London Biggin Hill Airport - Airspace Change Proposal

ACP-2019-86

Initial Options Appraisal

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Glossary of Terms

Acronym/Term	Definition
ACP	Airspace Change Proposal
AMS	Airspace Modernisation Strategy
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Area
ATC	Air Traffic Control
CAA	Civil Aviation Authority (UK)
CAP	Civil Aviation Publication
CTA	Control Area
DME	Distance Measuring Equipment
DP	Design Principle
DPE	Design Principles Evaluation
EASA	European Aviation Safety Agency
GA	General Aviation
GNSS	Global Navigation Satellite System
HazID	Hazard Identification
IAP(s)	Instrument Approach Procedure(s)
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IOA	Initial Options Appraisal
IR	Implementing Rule
LBHA	London Biggin Hill Airport
MAP	Missed Approach Procedure
NM	Nautical Mile

Acronym/Term	Definition
NO_2	Nitrogen Dioxide
PANS-OPS	Procedures for Air Navigation Services – Operations
PBN	Performance Based Navigation
RNAV	Area Navigation
SoN	Statement of Need
SSSI	Site of Special Scientific Interest
VOR	VHF (Very High Frequency) Omni-Directional Range

1 Introduction

1.1 Introduction

London Biggin Hill Airport (LBHA) are currently progressing an Airspace Change Proposal (ACP) to re-design Instrument Approach Procedures (IAPs) at the airfield in accordance with the ACP process defined in Civil Aviation Publication (CAP) 1616 [Ref 1] as regulated by the UK Civil Aviation Authority (CAA). In line with this process, LBHA is currently at Step 2B, requiring a change sponsor (LBHA in this case) to carry out an Initial Options Appraisal (IOA) of the options identified in Step 2A (Options Development) of the process.

1.1.1 Document Purpose and Scope

The overall purpose of this document is to provide a narrative, explaining the steps, rationale, and outcomes of Step 2B. It must be highlighted that this document does not contain a detailed IOA analysis of each option. Full analysis can be found, alongside this document on the CAA Airspace Change Portal, available via the link below.

https://airspacechange.caa.co.uk/PublicProposalArea?pID=207

With reference to the ACP quoted above, this document includes the methodology, baseline definition and results summary of the IOA along with supporting Appendices.

This document is structured as follows:

1. Introduction (this Section)
2. Initial Options Appraisal Methodology
3. Baseline Definition
4. Initial Options Appraisal Results
5. Qualitative Safety Assessment
6. Qualitative Noise Assessment Methodology
7. Design Options Short List
8. Initial Options Appraisal Full Analysis Table (shown in Appendix A1)

Please note, it is recommended that readers review this document either before or alongside the IOA Full Analysis Table (Appendix A1) to provide additional context, clarification, and rationale.

1.2 Background

LBHA has embarked on this airspace change for 2 reasons:

- In order to be compliant with European Aviation Safety Agency (EASA) Regulatory requirements detailed within Implementing Rule (IR) (EU) 20 18/10 48 [Ref 2]. This will also meet the requirements within the CAA Airspace Modernisation Strategy (AMS) [Ref 3].

- If successful, it will also add a layer of resilience to the airport operation by providing a second instrument approach in the event that the current procedure is unavailable.

As part of this redesign, LBHA must follow guidance provided by the CAA and successfully complete the first 6 stages of CAP 1616 – Airspace Design [Ref 1].

The overall aim of this ACP is to establish new IAPs and a Missed Approach Procedure (MAP) that are safe, efficient, and fully compliant with the appropriate regulations.

This is reflected in the Statement of Need (SoN) submitted to the CAA in April 2020, which reads:

"London Biggin Hill Airport is proposing to implement an RNAV (GNSS) Instrument Approach Procedure (IAP), with LNAV and LPV Minima, to Runway 21. The IAP will be designed for aircraft in Speed Categories A, B and C, and will include an RNAV Missed Approach Procedure.

The RNAV (GNSS) IAP will replicate / mimic the existing Runway 21 ILS/DME/VOR procedure. The RNAV (GNSS) Procedure for Runway 21 will not only act as a back-up in the event of an ILS failure, but will also future proof the airfield and provide an alternative to procedures utilising the BIG VOR, which is due to be removed in the near future."

Current approaches at LBHA rely on a ground beacon, known as a VHF Omni-directional Range (VOR) in combination with Distance Measuring Equipment (DME), located at LBHA. As part of the drive to facilitate airspace modernisation, the VOR is being removed, as of 1st December 2022, making the existing procedures at LBHA unviable. If this were to occur without any mitigating actions, there would be no published link between the airways network and LBHA, resulting in an in-efficient utilisation of airspace, leading to additional fuel burn, aircraft noise and emissions. This ACP attempts to address this issue, by establishing Area Navigation (RNAV) approaches utilising Global Satellite System (GNSS) technology as opposed to conventional ground-based beacons.

1.3 CAP1616 Airspace Change Process

In designing and implementing airspace changes, change sponsors are subject to the process described in CAP1616 [Ref 1]. This is a seven-stage process, published by the CAA, which also provides guidance to those seeking to change the way in which airspace is used and managed. The seven-stage process is visualised in Figure 1 below, highlighting the current stage (Stage 2) within the process.

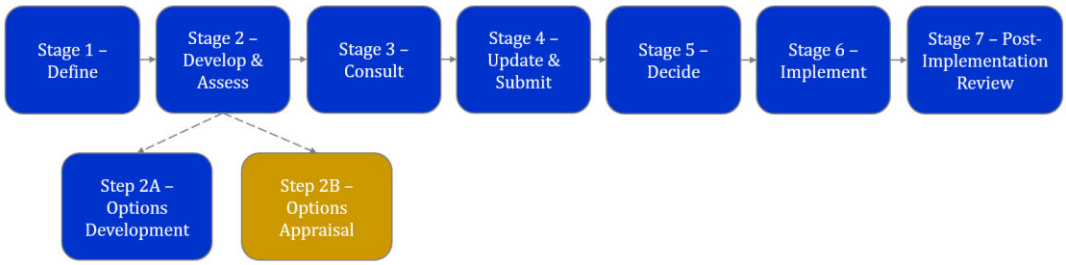

Figure 1 High-level CAP 1616 Process

1.3.1 Progress So Far

LBHA has completed Stage 1 of the process, requiring a justified Statement of Need to be submitted and approved by the CAA along with the establishment of Design Principles (DPs) to be used as high-level requirements. The first stage of the CAP 1616 [Ref 1] process was completed in January 2021. A copy of the Statement of Need (see Section 1.2) and DPs can be found on the CAA airspace change portal.

As part of the second stage (Develop & Assess), LBHA is required to develop a set of design options, test these at targeted focus groups, assess them against the DPs (as established in Stage 1) and carry out an IOA to compare them against an established baseline. The baseline used for this (and subsequent) assessments is the projected situation, following the removal of the VOR. Further details regarding the baseline can be found in Section 3 of this document.

1.3.2 Step 2A – Options Development

During Step 2A, LBHA produced a full comprehensive list of design options covering both instrument and missed approaches for Runway 21. These options considered the fixed constraints identified during Step 1A and the DPs as established in Step 1B.

The identified constraints are as follows:

- Designers are limited to the PANS-OPS design options.
- This change should not necessitate any change to any other air traffic procedure.
- This change should not change any airspace configuration or classification.
- This change is limited to changes at 3000 feet and below, as procedures above are “owned” by NATS and are not part of this change.

In accordance with the requirements of CAP 1616 [Ref 1], a set of high-level criteria was developed from the DPs to support the design process; the application of these criteria to the initial comprehensive list (tested with the stakeholders) generated the Long List of designs to take forward to Design Principle Evaluation (DPE). The best practice guidance contained in the government Green Book [Ref 4] was used to develop five high-level objectives or criteria. These criteria are shown in Table 1 below along with the applicable DP and the quantitative ‘measures’ used to gauge each option against the objective:

Priority	Design Principle	Criteria used during development
1	SAFETY - New routes must be safe and must not erode current ANSP safety barriers	The options should not necessitate ground-breaking safety work or require multiple knock-on changes.
2	ENVIRONMENTAL CONCERNS - Arrival routes should, where possible, be designed to minimise the impact of noise below 7,000' and should avoid the overflight of populations not previously overflown	The options should minimise the impact of noise and should avoid the overflight of populations not previously overflown.
3	COMPLIANCE - Routes should, where possible, be designed to be PANS Ops compliant	Designs should be PANS-OPS compliant, which means that the parameters of the Instrument Flight Procedures (IFP) for all the options, e.g., shape, accuracy, turn areas and obstacle clearances are predetermined (to a degree) in ICAO document PANS-OPS 8168 Aircraft Operations – Volume 2 Construction of Visual and Instrument Flight Procedures. This is the international standard for all IFPs.
4	NAVIGATION STANDARDS - New routes must be designed to use PBN	PBN standards used should be accessible to the largest number of operators.
5	EFFICIENT ROUTES - Arrival routes should, where possible, be designed to minimise emissions and optimise operational efficiencies	Options should have minimal track miles/fuel burn, and not cause operational complexity.
6	REPLICATION - Procedure should, where possible mimic the existing procedure and/or the existing ILS positioning by ATC vectors	Options should mimic the existing procedure and/or the existing radar vector swathe.

Table 1 Prioritised Design Principles and Development Criteria

1.3.3 Step 2A – Design Principle Evaluation

Each of the options developed has been assessed against the prioritised list of DPs developed in Stage 1. The DPE shows to what extent the options meet the DPs and can be found at Step 2A on the CAA airspace portal.

In accordance with CAP 1616 Appendix E [Ref 1] format, each of the options has been assessed as ACCEPT or REJECT.

Options were marked as REJECT only when the Safety Design Principle (DP1) was not met. Some other DPs have resulted in RED and AMBER assessments; however, these were taken forward into the IOA as they all meet the high-level technical criteria assessment.

The options progressed into Step 2B as future route possibilities are 2A, 2AD, 2B, 2BD, 6A, 6B, 9 and 12, these options are known as the Long List.

1.3.4 Step 2B – Initial Options Appraisal

At Step 2B of the process, the longlist of design options is tested against the criteria contained within CAP1616, Appendix E, Table E2 [Ref 1], with the addition of qualitative assessments of noise and safety impacts, as required by a Level 1 change.

The methodology used to carry out the IOA is described in Section 2 of this document. Furthermore, a summary of the IOA results can be found in Section 4, please note, a more detailed analysis can be found as an Appendix to this document on the airspace change portal.

The main output of the IOA, is a Short List of options can be found in Section 7 of this document.

2 Initial Options Appraisal Methodology

2.1 CAP 1616 Options Appraisal Requirements

The Options Appraisal process was carried out in accordance with the guidance in CAP 1616, and in conjunction with The Green Book [Ref 4] and the Department of Transport's WebTAG [Ref 5], which constitute best practice in options appraisal.

Options Appraisal is used as an iterative tool throughout the CAP 1616 [Ref 1] process to help refine the options from an initial Long List, down to a Short List and a final Short List of preferred options.

The appraisal process typically consists of the following elements:

- High-level objective and assessment criteria.
- Baseline definition – current operations.
- Longlist of options (including a do-nothing/minimum option).
- Shortlist of options.
- Preferred or final option(s).

The Options Appraisal requirement of CAP 1616 [Ref 1] evolves through three iterations with the CAA reviewing at each phase as follows:

1. 'Initial' Options Appraisal at Step 2B with the CAA review at the Stage 2, as part of the Develop and Assess gateway.
2. 'Full' Options Appraisal at Step 3A with the CAA review at Step 3B and the subsequent Consult gateway.
3. 'Final' Options Appraisal at Step 4A, with the CAA review after the formal submission of the Airspace Change Proposal at the end of Stage 4.

Iteration 1, IOA, is the subject of this document and is submitted to the CAA as part of Step 2B.

The remainder of this section of the document focusses on the definition of the 'high-level objective and assessment criteria' and the assessment method.

2.2 High-level Objectives & Assessment Criteria

For a Level 1 airspace change, the criteria against which appraisal options are assessed is defined within CAP 1616, Appendix E, Table E2 [Ref 1]. These criteria are described in Table 2 below. Additionally, Safety Assessment, Tranquillity and Biodiversity (as defined in CAP 1616, Appendix B [Ref 1]) have been added at the bottom. It is worth stressing that the IOA provides a qualitive assessment only, therefore no numerical, statistical or noise contour analysis has been conducted at this stage. This approach has been chosen because of the relatively small scale of the proposed change, compared to other in progress ACPs, it is therefore deemed proportionate. The change sponsor will be conducting more detailed quantitative analysis in subsequent stages of the process.

Affected Group	Impact	Description
Communities	Noise impact on health and quality of life	Requires consideration of noise impact on communities including residents, schools, hospitals, parks, and other sensitive areas.
	Air Quality	Any change in air quality is to be considered[1].
Wider Society	Greenhouse Gas impact	Assessment of changes in greenhouse gas levels in accordance with WebTAG is required.
	Capacity and resilience	A qualitative assessment of the impact on overall UK airspace structure.
General Aviation	Access	A qualitative assessment of the effect of the proposal on the access to airspace for GA users.
General Aviation/commercial airlines	Economic impact from increased effective capacity	Forecast increase in air transport movements and estimated passenger numbers or cargo tonnage carried.
	Fuel burn	The change sponsor must assess fuel costs based on its assumptions of the fleets in operation.
Commercial airlines	Training costs	An assessment of the need for training associated with the proposal.
	Other costs	Where there are likely to be other costs imposed on commercial aviation, these should be described.
Airport/Air Navigation Service Provider	Infrastructure costs	Where a proposal requires a change in infrastructure, the associated costs should be assessed.
	Operational costs	Where a proposal would lead to a change in operational costs, these should be assessed.
	Deployment costs	Where a proposal would lead to a requirement for retraining and other deployment, the costs of these should be assessed.

[1] Air Quality assessments are only applicable below 1,000 feet and includes the consideration of Air Quality Management Areas (AQMAs).

Affected Group	Impact	Description
Safety Assessment	Safety Assessment	CAP 1616 requires a safety assessment of the proposal to be undertaken in accordance with CAP 760 (Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers) [Ref 6].
Wider Society	Tranquillity	The impact upon tranquillity need only be considered with specific reference to Areas of Outstanding Natural Beauty (AONB) and National Parks unless other areas for consideration are identified through community engagement.
	Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Table 2 IOA Assessment Criteria

2.3 Method

2.3.1 Overview

The IOA was carried out by comparing all the options side by side against the CAP 1616 [Ref 1] criteria in tabular form. The Appraisal also included the results of a Qualitative Safety Assessment (as described in Section 5), and the noise impact for communities was supported by a qualitative noise assessment methodology (as described in Section 6. The full analysis of all the options is described in Appendix A1 and included as a separate Microsoft Excel spreadsheet, which can be accessed via the airspace change portal.

Each option was compared against the 'Do Nothing' option which was established as the baseline. This is explored further in Section 3 of this document.

2.3.2 Shortlisting

Once all the options had been assessed against the criteria, the list of options was refined to identify the Short List to be taken forward to Stage 3. The Short List is contained in Section 7.

3 Baseline Definition

3.1 Baseline Definition

In accordance with CAP 1616 [Ref 1], a baseline will be required for all environmental assessments. This will allow the change sponsor to conduct an assessment to understand the current impacts so that a comparison can be made with the impacts of the options.

In most cases, the baseline will be the 'Do Nothing' option and will largely reflect the today's operation. However, as per CAP1616, Appendix E, Paragraph E21 [Ref 1] in certain cases, doing nothing is not a feasible option in reality. In such cases, the change sponsor must set out its informed view of the future and the minimum changes required to address the issues identified – a 'Do Minimum' (Option 2A) option.

For this ACP it is necessary to set the baseline at the 'Do Minimum' situation which is reflective of the SoN (see Section 1.2). The reasoning is that there is a forced change taking place on 1st December 22, and therefore it is not applicable to take the 'Do Nothing' as the baseline for each options appraisal and the environmental assessments. The informed view of the future is that an RNAV procedure will replace the VOR procedure, in accordance with the AMS [Ref 3].

3.2 The 'Do Nothing' Option

As per Section 3.1 above, in most cases the 'Do Nothing' option is used as the baseline for the IOA and subsequent assessments in the CAP1616 process, as it reflects today's operations. In relation to LBHA, the 'Do Nothing' option entails aircraft receiving radar vectors to establish an approach using the existing VOR/DME ground based navigation beacon, which is being removed from service on 1st December 2022.

3.3 The 'Do Minimum Option' (Baseline)

The ground based VOR beacon that supports LBHA approaches in today's operation is being removed as of 1st December 2022. The consequence of this removal from a LBHA perspective, is that there would be no Instrument Flight Rules (IFR) approach for Runway 21 at LBHA other than the ILS, resulting in a lack of resilience. As a result, aircraft would require constant radar vectoring to establish the ILS approach. Furthermore, the 'Do Nothing' option would leave LBHA without a functioning MAP. In addition, by not implementing a PBN approach LBHA will not be compliant with EASA Regulatory requirements detailed within IR (EU) 20 18/10 48.

In today's operation, it is worth highlighting that the majority of aircraft approaches are vectored from OSVEV, over Dartford, roughly perpendicular to Runway 21 at LBHA, before making a left-hand turn to line up with the runway and establish the ILS approach from there. This area is highlighted (in purple) in Figure 2 below.

Implementation of this ACP is expected to be post 1st December 2022. The change sponsor recognises that as a result, the baseline would change throughout the lifespan of this ACP, meaning the 'Do Nothing' option would be invalid as a baseline at the point of implementation. Therefore, in accordance with CAP1616, Appendix E, Paragraph E21 [Ref 1], the 'Do Minimum' option (Option 2A) will be utilised as the 'Do Minimum' baseline for this IOA and subsequent environmental assessments throughout the process.

As visualised in Figure 2 below, the 'Do Minimum' option is as close a replication as possible (given IFP design criteria) to the procedure which exists in today's operation, with aircraft being radar vectored to ALKIN (a fly-by waypoint) and then establishing on the ILS.

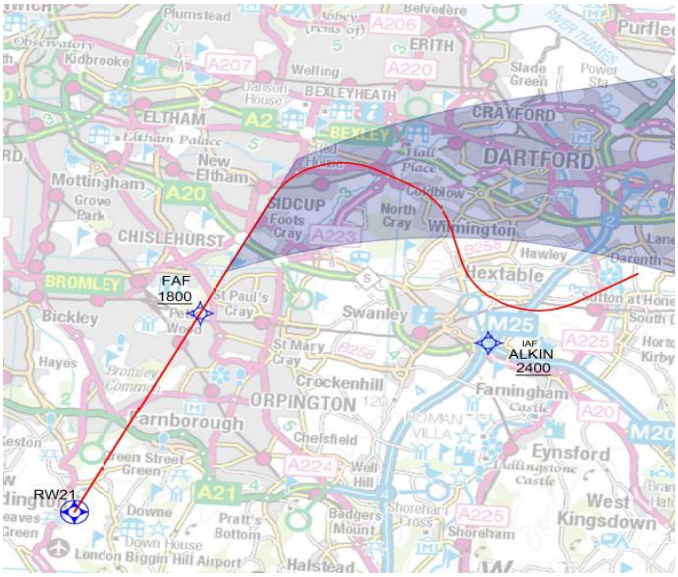

Figure 2 'Do Minimum' Baseline - Option 2A

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4 Initial Options Appraisal Results

4.1 Introduction

This section provides some additional clarification to assist the reader in understanding the rationale behind the IOA Results, which are presented in full, at the end of this section. The Results Summary, presented in Section 4.4 is a high-level extract of the Full Analysis Table, which can be found in Appendix A1 or on the airspace change portal as a separate document. It is recommended that any reader has already read this section before proceeding to read the Full Analysis Table (found in Appendix A1) to provide context and understand the terminology used.

4.2 IOA Background

This sub-section provides some additional clarification which should be considered when reviewing the IOA Full Analysis Table (as shown in Appendix A1). Furthermore, the details provided in this sub-section form a crucial element in terms of the rationale and thought process behind which options are taken forward into the next Stage of the CAP1616 [Ref 1] process.

4.2.1 Option Variations

It is worth noting that in order to distinguish between option characteristics, each option has been assigned not only a number but a letter or combination of letters. Some options have been allocated numerous variation codes to specify the final approach angle and/or routing incorporated within said option. This coding system is explained in Table 3 below.

Variation Code	Basic Description
A	Utilises a 3° final approach angle, which is currently industry standard.
B	Utilises a 3.2° final approach angle.
C	Utilises a 3.5° final approach angle.
T	Utilises a T-bar lateral approach philosophy where aircraft join from either the right- or left-hand side (making a T on the map) of the approach.
D	Utilises a direct routing between OSVEV and ALKIN.

Table 3 Variation Coding Explained

Where the variation codes defined in Table 3 are combined, this means that that particular option utilises both those characteristics. For example, an option ending in

"AD" would involve a 3° final approach angle and include a direct routing from OSVEV to ALKIN.

4.2.2 AONB Overflight

As detailed in Table 2 (see Section 2.2), CAP1616, Appendix B [Ref 1] requires change sponsors to consider the impact of the proposed change on AONB and Sites of Special Scientific Interest (SSSI).

The location of LBHA, means that it is close to the Kent Downs AONB and Surrey Hills AONB [Ref 7]. This is illustrated in Figure 3, which highlights the location of LBHA (shown in red) in relation to these areas.

Figure 3 LBHA Location relative to AONB (Source: Natural England)

From Figure 3 above, it is clear to see that any aircraft inbound to LBHA, routing from the south or east would be required to overfly either the Kent Downs AONB or Surrey Hills AONB. However, it must be stressed that this occurs in the current operation. In today's traffic environment, Thames Radar (provided by NATS) controllers use radar vectoring to transit aircraft from their initial location to ALKIN, to then begin their approach to LBHA.

The design options considered as part of this ACP originate from either ALKIN or OSVEV, both of which are outside either of the specified AONB. Consequently, there will be no impact on either AONB as a direct result of this ACP, taking into account the possible increase in uptake of this route. This is reflected in the IOA Full Analysis Table (as seen in Appendix A1). However, it is acknowledged that one of the MAP Options (Option 9) will involve aircraft flying close (by not over) the far northerly edge of the Surrey Hills AONB.

4.2.3 AQMA Overflight

Like, AONB, CAP 1616, Appendix E [Ref 1] requires change sponsors to consider the impact of proposed changes on Air Quality Management Areas (AQMAs). AQMAs are areas within which local authorities are required to measure, review, and assess the impact of air quality on people's health and the environment [Ref 8].

With reference to LBHA, the Croydon AQMA is located to the west of the airfield and the Bromley AQMA is located to the north. Both these areas require local authorities to measure the levels of Nitrogen Dioxide (NO_2) in the air. The locations of these AQMAs in relation to LBHA (highlighted in red) is illustrated in Figure 4 below.

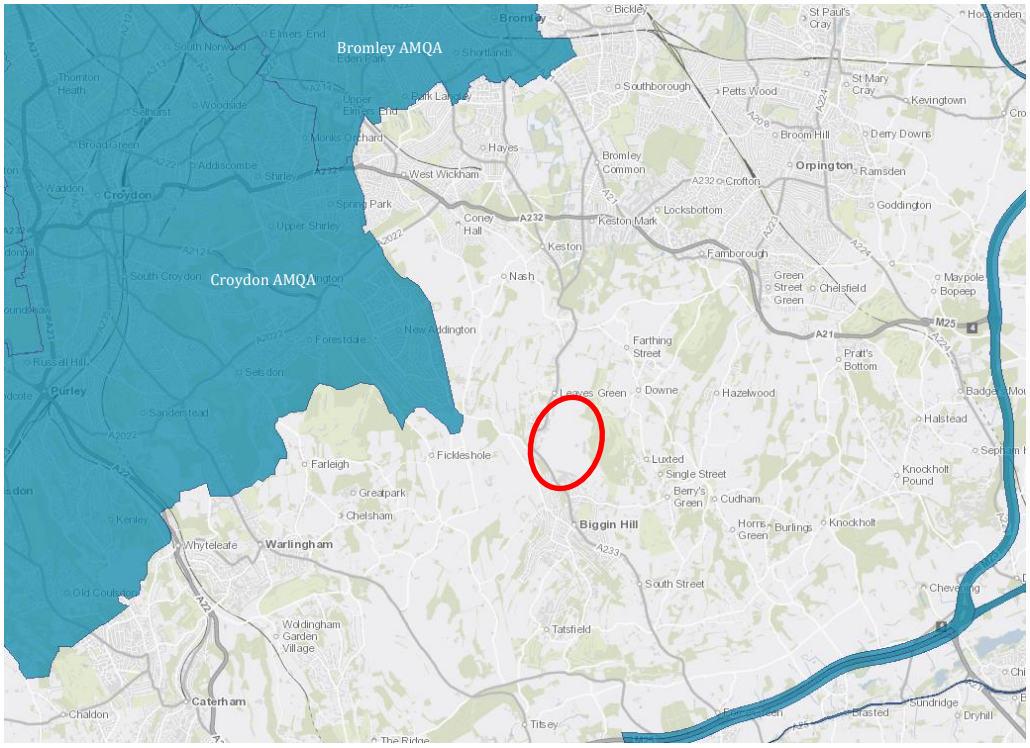

Figure 4 LBHA Location relative to AQMAs (Source: UK Government: DEFRA)

It has been determined that although the MAP options do overfly the Croydon AQMA, it is expected that aircraft would be flying above 1,000 ft at the point of overflight. As a result, the impact is considered minimal, as per air quality guidance in CAP1616, Appendix B [Ref 1]. This is reflected in the IOA Full Analysis Table (as seen in Appendix A1).

4.3 Long List of Options

Table 4 below provides a basic description of the longlist of options developed at Step 2A, along with an additional option suggested at a stakeholder focus group.

Option No	Variations	Basic Description
2	6	'Do Minimum' – This option would be to replicate/mimic the current VOR/DME approach which starts from ALKIN with some variations including a link from OSVEV to ALKIN.
6	6	From OSVEV and ignoring ALKIN, to enable inbounds to exit the network routing down the left of the current ILS vectoring swathe, with some variations featuring a final approach at 3°/3.2°/3.5° along with some variations of a T-bar.
9	1	MAP 'Do Minimum' – Mimic the current right turn MAP to ALKIN and then radar vectors from NATS.
12	1	Following the suggestion at a Stakeholder Focus Group in Stage 2A, this option would laterally mimic the Runway 03 MAP at LBHA.

Table 4 Longlist of Options

A more detailed list of options, including map overlays is published on the CAA airspace change portal at Step 2A.

4.4 Results Summary

This section provides a high-level summary of the IOA. The full analysis table is available via a separate Appendix, see Appendix A1 for further details.

Table 5 below outlines the colour coding scheme used in the subsequent table (Table 6) to distinguish between which options will be carried forward and which have not.

Colour Key	
Carry Forward	Meets objectives, insignificant impact, and is one of the Short-Listed options.
Not Carried Forward	Meets objectives or has an insignificant impact but is less attractive than other options.
Reject	Fails to meet one or more objectives or has a significant impact that cannot be effectively mitigated.
Previously Rejected	Included for completeness

Table 5 Results Summary Colour Key

Table 6 below contains a high-level summary of the IOA results, broken down by option number and variation. For details on the full analysis, please refer to the separate Appendix on the CAA airspace change portal, as detailed in Appendix A1 of this document. Please note, the same colour key is applicable to the Full Analysis Table (as shown in Appendix A1).

Option No	Variation	Status
1	N/A	Rejected at DPE
2	A	Not Carried Forward – This option includes a 3° glideslope as opposed to a 3.2° glideslope, the noise impact on local communities is less favourable. However, this option will be used as the 'Do Minimum' baseline going forward.
	AD	Not Carried Forward – This option includes a 3° glideslope as opposed to a 3.2° glideslope, the noise impact on local communities is less favourable.
	B	Carry Forward – As this option includes a 3.2° glideslope as opposed to a 3° glideslope, the noise impact on local communities is more favourable.
	BD	Carry Forward – As this option includes a 3.2° glideslope as opposed to a 3° glideslope, the noise impact on local communities is more favourable.
	C	Rejected at DPE
	CD	Rejected at DPE
3	A	Rejected at Options Development
	B	Rejected at Options Development
	C	Rejected at Options Development
4	A	Rejected at Options Development
	B	Rejected at Options Development
	C	Rejected at Options Development
5	A	Rejected at DPE
	AT	Rejected at DPE
	B	Rejected at DPE
	BT	Rejected at DPE
	C	Rejected at DPE
	CT	Rejected at DPE
6	A	Not Carried Forward – As this option includes a 3° glideslope as opposed to a 3.2° glideslope, the noise impact on local communities is less favourable.
	AT	Rejected at DPE
	B	Carry Forward – As this option includes a 3.2° glideslope as opposed to a 3° glideslope, the noise impact on local communities is more favourable.
	BT	Rejected at DPE

Option No	Variation	Status
	C	Rejected at DPE
	CT	Rejected at DPE
7	A	Rejected at DPE
	AT	Rejected at DPE
	B	Rejected at DPE
	BT	Rejected at DPE
	C	Rejected at DPE
	CT	Rejected at DPE
8	N/A	Rejected at DPE
9	N/A	Carry Forward – Favourable MAP option as it is the most efficient routing and replicates the existing MAP.
10	N/A	Rejected at DPE
11	N/A	Rejected at DPE
12	N/A	Carry Forward – While not as efficient as other MAP options, this option is a workable solution and is carried forward to provide an alternative.

Table 6 IOA Results Summary

5 Qualitative Safety Assessment

5.1 CAP1616 Safety Assessment Requirements

A qualitative Safety Assessment is required for all options identified during Step 2B, and a detailed final safety assessment must be completed by the change sponsor prior to submission in Step 4B. LBHA is carrying out the safety assessment activities in accordance with CAP 760 [Ref 6], the separate guidance provided by the CAA for safety assessment.

LBHA is developing a full four-part Safety Case iteratively throughout the CAP 1616 [Ref 1] process which will be submitted to the CAA at Step 4B.

5.2 Safety Assessment Method

The Qualitative Safety Assessment uses the results of a formal Hazard Identification (HazID) workshop held on 21st April 2021 during which the hazards, causes and consequences relating to each of the longlist of options were identified.

5.3 Safety Assessment Results – Non-Technical Summary

The HazID identified several dependencies and/or influencing factors that were common to all the IFP options e.g., Loss of surveillance, loss of GNSS signal in space.

In addition, Table 7 below describes the high-level safety assessments of for the Long List of options.

The safety work to date implies that all the options in the Long List will meet acceptable levels of flight safety and will provide a resilient procedure. In addition, Options 2AD, 2BD, 6A and 6B reduce the need for radar vectors for traffic leaving the network at OSVEV which will impact positively on safety. The positioning with respect to the London City zone/operations is similar to the radar vectoring of today and would be addressed in the same manner. The positioning of Option 12 is close to the Gatwick Zone but does not penetrate it.

Option No	High-level Safety Assessment
2	There were no specific hazards identified for Option 2 other than the standard loss of communications with Thames Radar during the provision of radar vectors from OSVEV to ALKIN (where applicable). However, it was concluded that standard radio failure procedures were able to mitigate against this.
6	Hazards relating to Option 6 are based around the interaction with London City traffic as this option involves aircraft routing close (but not into) London City airspace. However, as this is present in today's operations, it was deemed not to be a cause for concern as part of this ACP.
9	The hazards identified as part of this option were MAP conflicts with Kenley airfield (existing hazard) and a potential increase in pilot workload. Discussions at the HazID workshop did look at increasing the height of this MAP option, but it was concluded that this would cause conflict with London Gatwick traffic. Furthermore, no changes could be made to the lateral track, as this would make this option non-compliant with PAN-OPS.
12	Following the suggestion of this option at a stakeholder focus group, it has been assessed that this option would extend aircraft transit through Class G (uncontrolled) airspace, conflict with other IAP options and conflict with Redhill traffic. Furthermore, this option would have a knock-on effect for traffic at London City Airport and the wider London airspace design.

Table 7 High-level Safety Assessment

6 Qualitative Noise Assessment Methodology

6.1 Overview

To support the assessment of the noise related criteria in Section 4, LBHA carried out a qualitative assessment of the likely noise impacts of each option on people on the ground. A comparative assessment was made amongst the options for each procedure considering the following contributors to noise exposure:

Length of track overpopulated areas/qualitative assessment of numbers overflown.

Overflight of sensitive areas and communities below 7,000 ft e.g., schools, hospitals, care homes.

Overflight of national parks, Areas of Outstanding Natural Beauty (AONB), parkland, habitats.

Comparative power setting of aircraft engines required to execute the procedure.

Continuous ascent/descent profile of procedure.

6.2 Design Principle Application

DP 2 is applicable to the assessment of noise.

ENVIRONMENTAL CONCERNS - Arrival routes should, where possible, be designed to minimise the impact of noise below 7,000' and should avoid the overflight of populations not previously overflown.

The qualitative noise assessment (see Appendix 7.1A1) of the options was supported by analysis of whether each option met the above stated design principles.

7 Design Options Short List

7.1 Shortlist of Options Taken Forward

Table 8 below presents the Short List of options carried forward to Stage 3 along with a summary of the Initial Appraisal Outcome for that option. The IOA has shown that the options with a slightly steeper final approach gradient offer more in terms of noise mitigation than those with a standard final approach, consequently, although options 2A, 2AD and 6A are viable they are not included on the shortlist.

Shortlist Option	Initial Appraisal Outcome
2B	The shortest (viable) option in terms of track miles (keeping fuel burn and emissions to an absolute minimum) which does not greatly differ from today's operations. In addition, this option includes a slightly higher glideslope (compared to the 'Do Minimum' baseline) further mitigating noise pollution.
2BD – Preferred Option	One of the shortest (viable) option in terms of track miles (keeping fuel burn and emissions to an absolute minimum) which includes a direct link from OSVEV to ALKIN and does not differ greatly from today's operations. In addition, this option includes a slightly higher glideslope (compared to the 'Do Minimum' baseline) further mitigating noise pollution.
6B	Not the shortest of the Short-Listed options, however this option is contained solely with the current ILS radar vectoring swathe and therefore mitigates against additional noise, fuel burn or emissions concerns when compared to today's operations. In addition, this option includes a slightly higher glideslope (compared to the 'Do Minimum' baseline) further mitigating noise pollution.
9 – MAP Preferred Option	This MAP option has been carried forward as it mitigates against any additional impacts in terms of noise, fuel burn and emissions.
12	Whilst this option does not provide mitigations against the impacts of noise, fuel burn and emissions, Option 12 is carried forward as an alternative option to the preferred option.

Table 8 Shortlist of Options Taken Forward

References

Ref No	Source	Link
1	UK CAA	https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8127
2	European Union	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R1048
3	UK CAA	https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&pagetype=65&appid=11&mode=detail&id=8960
4	UK Government	https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent
5	UK Government – Department for Transport	https://www.gov.uk/guidance/transport-analysis-guidance-webtag
6	UK CAA	https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=2119
9	Natural England	https://naturalengland-defra.opendata.arcgis.com/maps/edit?content=Defra%3A%3Aareas-of-outstanding-natural-beauty-england
8	UK Government – Department for Environment, Food & Rural Affairs	https://uk-air.defra.gov.uk/aqma/

Table 9 References

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A1 Initial Options Appraisal Full Analysis Table

This Appendix is delivered as a separate Microsoft Excel based file with the format as in the extract below (as shown in Figure 5). The Appendix contains the full analysis carried out on the longlist of Options considered during CAP 1616 Stage 2 (Develop & Assess). The full analysis of the options is contained in the Initial Options Appraisal Table Issue 1, that can be found in PDF format alongside this document on the CAA airspace portal.

LBHA 21 RNAV - INITIAL OPTIONS APPRAISAL - FULL ANALYSIS TABLE

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Group	Impact	Level of Analysis	Option 2A - Do Minimum (Baseline) - VOR/DME Replication from ALKIN (3 Deg)	Option 2AD - VOR/DME Replication direct from OSVEV (3 Deg)	Option 2B - VOR/DME Replication from ALKIN (3.2 Deg)	Option 2BD - VOR/DME Replication direct from OSVEV (3.2 Deg)
Communities	Noise impact on health and quality of life	Initial Options Appraisal: Qualitative	Option 2A replicates the exiting VOR/DME approach, therefore there will be very little change to tracks flow, meaning that the dispersion of traffic and therefore noise will be relatively similar to todays operation. However, it is acknowledged that any aircraft arriving from the south would require radar vectoring to return to ALKIN, as they do today (prior to the removal of the VOR).	As this option replicates the exiting VOR/DME approach, there should be very little change to tracks flow, meaning that the dispersion of traffic and therefore noise will be relatively similar to today and the baseline scenario. However, it is acknowledged that any aircraft arriving from the south would require radar vectoring to OSVEV, but this is also the case in todays operation. Consequently, this option creates no change in terms of noise impact when compared to the baseline scenario.	As this option replicates the exiting VOR/DME approach, there should be very little change to tracks flow, meaning that the dispersion of traffic and therefore noise will be relatively similar to todays operation and the baseline scenario. However, it is acknowledged that any aircraft arriving from the south would require radar vectoring to ALKIN, but this is the case today and in the baseline scenario. Additionally, this option introduces a slightly steeper (3.2 Deg) approach, which means aircraft will be at a higher altitude for slightly longer, reducing the overall noise footprint compared to current operations and the baseline scenario.	As this option replicates the exiting VOR/DME approach, there should be very little change to tracks flow, meaning that the dispersion of traffic and therefore noise will be relatively similar to todays operations and the baseline scenario. However, it is acknowledged that any aircraft arriving from the south would require radar vectoring to OSVEV, in the same way they do today. Additionally, this option introduces a slightly steeper (3.2 Deg) approach, which means aircraft will be at a higher altitude for slightly longer, reducing the overall noise footprint compared to current operations and the baseline scenario.
Communities	Air Quality	Initial Options Appraisal: Qualitative	Like the existing procedure, the majority of local areas overflown are impacted when the aircraft is above 1,000ft. It is acknowledged that parts of Locksbottom and Farnborough are likely to be impacted as the aircraft will be at approximate 1,000 ft around 3 NM from touchdown. This will have the same impact as todays operations. In addition, it is also acknowledged that this will involve the overflight of the Princess Royal University Hospital. Having said that, this is unavoidable to ensure a safe and stable approach is flown following the establishment of the FAF, as per todays operations. Please note, the location of the FAF and associated flight path thereafter will remain the same as it is today.	Like the existing procedure, the majority of local areas overflown are impacted when the aircraft is above 1,000ft. However, it is acknowledged that parts of Locksbottom and Farnborough are likely to be impacted as the aircraft will be at approximate 1,000 ft around 3 NM from touchdown. In addition, it is also acknowledged that this will involve the overflight of the Princess Royal University Hospital. Having said that, this is unavoidable to ensure a safe and stable approach is flown following the establishment of the FAF. Please note, the location of the FAF and associated flight path thereafter will remain the same as it is today and in the baseline scenario. So, when compared to the baseline scenario, this option creates no change in terms of air quality.	Like the existing procedure, the majority of local areas overflown are impacted when the aircraft is above 1,000ft. However, it is acknowledged that parts of Locksbottom and Farnborough are likely to be impacted as the aircraft will be at approximate 1,000 ft around 3 NM from touchdown. In addition, it is also acknowledged that this will involve the overflight of the Princess Royal University Hospital. Having said that, this is unavoidable to ensure a safe and stable approach is flown following the establishment of the FAF. Please note, the location of the FAF and associated flight path thereafter will remain the same as it is today and in the baseline scenario. So, when compared to the baseline scenario, this option creates no change in terms of air quality.	Like the existing procedure, the majority of local areas overflown are impacted when the aircraft is above 1,000ft. However, it is acknowledged that parts of Locksbottom and Farnborough are likely to be impacted as the aircraft will be at approximate 1,000 ft around 3 NM from touchdown. In addition, it is also acknowledged that this will involve the overflight of the Princess Royal University Hospital. Having said that, this is unavoidable to ensure a safe and stable approach is flown following the establishment of the FAF. Please note, the location of the FAF and associated flight path thereafter will remain the same as it is today and in the baseline scenario. So, when compared to the baseline scenario, this option creates no change in terms of air quality.

Figure 5 IOA Full Analysis Table Extract