410 Stansted arrivals, total benefit of 1,111t.

In 2032 with LLAL's DCO, the changes would apply to a total of 193,910 combined LLA and Stansted arrivals, resulting in a net increase of 6,191 tonnes of fuel. These figures are the sum of forecast 91,500 LLA arrivals, total increase of 7,302t, combined with forecast 102,410 Stansted arrivals, total benefit of 1,111t.

	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 1A	-1,932	-1,310	-1,330
Reduced disbenefit	-3,909	-3,909	-4,861
	CO_2 equivalent (3.18 conversion)		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-18,574	-16,596	-19,687
Option 1A	-6,144	-4,166	-4,229
Reduced disbenefit	-12,431	-12,431	-15,458
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 1A	-£689,000	-£467,000	-£474,000
Reduced disbenefit	-£1,395,000	-£1,395,000	-£1,735,000

	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
Opt 1	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
Opt 1A	t fuel total	-2421	-2421	-2441
	t fuel per flight	-0.034	-0.034	-0.027
	t CO2e per flight	-0.109	-0.109	-0.085
Additional cost per flight	£/flt Opt 1	-£31.92	-£31.92	-£28.47
	£/flt Opt 1A	-£12.21	-£12.21	-£9.52
Opt1 minus Opt1A	Reduced disbenefit	-£19.71	-£19.71	-£18.95
	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 1A	£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.

These costs assume no change in fuel cost per tonne and currency exchange rate from 28 Feb 2020#.
Qualitatively, Option 1 is not expected to cause any fuel cost disbenefit to GA. #For ease of comparison with Stage 3 Options Appraisal

Commercial airlines	Training costs	Qualitative

Qualitatively, flight procedures change worldwide with each AIRAC cycle and airlines would update their procedures accordingly, training if required. This proposal is not anticipated to require additional training costs for airlines.

Commercial airlines	Other costs	Qualitative

No other airline costs are foreseen.

Airport/ ANSP	Infrastructure costs	Qualitative

This proposal is not expected to change airport or ANSP infrastructure, beyond the initial deployment phase which would require some systems engineering amendments.

Airport/ ANSP	Operational costs	Qualitative

This proposal is not expected to change airport or ANSP operational costs.

Airport/ ANSP	Deployment costs	Quantified, monetised estimate

This proposal is expected to require significant air traffic controller training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, the extensive use of the NATS simulator facility, also 25 controllers and 5 assistants based at LLA. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availabilty of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery. Other costs include that of the end to end CAP1616 process. Without or with the DCO, this is estimated to be £4.13m, for both sponsors combined.

Government policy	Alignment with AMS	Qualitative

This Option 1 is partially aligned with the AMS because the upper-altitude arrivals are systemised using appropriate PBN routes. It is not fully aligned because the lower-altitude arrivals are not systemised at all, and operate in the same way as baseline Option 0.

End of Option 1 table.

4. Option 1A – Final Design

This option is similar to Option 1 with changes to the holding region, route adjustments and CAS volume reductions compared with Option 1 (see Ref 10B and 10D for details).

Group	Impact	Level of Analysis	Evidence – see the row below each heading
Communities	Noise impact on health and quality of life	Quantitative impacts of LLA traffic Qualitative (other impacts)	Noise contour, area covered, population count Hospitals, places of worship and schools This includes impacts on tranquillity and visual intrusion (Chilterns AONB). (Biodiversity is covered on page 5).

Noise Metric Images (contours) and Data Tables are provided in the consultation document. Annex D for 2022, Annex E for 2032 without DCO, and Annex F for 2032 with DCO. See Ref 9 Section 6 for the analysis forecasts and methodology summaries.

Data types:

Contours, overflight areas and summary tables (images only, Excel tables supplied to CAA directly)

LAeq16hr Day, LAeq8hr Night N65 Day N60 Night CAP1498 Overflight 48.5° angle Day CAP1498 Overflight 48.5° angle Night

Numbers of hospitals, places of worship and schools

Data info:

Summer arrivals & departures (16 June-15 Sept, forecast for the scenario years and types), average runway split (30% rwy 07, 70% rwy 25).

Fleet analysis assumptions: retire older/noisier aircraft and replace with equivalent newer quieter aircraft over the 10-year period (Fleet change is not due to this proposal, would happen regardless, and is common between analyses)

Population forecasts are from CACI, for 2021 and ten years later, 2031. Analysis using this population data was performed before the coronavirus pandemic caused a nine month delay to the planned implementation, to 2022. The population data for 2021 is a valid illustration for 2022, likewise 2031 for 2032, and it would be disproportionate to perform a new noise analysis.

WebTAG 10-year adverse impact cost data is based on differences from the baseline no-change option and the comparison is made using 2021-2031 analyses which we contend are valid illustrations for 2022-2032.

The base year has been set to 2010 because it aligns with the most recent official valuations of health impacts on environmental noise exposure and is consistent with the example used in CAP1616a.

The full Excel WebTAG sheets will be supplied directly to the CAA.

Description *positive value reflects a **net benefit** (i.e. a reduction in noise)	2032 No DCO Option 1A		2032 With DCO Option 1A	
	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£471,306	-£30,221	£572,196	£402,581
Net present value of impact on sleep disturbance (£, 2010 prices):	£236,442	£98,896	-£105,328	£122,790
Net present value of impact on amenity (£, 2010 prices):	£282,335	-£81,645	£603,711	£205,978
Net present value of impact on AMI (£, 2010 prices):	£4,844	£4,844	£11,836	£11,836
Net present value of impact on stroke (£, 2010 prices):	-£20,793	-£20,793	£24,776	£24,776
Net present value of impact on dementia (£, 2010 prices):	-£31,521	-£31,521	£37,202	£37,202
Households experiencing increased daytime noise in forecast year:	2252		2798	
Households experiencing reduced daytime noise in forecast year:	2959		3858	
Households experiencing increased night time noise in forecast year:	872		979	
Households experiencing reduced night time noise in forecast year:	1156		934	

The numbers in this table are the same as for Option 1 because the same vectoring arrival concept is used for both, and there would be minimal change to flightpaths below 5,000ft which is where these impacts are measured. It would not be proportionate to reperform noise analysis when the differences between the Options occur above 5,000ft.

Option 1A would also keep aircraft higher for longer, and if the hold needed to be used, it would be used 1,000ft higher than Option 1. The adjusted position of the hold is further away from the towns of Huntingdon and St Neots. Aircraft are likely to be slightly higher for longer on several of the arrival routes. The adjusted position of the hold is likely to improve dispersal between FL80-5,000ft when the hold is not in use.

Qualitatively, these items would reduce the overall noise impact under the new airspace volumes compared with Option 1.

However, the CAA-sourced measurements only go down to 55dB LAmax for the most typical aircraft descending c.8,000ft, therefore the same aircraft at 9,000ft can only be said to be 'less than 55dB LAmax'.

Tranquillity (qualitative discussion) – See Consultation Document Annex G for illustrations

This Option 1A would not change the likelihood of overflight of the Chilterns AONB by LLA arrivals, compared with the quantified estimates provided in baseline Option 0 and Option 1 as consulted. The proportions would be broadly similar, and at similar altitudes. (See Consultation Document Annex G for illustrations).

Group	Impact	Level of Analysis	Evidence
Communities	Air quality	Qualitative	See also Government guidance ANG2017 (Ref 15).

Government guidance says that aircraft flying higher than 1,000ft are unlikely to have a significant impact on local air quality.

Arriving aircraft would still descend through 1,000ft between 4 and 2 nautical miles (about 7-4km) from touchdown at either end of the runway. This is close to landing, in the very final stages of the approach, and there are no proposed changes this close to touchdown.

Option 1A Final Design Continued…

Communities	Historic environment	Quantitative estimate, qualitative discussion	Overflight of registered historic parks and gardens below 4,000ft

See Consultation Document Annex H for illustrations. Vectoring is unlikely to change significantly below 4,000ft, compared with Option 0 or Option 1. The proportions would be broadly similar, and at similar altitudes.

For Runway 07:

Mentmore Towers is still likely to be overflown by c.10% of LLA arrivals below 4,000ft

The northern edge of Luton Hoo is still likely to be overflown by all arrivals below 4,000ft, indeed below 1,000ft, due to its location directly adjacent to final approach.

For Runway 25:

Julians Gardens is still likely to be overflown by c.20% of LLA arrivals below 4,000ft

Garden House is still likely to be overflown by c.87% of LLA arrivals below 4,000ft

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

Wider society	Greenhouse gas impact	Quantitative	Fuel simulation analysis

In 2022, the changes would apply to a total of 172,459 combined LLA and Stansted arrivals, resulting in a net increase of 6,144 tonnes of CO_2e. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 7,699t, combined with forecast 101,719 Stansted arrivals, total benefit of 1,555t.

In 2032 without LLAL's DCO, the changes would apply to a total of 173,150 combined LLA and Stansted arrivals, resulting in a net increase of 4,166 tonnes of CO_2e. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 7,699t, combined with forecast 102,410 Stansted arrivals, total benefit of 3,533t.

In 2032 with LLAL's DCO, the changes would apply to a total of 193,910 combined LLA and Stansted arrivals, resulting in a net increase of 4,229 tonnes of CO_2e. These figures are the sum of forecast 91,500 LLA arrivals, total increase of 7,762t, combined with forecast 102,410 Stansted arrivals, total benefit of 3,533t.

WebTAG was used to assess the greenhouse gas impact over time from the proposed changes. Both options would yield a negative Net Present Value which reflects a disbenefit, i.e. a CO_2e increase.

Without LLAL's DCO, there would be an increase of CO_2e in the opening year (2022) of 6,144t which would, over a 60 year appraisal period, total 56,703t.

WebTAG was also used to calculate the overall Net Present Value of CO_2e emissions increase for the non-traded sector at £432,274.

With LLAL's DCO, there would be an increase of CO_2e in the opening year (2022) of 6,144t which would, over a 60 year appraisal period, total 57,052t.

WebTAG was also used to calculate the overall Net Present Value of CO_2e emissions increase for the non-traded sector at £434,606.

Traded and non-traded flights were categorised as intra-EU for traded (82.1% for LLA, 86.1% for Stansted) and all other flights as non-traded (17.9% for LLA, 13.9% for Stansted). These figures were calculated by analysing the origins and destinations for LLA and Stansted flights for 2019 and factored into the calculations, assuming the ratios remain constant for the WebTAG period.

The disbenefit compared with Option 1 has reduced. The tracks flown by LLA arrivals would still be longer than the baseline Option 0 however this Option 1A has reduced the track miles compared with Option 1 where possible. Option 1A's arrivals would also remain higher for longer due to the revised routing and CAS bases. If the hold was used, the lowest level would be 1,000ft higher under this Option 1A than Option 1. The adjustment to the hold position and route confluence provides additional vectoring space in the region south and east of the hold, meaning controllers are more likely to be able to bypass the hold so aircraft are less likely to enter the hold.

Also there is some benefit to Stansted arrivals due to the separation from LLA arrivals at an early, higher stage of flight.

Option 1A Final Design Continued…

Wider society	Capacity/ resilience	Quantitative/ qualitative	Monitoring value Minutes of delay avoided due to improved traffic flows Changes in number of radio exchanges

Capacity (quantified)

All arrivals to LLA are entwined with arrivals to Stansted for most of their time in UK airspace, until they reach the holds. Only after leaving the holds are they separated into their respective arrival flows. This means that LLA arrivals are highly dependent on Stansted arrivals and vice-versa. For example, if a Stansted flight is at the lowest level in the hold and LLA aircraft are holding in the levels above, then any delay at Stansted Airport (like a temporarily closed runway) means the LLA arrivals are stuck and Air Traffic Controllers will find it difficult to extract them from the holds. This applies the other way around, should Stansted traffic get stuck above LLA traffic. The dependencies on each other cause capacity and resilience issues which we intend to solve through this airspace change proposal. So the main comparison will be, do the other options improve the situation compared to this baseline do-nothing scenario. 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.

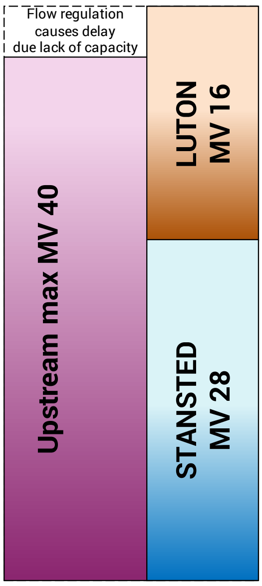
When the actual number of upstream movements per hour approaches the MV (known as over-demand), safety is highest priority, so the air traffic control supervisor considers applying flow regulations.

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.

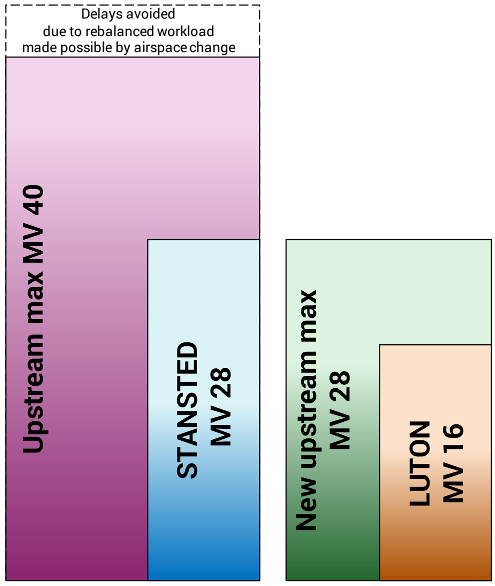
The LUTON arrival flow has an MV of 16, STANSTED an MV of 28, totalling 44, which is greater than the upstream MV. This means flow regulation is more likely to be applied when both LUTON and STANSTED are busy.

The LUTON and STANSTED arrival flows cannot be separated without changing the airspace design.

Under Option 1 and Option 1A 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.



Option 0 Baseline do-nothing flow management illustration (left)



Option 1 and Option 1A flow management illustration (right)

(See also see Consultation Document Annex I). The extra capacity created by separating the LLA flow from the Stansted upstream flow removes the probability of upstream delay.

In 2022 the forecast shows an estimated net delay avoidance (reduction) of c.10,200 minutes given either Option 1 or Option 1A.

In 2032 this forecast rises to an estimated saving of c.11,200 minutes (with or without LLAL's DCO).

Capacity (qualitatively assessed)

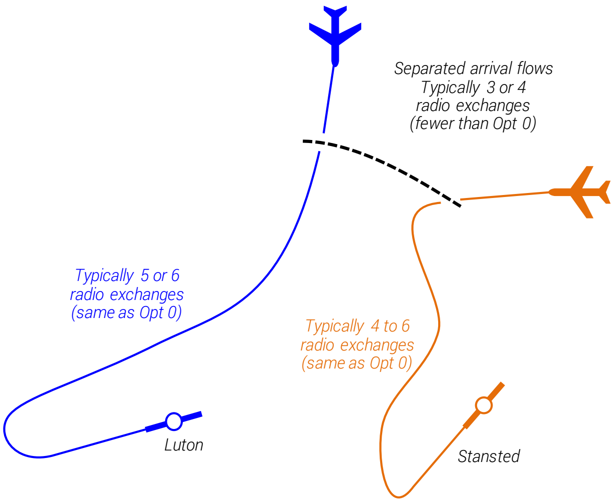
The broader impact of delay to the travelling public, businesses and local communities would reduce. There would be additional capacity to absorb delay to cater for the forecast return and allow for an increase in air traffic.

Resilience (quantified estimates, qualitatively discussed)

Air traffic controllers can manage aircraft by providing heading and level instructions, which is referred to as vectoring. Vectoring is highly manual, tactical and intense because each instruction to the pilot must be read back by the pilot to the controller to ensure accuracy. Therefore, a single radio exchange to an aircraft involves at least two radio transmissions (one call, one response), or at least four if an error needs to be corrected (call, incorrect response, correction call, correct response).

Option 1A Final Design Continued…

This is the same information as Option 1 as the concept is identical. Radio exchanges are an indicator for resilience. The lower the need for radio exchanges per flight, the more resilient the airspace system because controllers can spend more time managing the overall flows and less time making constant adjustments to individual flights. Should there be any disruption, the lower the complexity, the easier it is to recover. The illustration below is an extract from the consultation document Annex I.



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

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

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

The typical number of radio exchanges per flight for this scenario would be 6-8 (upper, 3-4 x2), 5-6 (Luton) and 4-6 (Stansted).

Under this Option 1A, controllers working with arrivals from the simplified upper system would typically require 15-20 radio exchanges which is 6-8 fewer than Option 0's 21-28 radio exchanges.

This makes Option 1 more resilient than Option 0 by the predicted removal of 6-8 radio exchanges from the controllers' workloads.

The number of radio exchanges for the westerly runway configurations would be comparable.

The lower the need for radio exchanges per flight, the more resilient the airspace system because controllers can spend more time managing the overall flows and recovering from the disruptive event, and less time making constant adjustments to individual flights.

Should there be any disruption, the lower the complexity, the easier it is to recover.

General Aviation (GA)	Access	Qualitative	

This Option 1A requires a similar increase in the volume of controlled airspace, but 10% less by area than that required by Option 1.

See Refs 10B and 10D for details of the differences in CAS. Quantitatively, Option 1 would require c.473nm^2 of CAS with Option 1A requiring c.424nm^2. In both cases, all CAS would be required FL75+.

Qualitatively this impact would be a potential increased access restriction on GA who fly FL75 and above in the region, compared with the baseline do-nothing upper Option 0, but a reduced restriction at lower altitudes near Stansted and overall a lesser impact than Option 1.

We have engaged GA organisations in order to offer access under set conditions, further mitigating impacts on these stakeholders (details in Ref 10D).

Although not a requirement under CAP1616, this section of the table considers impacts on military aviation. Qualitatively this impact would be a potential increased access restriction on the MoD, specifically USAFE operating from RAF Lakenheath and RAF Mildenhall who fly FL75 and above in the region, compared with the baseline do-nothing upper Option 0. However, we have worked with USAFE to mitigate impacts on their operation (details in Ref 10D). Additionally, 78 Sqn Swanwick (Military) would also be partially impacted and we have likewise worked with them to mitigate impacts on their operation.

General Aviation/ commercial airlines	Economic impact from increased effective capacity	Quantified, monetised estimate	Cost per minute of delay avoided

Earlier in this table, capacity was discussed and quantified. Since April 2018, NATS monetises airline delay costs at £3.68/min where delay ≤ 15 mins and £53.50/min where delay > 15 mins.

In both Option 1 and Option 1A we presume the individual delays avoided are ≤ 15 mins, at £3.68/min, and the costs shown here assume no change year on year.

In 2022 the forecast shows an estimated net delay avoidance (reduction) of c.10,200 minutes given either Option 1 or Option 1A

This monetises at 10,200*£3.68=£37,500pa

In 2032 this forecast rises to an estimated saving of c.11,200 minutes (with or without LLAL's DCO).

This monetises at 11,200*£3.68=£41,200pa

Option 1A Final Design Continued…

General Aviation/ commercial airlines	Fuel Burn	Quantified, monetised estimate

This section provides data applicable to each Option using the no-DCO and with-DCO traffic forecasts and is calculated using the same data as the Greenhouse Gas section earlier in this table. The ratio of 1kg fuel burnt emits 3.18kg of CO_2e. Each tonne of jet fuel in Europe cost 356.76GBP based on IATA jet fuel website, at 457.38USD converted to GBP at 0.78 using XE.com's rate (both as of 28 Feb 2020#).

The overall fuel cost disbenefit would be c.£690k in 2022, £470k in 2032 (no DCO) or £470k in 2032 (with DCO) – see left panel of table below. This would be apportioned as per the forecasts described in the Greenhouse Gas section earlier, duplicated here.

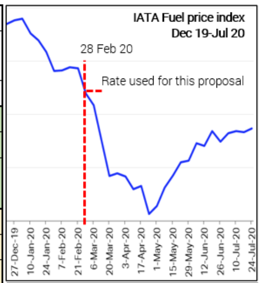
In 2022, the changes would apply to a total of 172,459 combined LLA and Stansted arrivals, resulting in a net increase of 1,932 tonnes of fuel. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 2,421t, combined with forecast 101,719 Stansted arrivals, total benefit of 489t.

In 2032 without LLAL's DCO, the changes would apply to a total of 173,150 combined LLA and Stansted arrivals, resulting in a net increase of 1,310 tonnes of fuel. These figures are the sum of forecast 70,740 LLA arrivals, total increase of 2,421t, combined with forecast 102,410 Stansted arrivals, total benefit of 1,111t.

In 2032 with LLAL's DCO, the changes would apply to a total of 193,910 combined LLA and Stansted arrivals, resulting in a net increase of 1,330 tonnes of fuel. These figures are the sum of forecast 91,500 LLA arrivals, total increase of 2,441t, combined with forecast 102,410 Stansted arrivals, total benefit of 1,111t.

	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 1A	-1,932	-1,310	-1,330
Reduced disbenefit	-3,909	-3,909	-4,861
	CO_2 equivalent (3.18 conversion)		
Do Nothing	Baseline	Baseline	Baseline
Option 1	-18,574	-16,596	-19,687
Option 1A	-6,144	-4,166	-4,229
Reduced disbenefit	-12,431	-12,431	-15,458
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 1A	-£689,000	-£467,000	-£474,000
Reduced disbenefit	-£1,395,000	-£1,395,000	-£1,735,000

		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
Opt 1	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
Opt 1A	t fuel total	-2421	-2421	-2441
	t fuel per flight	-0.034	-0.034	-0.027
	t CO2e per flight	-0.109	-0.109	-0.085
Additional cost per flight	£/flt Opt 1	-£31.92	-£31.92	-£28.47
	£/flt Opt 1A	-£12.21	-£12.21	-£9.52
Opt1 minus Opt1A	Reduced disbenefit	-£19.71	-£19.71	-£18.95
	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 1A	£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.

These costs assume no change in fuel cost per tonne and currency exchange rate from 28 Feb 2020#.
Qualitatively, Option 1A is not expected to cause any fuel cost disbenefit to GA. #For ease of comparison with Stage 3 Options Appraisal

Commercial airlines	Training costs	Qualitative

Qualitatively, flight procedures change worldwide with each AIRAC cycle and airlines would update their procedures accordingly, training if required. This proposal is not anticipated to require additional training costs for airlines.

Commercial airlines	Other costs	Qualitative

No other airline costs are foreseen.

Airport/ ANSP	Infrastructure costs	Qualitative

This proposal is not expected to change airport or ANSP infrastructure, beyond the initial deployment phase which would require some systems engineering amendments.

Airport/ ANSP	Operational costs	Qualitative

This proposal is not expected to change airport or ANSP operational costs.

Airport/ ANSP	Deployment costs	Quantified, monetised estimate

This proposal is expected to require significant air traffic controller training, in the order of 120-150 controllers and c.50 assistants at NATS Swanwick, the extensive use of the NATS simulator facility, also 25 controllers and 5 assistants based at LLA. Support staff are required to run the simulator – planning, training staff, data preparation and testing, pseudo pilots, safety analysts, outputs to be recorded and reported etc. Some staff may only require briefings. There may be occasions where the reduced availabilty of operational controllers during their conversion training could mean operational rostering becomes a factor when considering continuous service delivery. Other costs include that of the end to end CAP1616 process. Without or with the DCO, this is estimated to be £4.13m, for both sponsors combined.

Government policy	Alignment with AMS	Qualitative

This Option 1A is partially aligned with the AMS because the upper-altitude arrivals are systemised using appropriate PBN routes. It is not fully aligned because the lower-altitude arrivals are not systemised at all, and operate in the same way as baseline Option 0 and consulted Option 1.

End of Option 1A table.

5. Cost-Benefit Analysis

5.1 Four cost-benefit analysis tables are provided, giving the Net Present Value (NPV)[2] for the consulted Option 1 without and with LLAL's DCO, and the final design Option 1A.

5.2 A summary of the differences between cost benefit analyses is presented in Table 1 rounded to the nearest £1,000. Negative numbers indicate a cost or disbenefit.

5.3 For the conclusions drawn, see Section 7 on p. 23.

Without DCO	NPV	With DCO	NPV
Option 1 (Table 2)	-£ 27,998,000	Option 1 (Table 4)	-£ 30,001,000
Option 1A (Table 3)	-£ 10,864,000	Option 1A (Table 5)	-£ 10,892,000
Difference (Opt 1A minus Opt 1)	**£17,134,000**	**Difference** (Opt 1A minus Opt 1)	**£19,109,000**

Table 1 Rounded summary of cost benefit analyses showing the differences in NPVs

5.4 The final design Option 1A would provide a significantly reduced disbenefit compared with the consulted Option 1, for either DCO scenario.

5.5 The tables on the following pages are based on the example provided in CAP1616 (Ref 11) Table E3 using a social time preference rate to discount at 3.5%.

[2] 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.

Negative values are cost or disbenefit	2022	2023	2024	2025	2026	202$7$	2028	2029	2030	2031	2032	Net
Year	0	1	2	3	4	5	6	7	8	9	10	Present
Discount factor	1	0.9662	0.9335	0.9019	0.8714	0.8420	0.8135	0.7860	0.7594	0.7337	0.7089	Value
Option 1 Without DCO												
Net community benefit (Noise)	-£4,678	-£2,718	-£847	£946	£2,670	£4,334	£5,943	£7,501	£9,014	£10,478	£11,893	
Net community benefit (CO_2)	-£140,267	-£136,291	-£132,394	-£128,576	-£124,837	-£121,177	-£119,104	-£115,539	-£112,055	-£116,601	-£121,823	
Net airspace users benefit (CO_2)	-£235,871	-£283,761	-£326,863	-£357,874	-£392,661	-£423,531	-£444,120	-£468,237	-£489,173	-£507,151	-£527,881	
Net airspace users benefit (Fuel costs)	-£2,084,000	-£2,062,000	-£2,039,000	-£2,017,000	-£1,995,000	-£1,973,000	-£1,951,000	-£1,929,000	-£1,906,000	-£1,884,000	-£1,862,000	
Net airspace users benefit (Delay)	£37,500	£37,870	£38,240	£38,610	£38,980	£39,350	£39,720	£40,090	£40,460	£40,830	£41,200	
Deployment costs	-£4,130,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	NPV
Present value (rounded to nearest whole £1,000, NPV is sum of unrounded data)	-£6,557,000	-£2,378,000	-£2,328,000	-£2,270,000	-£2,219,000	-£2,168,000	-£2,112,000	-£2,061,000	-£2,009,000	-£1,966,000	-£1,929,000	**-£27,998,000**

Table 2 Cost Benefit Analysis Option 1 without DCO

Negative values are cost or disbenefit	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Net
Year	0	1	2	3	4	5	6	7	8	9	10	Present
Discount factor	1	0.9662	0.9335	0.9019	0.8714	0.8420	0.8135	0.7860	0.7594	0.7337	0.7089	Value
Option 1A Without DCO												
Net community benefit (Noise)	-£4,678	-£2,718	-£847	£946	£2,670	£4,334	£5,943	£7,501	£9,014	£10,478	£11,893	
Net community benefit (CO_2)	-£48,113	-£46,017	-£43,977	-£41,995	-£40,068	-£38,198	-£36,848	-£35,059	-£33,324	-£33,959	-£34,717	
Net airspace users benefit (CO_2)	-£77,358	-£90,902	-£102,161	-£108,999	-£116,389	-£122,001	-£124,131	-£126,767	-£128,041	-£128,079	-£128,332	
Net airspace users benefit (Fuel costs)	-£689,000	-£667,000	-£645,000	-£623,000	-£600,000	-£578,000	-£556,000	-£534,000	-£512,000	-£490,000	-£467,000	
Net airspace users benefit (Delay)	£37,500	£37,870	£38,240	£38,610	£38,980	£39,350	£39,720	£40,090	£40,460	£40,830	£41,200	
Deployment costs	-£4,130,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	NPV
Present value (rounded to nearest whole £1,000, NPV is sum of unrounded data)	-£4,912,000	-£747,000	-£713,000	-£677,000	-£643,000	-£609,000	-£575,000	-£543,000	-£510,000	-£481,000	-£453,000	**-£10,864,000**

Table 3 Cost Benefit Analysis Option 1A without DCO

Negative values are cost or disbenefit	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Net
Year	0	1	2	3	4	5	6	7	8	9	10	Present
Discount factor	1	0.9662	0.9335	0.9019	0.8714	0.8420	0.8135	0.7860	0.7594	0.7337	0.7089	Value
Option 1 With DCO												
Net community benefit (Noise)	-£4,678	-£2,434	-£291	£1,763	£3,739	£5,646	£7,491	£9,277	£11,013	£12,692	£14,315	
Net community benefit (CO_2)	-£140,267	-£138,351	-£136,428	-£134,502	-£132,573	-£130,643	-£130,364	-£128,392	-£126,425	-£133,570	-£141,696	
Net airspace users benefit (CO_2)	-£235,871	-£288,161	-£337,115	-£374,906	-£417,871	-£457,925	-£487,920	-£522,766	-£555,081	-£584,981	-£619,031	
Net airspace users benefit (Fuel costs)	-£2,084,000	-£2,062,000	-£2,039,000	-£2,155,000	-£2,133,000	-£2,136,000	-£2,164,000	-£2,192,000	-£2,220,000	-£2,214,000	-£2,209,000	
Net airspace users benefit (Delay)	£37,500	£37,870	£38,240	£38,610	£38,980	£39,350	£39,720	£40,090	£40,460	£40,830	£41,200	
Deployment costs	-£4,130,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	NPV
Present value (rounded to nearest whole £1,000, NPV is sum of unrounded data)	-£6,557,000	-£2,385,000	-£2,342,000	-£2,417,000	-£2,372,000	-£2,348,000	-£2,339,000	-£2,333,000	-£2,326,000	-£2,300,000	-£2,283,000	**-£30,001,000**

Table 4 Cost Benefit Analysis Option 1 with DCO

Negative values are cost or disbenefit	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Net
Year	0	1	2	3	4	5	6	7	8	9	10	Present
Discount factor	1	0.9662	0.9335	0.9019	0.8714	0.8420	0.8135	0.7860	0.7594	0.7337	0.7089	Value
Option 1A With DCO												
Net community benefit (Noise)	-£4,678	-£2,434	-£291	£1,763	£3,739	£5,646	£7,491	£9,277	£11,013	£12,692	£14,315	
Net community benefit (CO_2)	-£48,113	-£46,017	-£43,977	-£42,171	-£40,241	-£38,397	-£37,107	-£35,371	-£33,688	-£34,361	-£35,162	
Net airspace users benefit (CO_2)	-£77,358	-£90,902	-£102,161	-£109,506	-£116,952	-£122,726	-£125,137	-£128,093	-£129,711	-£129,924	-£130,375	
Net airspace users benefit (Fuel costs)	-£689,000	-£667,000	-£645,000	-£626,000	-£603,000	-£582,000	-£560,000	-£539,000	-£518,000	-£496,000	-£474,000	
Net airspace users benefit (Delay)	£37,500	£37,870	£38,240	£38,610	£38,980	£39,350	£39,720	£40,090	£40,460	£40,830	£41,200	
Deployment costs	-£4,130,000	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	NPV
Present value (rounded to nearest whole £1,000, NPV is sum of unrounded data)	-£4,912,000	-£747,000	-£713,000	-£680,000	-£645,000	-£612,000	-£578,000	-£546,000	-£515,000	-£486,000	-£458,000	**-£10,892,000**

Table 5 Cost Benefit Analysis Option 1A with DCO

6. Safety Assessments

This section provides a brief, qualitative overview of the impact of each option on aviation safety.

The formal application documentation for this airspace change proposal will contain more detailed technical safety information for the CAA to review.

Option 0 Do-nothing baseline option

The region is a complex system of LLA and Stansted arrivals with a high controller workload. Separating the shared arrival routes and holds requires intense and complex air traffic control interactions to be solved within congested airspace, mostly at lower altitudes from 8-7,000ft and below.

A 'controller interaction' is typically a radio transmission (RT) with a pilot or a telephone call with a controller colleague, within the same centre or to the control tower at the airport. Each time a controller interacts with either a pilot or a controller, the other party must repeat the decision/instruction to ensure accuracy. Thus, a single controller interaction is comprised of at least two events – the outbound instruction or request, and the returning confirmation check, known as a 'readback'. When controller interactions with pilots get busy, it is known as a high RT loading. RT loading is one of the major limiting factors to the operating efficiency of an air traffic control sector and this region is especially complex.

Aircraft holding for one airport also depend on those holding for the other airport, a uniquely complex situation.

During periods where workload and RT loading is predicted to become too intense, safety dictates that we apply temporary limits to the numbers of flights entering the region before the number exceeds safe limits, causing delays and different complexity problems for air traffic controllers, the airports and airlines.

This is the current situation and is managed safely but is not sustainable in the medium term hence the initiation of this airspace change proposal and the reason why this option was discounted during the design principles evaluation Step 2A (ii).

Option 1, Option 1A Controller Vectoring to Runway 07 and 25 respectively, from a new hold to the north of LLA

Both options separate out the LLA arrivals from the Stansted arrivals with separate holds for each airport, removing the dependencies of each airport's arrivals on the other at a high level and by route design. No particular action by the controller is needed to initiate the separation, which occurs as a consequence of the route flight planning to end at the hold, dedicated to LLA arrivals only. Stansted arrivals would follow the same arrival routes to the same two holding patterns as today, known as LOREL and ABBOT.

Flights would arrive at the dedicated delay absorption area from each direction and the controller would tactically vector each flight into the sequence of arrivals. This is a manual task, with the controller directing each flight's heading and altitude into an appropriate landing order correctly spaced. There would be less complexity which is anticipated to significantly reduce the number of controller interactions. This would reduce the likelihood of approaching the limit of controller workload, meaning fewer temporary limits on aircraft movements through the sector would be applied, reducing those consequential complexity problems. Therefore, this option is considered sustainable and safe.

7. Summary and conclusions

7.1 Our stated preferred option for this proposal was Option 2. Option 1 was not our preferred option because it is less aligned with the Government's Airspace Modernisation Strategy AMS (Ref 14).

7.2 However we acknowledge that the modified version of Option 1, analysed here as Option 1A, is a viable solution to the latent issue identified as the root cause of this airspace change proposal.

Cost-benefit analyses and Net Present Values NPV

7.3 See Section 5's Table 1 Rounded summary of cost benefit analyses showing the differences in NPVs, on page 19.

7.4 If the DCO does not progress, Option 1A would cause c.£17m NPV less disbenefit than Option 1.
If the DCO does progress, Option 1A would cause c.£19m NPV less disbenefit than Option 1.

7.5 Option 1A therefore is a significant improvement over Option 1 due to the reduction in disbenefit.

Consideration of Resilience

7.6 Throughout the development of the options the impact to resilience has been considered, which provides an indication of the ability to react to unforeseen events that affect the air traffic network, such as a runway closure or bad weather. Due to the unpredictable nature of these events and the many complex factors that can influence the level of resilience, it is not proportional to monetise these impacts. However, considering the radio transmission quantification used in this document, the benefit of each option can be quantified as a percentage improvement against the baseline. Using this measure, both Option 1 and Option 1A would improve resilience by up to c.30%.

7.7 Improving resilience provides a significant benefit to controllers and the overall air traffic system – it helps to improve safety, reduce delays and reduce fuel burn and CO_2 emissions should a disruption occur.

Conclusion

7.8 Taking all the analyses into account, the outcome of the final options appraisal is that Option 1A, a modified version of Option 1 as consulted, will progress to Step 4B Airspace Change Proposal submission.

8. Annex: WebTAG Output Summaries

The following are extracts from the WebTAG workbooks for greenhouse gas emissions and for noise.

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: Insert scheme name

Present Value Base Year 2010

Current Year 2021

Proposal Opening year: 2022

Project (Road/Rail or Road and Rail): road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): -£1,368,665

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): 193,474
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded 157724.5052

Change in carbon dioxide equivalent emissions in opening year (tonnes): 18,578
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): -£4,457,123
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	15190.10316	73395.98046
Non-traded sector	0	0	3387.45684	16524.87954

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£2,050,314

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£683,597

Figure 1 WebTAG Greenhouse Gas Output: Option 1 Without DCO (July 2020 Worksheet Update)

Greenhouse Gases Workbook - Worksheet 1

Scheme Name:	Insert scheme name
Present Value Base Year	2010
Current Year	2021
Proposal Opening year:	2022
Project (Road/Rail or Road and Rail):	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£):	-£1,473,211 *positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): (between 'with scheme' and 'without scheme' scenarios)	209,075
Of which Traded	170532.9919
Change in carbon dioxide equivalent emissions in opening year (tonnes): (between 'with scheme' and 'without scheme' scenarios)	18,578
Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): (N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)	-£4,881,629 *positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	15190.10316	76889.2041
Non-traded sector	0	0	3387.45684	17286.4959

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£):	-£2,207,060
Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£):	-£735,797

Figure 2 WebTAG Greenhouse Gas Output: Option 1 With DCO (July 2020 Worksheet Update)

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: Insert scheme name

Present Value Base Year 2010

Current Year 2021

Proposal Opening year: 2022

Project (Road/Rail or Road and Rail): road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): -£432,274

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): 56,703
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded 45433.45818

Change in carbon dioxide equivalent emissions in opening year (tonnes): 6,144
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): -£1,253,159
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	4981.82616	22354.59546
Non-traded sector	0	0	1161.93384	5397.26454

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£647,517

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£215,911

Figure 3 WebTAG Greenhouse Gas Output: Option 1A Without DCO (July 2020 Worksheet Update)

Greenhouse Gases Workbook - Worksheet 1

Scheme Name:	Insert scheme name
Present Value Base Year	2010
Current Year	2021
Proposal Opening year:	2022
Project (Road/Rail or Road and Rail):	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): -£434,606

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): 57,052
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded 45720.39246

Change in carbon dioxide equivalent emissions in opening year (tonnes): 6,144
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): -£1,262,843
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	4981.82616	22420.69498
Non-traded sector	0	0	1161.93384	5411.676006

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£651,013

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): -£217,075

Figure 4 WebTAG Greenhouse Gas Output: Option 1A With DCO (July 2020 Worksheet Update)

Noise Workbook - Worksheet 1

Proposal Name: LLA Option 1 and 1A - No DCO

Present Value Base Year 2010

Current Year 2020

Proposal Opening year: 2022

Project (Road, Rail or Aviation): aviation

	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£471,306	-£30,221
	*positive value reflects a **net benefit** (i.e. a reduction in noise)	
Net present value of impact on sleep disturbance (£, 2010 prices):	£236,442	£98,896
Net present value of impact on amenity (£, 2010 prices):	£282,335	-£81,645
Net present value of impact on AMI (£, 2010 prices):	£4,844	£4,844
Net present value of impact on stroke (£, 2010 prices):	-£20,793	-£20,793
Net present value of impact on dementia (£, 2010 prices):	-£31,521	-£31,521

Quantitative results

households experiencing increased daytime noise in forecast year:	2251.583747
households experiencing reduced daytime noise in forecast year:	2959.290252
households experiencing increased night time noise in forecast year:	871.5697687
households experiencing reduced night time noise in forecast year:	1155.975304

Figure 5 Above: WebTAG Noise Output: Options 1 and 1A Without DCO (July 2020 Worksheet Update)

Figure 6 Below: WebTAG Noise Output: Options 1 and 1A With DCO (July 2020 Worksheet Update)

Noise Workbook - Worksheet 1

Proposal Name: LLA Option 1 and 1A - With DCO

Present Value Base Year 2010

Current Year 2020

Proposal Opening year: 2022

Project (Road, Rail or Aviation): aviation

	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£572,196	£402,581
	*positive value reflects a **net benefit** (i.e. a reduction in noise)	
Net present value of impact on sleep disturbance (£, 2010 prices):	-£105,328	£122,790
Net present value of impact on amenity (£, 2010 prices):	£603,711	£205,978
Net present value of impact on AMI (£, 2010 prices):	£11,836	£11,836
Net present value of impact on stroke (£, 2010 prices):	£24,776	£24,776
Net present value of impact on dementia (£, 2010 prices):	£37,202	£37,202

Quantitative results

households experiencing increased daytime noise in forecast year:	2797.769189
households experiencing reduced daytime noise in forecast year:	3857.709951
households experiencing increased night time noise in forecast year:	978.8679648
households experiencing reduced night time noise in forecast year:	934.0811161

End of document