Initial Options Appraisal (IOA)

Stage 2 Develop and Assess

MAG East Midlands Airport

Document Details

Reference	Description
Document Title	Initial Options Appraisal Report (IOA)
Version	Version 2
Date	30 November 2023
Document History	Version 1 – submitted to CAA October 2023
Amendments	1. Appendix A2 Table 2 title amended to correct description to 'average summer night'. 2. Appendix A2 Table 4 first column amended to correct description to 'LAeq, 8hr dB'.

Table of Contents

1 Introduction

1.1 Document Purpose & Scope

The East Midlands Airport (EMA) Airspace Change Proposal (ACP) is currently at Stage 2 (Develop and Assess) of the CAA's CAP1616 Airspace Change Process. Step 2B requires the change sponsor to conduct an Initial Options Appraisal (IOA) in respect of the comprehensive list of options developed during Step 2A.

This IOA sets out the change sponsor's response to that requirement, explaining the steps, rationale, and outcomes of Step 2B. The analysis of the design options is then conducted using the Options Analysis tables. This document is the accompanying explanatory document to support the Initial Options Appraisal Analysis Tables which are provided separately and are available on the CAA Airspace Change Portal. An extract of the full analysis can be seen in Appendix A1 of this document.

This document forms part of a suite of documents submitted to the CAA at Gateway 2 of the CAP1616 process and is intended to be read alongside those documents.
The full suite of Stage 2 submission documents is:

- Stage 2 Summary Document, which draws together the key points from the Stage 2 submission and provides an overview of the Government's national programme of airspace change, the CAP1616 process and the progress to date of the EMA Future Airspace Project. This information is not repeated in this report.
- Design Options Evolution (DOE), Appendix A to the Stage 2 Summary Document, shows the evolution of the design options through Step 2A and Step 2B of the CAP1616 process. The resulting shortlist of design options will be considered in the Full Options Appraisal (FOA) at Stage 3.
- The Design Options Report (DOR), which sets out the change sponsor's approach to the design process and the output of that process in the form of design options for both departures and arrivals at the airport. It presents the design options identified and describes how those options were refined to provide a comprehensive list of design options to be progressed to the DPE.
- The Design Principle Evaluation (DPE), which assesses how the design options have responded to the design principles, which were established at Stage 1 of the CAP1616 process and identifies those that warrant further analysis at the next stage.
- Initial Options Appraisal Report (IOA), this document, building on the results of the DPE, the IOA is the first iteration of three option appraisals, required as part of the CAP1616 process. The purpose of the IOA is to provide, at a minimum, a qualitative assessment of each design option providing stakeholders and the CAA with the relative differences between impacts, both positive and negative.
- The Stakeholder Engagement Report (SER), which explains how engagement has been used in the processes described in the other Stage 2 documents and records its outputs.

The full suite of reports, together with their supporting appendices, have been published on the CAA Airspace Change Portal at https://airspacechange.caa.co.uk/.

1.2 Document Overview

This document forms part of the document set required for the CAP1616 Airspace Change Process: Stage 2 Develop and Assess, Step 2B Options Appraisal (Phase I Initial) including safety considerations. Its purpose is to consider the comprehensive list of viable options which have progressed through the DPE, to provide comparisons of each option via qualitative assessment or, if available and proportional, quantitative analysis, against the 'do nothing' scenario baseline. Under Stage 2, the designs are not fully developed, so the initial level of analysis possible and its granularity is inevitably less than applies to later, fuller appraisals as part of the CAP1616 process.

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
2. Initial Options Appraisal Methodology
3. Baseline Definition
4. Qualitative Safety Assessment
5. Noise Methodology
6. Initial Options Appraisal Results
7. Shortlisting of Design Options
8. Next Steps
9. Glossary
10. Initial Options Appraisal Full Analysis Table (Appendix A1 in this document)

It is important that readers review this document either before or alongside the IOA Options Analysis Tables (an example is shown in Appendix A1 to 9 this document) to provide additional context, clarification, and rationale. In addition, it is important to note that all altitudes referred to within this document are based on Above Mean Sea Level (AMSL).

1.3 Step 2B – Initial Options Appraisal

As part of the CAP1616 process, change sponsors are required to complete a formal Options Appraisal process that assesses the benefits and impacts of various design options compared to a baseline scenario. For the IOA that is required at Step 2B, the minimum requirement is to determine the high-level criteria and then conduct a qualitative assessment of each design option against the baseline scenario. This IOA serves as the foundation for a fuller and more quantitative assessment later in the CAP1616 process.

At Step 2B, options are tested against the criteria contained in CAP1616, (Appendix E, Table E2). In addition, the following qualitative assessments are required for any airspace change that has the potential to alter aircraft traffic patterns below 7,000ft (known as a Level 1 Airspace Change Proposal), such as this ACP:

- Safety
- Biodiversity
- Tranquillity

The Options Appraisal is used as a tool throughout the CAP1616 process to help refine the options from an initial longlist, down to a shortlist and a final set of preferred options.

The Options Appraisal consists of the following elements:

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

The options appraisal requirement of CAP1616 evolves through three iterations with the CAA reviewing at each phase as follows:

Phase I - 'Initial' appraisal at Step 2B with the CAA review at the 'Develop and Assess' Gateway.

Phase II - 'Full' appraisal at Step 3A with the CAA review at Step 3B and the subsequent 'Consult' Gateway.

Phase III - 'Final' appraisal at Step 4A, with the CAA review after the formal submission of the ACP at the end of Stage 4.

2 Initial Options Appraisal Methodology

2.1 CAP1616 Options Appraisal Requirements

The Options Appraisal process was carried out in accordance with the guidance in CAP1616, and in conjunction with the Green Book[1] and the Department for Transport's TAG[2] (although this is not applied to the Options Appraisal process until the Full Options Appraisal (FOA) at Stage 3), which constitutes the best practice in options appraisal.

The Options Appraisal process is an iterative tool throughout the CAP1616 process to help refine the design options from the comprehensive list to an initial comprehensive list of viable options, down to a shortlist (including the preferred option(s)).

2.2 IOA Minimum Requirements

CAP1616 prescribes that the following should be included within an IOA as a minimum:

- A comprehensive list of viable design options (including the 'do nothing'/'do minimum' option which will act as a baseline for analysis).
  - A description of the change proposal.
  - An indicator of likely noise impacts.
  - A high-level assessment of benefits and costs involved.
- The criteria for assessing the list of options and the application of these criteria to determine a shortlist of options.
- Shortlist options described qualitatively and an indication of the preferred option.
- What evidence the change sponsor will collect, and how it will be collected to fill in its evidence gaps and to develop the FOA, during Stage 3. (See Paragraph 2.2.3).

There is a minimum requirement within CAP1616 to conduct qualitative analysis within the IOA. However, change sponsors can elect to supplement their analysis with quantitative analysis if they so choose. This is the case for the EMA ACP, where the change sponsor has elected to use quantitative data to supplement the qualitative analysis in the areas relating to noise impact on health and quality of life, greenhouse gas impact, tranquillity, fuel burn and air quality.

2.3 FOA Evidence Capture

Consistent with the requirements of CAP1616, the IOA is primarily a qualitative analysis of each option (within the comprehensive list of viable options) against a defined baseline. This will be expanded on within the FOA, which will be conducted during Stage 3, to include a fuller and more quantitative analysis. The FOA requires change sponsors to assess each of the design options (within the short-list) in relation to the criteria defined within CAP1616, Appendix E using quantitative metrics, where it is possible to do so. These metrics will include the assessment of the environmental impacts of the proposed change.

[1] The Green Book – Appraisal and evaluation in central government (UK Government)

[2] WebTAG (UK Government)

As defined in CAP1616a, the FOA requires change sponsors to collect quantitative environmental metrics that describe the baseline scenario and conduct a series of modelling activities for each of the design options, to enable an environmental comparison. The required metrics articulated in CAP1616a include:

- 10-year traffic forecasts (including all intermediate years).
- Standard noise metrics:
  - L_{Aeq} noise contours.
  - 100% mode noise contours.
  - Nx contours.
  - Difference contours.
  - L_{max} spot point levels.
- Operational diagrams.
- Overflight (based on the CAA definition of overflight found in CAP1498).
- Climate change and CO2 emissions.

The modelling is intended to provide a comparison between today's operation (the baseline), to show the impact of the proposed change at the point of implementation and 10 years post-implementation. Modelling is also required to show the situation at the proposed implementation date and 10 years post-implementation **without** applying the proposed change.

It is acknowledged that, within the FOA, further information will be required, and Paragraph 8.7 of this IOA details that information and outlines how it is planned to collect it. The Stage 3 FOA will contain full details of the methodology used when generating the supporting data.

2.4 High-level Objectives & Assessment Criteria

For the purposes of CAP1616, the EMA Future Airspace Project has been provisionally assigned as a Level 1 ACP by the CAA. This is expected to be confirmed by the CAA following the Stage 2 Gateway. For a Level 1 ACP, the criteria against which options are assessed are defined within CAP1616, Appendix E, Table E2 and the criteria are described in Table 1 below. The change sponsor has also conducted some quantitative analysis to support the assessment within both the DPE and IOA that includes an assessment of overflight to support elements of the IOA. These metrics are designed to support the qualitative assessment of the criteria shown in Table 1, rather than act as additional criteria. Additionally, Safety Assessment, Tranquillity and Biodiversity (as defined in CAP1616, Appendix B) have been added at the bottom of the below table, as these additional assessments are required for Level 1 airspace changes.

Affected Group	Impact	Description[3]
Communities	Noise impact on health and quality of life	A quantitative assessment of number of population affected based upon number of households and planned property developments as known at this time.
	Air Quality	Any change in air quality is to be considered[4].
Wider Society	Greenhouse Gas impact	Assessment of changes in greenhouse gas levels in accordance with TAG[2] is required. At this stage, a quantitative statement based on track length has been used.
	Capacity and resilience	A qualitative assessment of the impact on overall UK airspace structure has been used at this stage. Dependent upon the category of the change, the CAA may require quantitative methodologies that allows monetisation of the impact.
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. At this stage, a quantitative statement based on track length has been used.
Commercial airlines	Training costs	An assessment of the need for training associated with the proposal.

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

Affected Group	Impact	Description[3]
	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.
Safety Assessment	Safety Assessment	CAP1616 requires a safety assessment of the proposal to be undertaken in accordance with CAP760 (Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers).
Wider Society	Tranquillity	The impact upon tranquillity need only be considered with specific reference to Areas of Outstanding Natural Beauty (AONB) and National Parks (NPs) 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 1 IOA Assessment Criteria

2.4.1 Appraisal methodology

A full explanation of the evolution of the design options through Stage 2 of the CAP1616 process can be found in the DOE (Stage 2 Summary Document Appendix A).

Consistent with the requirements of CAP1616, the change sponsor has adopted a clear and consistent methodology for assessing design options against a defined baseline (as explained in Paragraph 3). The IOA has enabled each of the design options, that were identified by the DPE as meriting further consideration to be further assessed against the criteria in Table 1, so that a shortlist of design options can be identified for taking forward to Stage 3 of the process.

The IOA has been conducted by comparing all the design options that were accepted within the DPE analysis against the defined 'do nothing' scenario baseline, considering each criterion defined in CAP1616 (as shown in Table 1). This exercise was completed using a tabular format; an assessment of each design option is shown against each criterion set against the baseline.

For clarity, the results are presented in multiple tables. For departures, each design envelope is reported within a separate table. Arrivals have been assessed by individual runway and position of the Initial Approach Fix (IAF). All relevant documents have been uploaded to the CAA Airspace Change Portal.

An extract of the full analysis of all the options is shown at Appendix A19.

2.4.2 Arrivals combined assessment

The process to develop arrivals has created a spread of IAFs within the design envelopes and a common IAF for both Runway 09 and Runway 27 from the north and south as the starting point for the design options, which will be used for both runway ends.

During the design development process, the concept of runway dependent IAFs was investigated in response to stakeholder questions. In doing this, it was considered whether any benefit could be gained. Following discussions with NERL, the conclusion of this analysis was:

- The EMA concept of having IAFs that serve both runways means that airlines can flight plan and fuel plan to a common arrival fix, and also that both ATC and the arriving aircraft share the same information on the intended routing and arrival point. This is especially important in the event of radio failure where ATC need to be assured of an aircraft's intended routing to provide safe separation.
- If runway dependant IAFs were used, this shared understanding and certainty may be removed. This is particularly the case if there is a runway change combined with a radio failure. Safety and hazard analysis work conducted by NERL concluded that, with runway dependant IAFs, there is an increased safety risk of an aircraft flying an incorrect routing to either the wrong runway or the wrong IAF if a runway change occurred.

It was concluded that this concept would be misaligned to the Design Principle Safety and was not taken forward. All IAFs will therefore deliver benefits for, and be compatible with, both runway approach ends (Runway 09 and Runway 27).

2.5 IOA Assessment Criteria Considerations

As part of the IOA assessment criteria, certain contextual factors were considered by the assessor whilst conducting the IOA. These allow the assessor to gain a more holistic view of the assessment criteria, enabling a more informed assessment. The remainder of this section explains these contextual factors.

2.5.1 Overflight Analysis

Quantitative overflight analysis (as defined in CAP1498) has been used to support judgements made in the IOA. As previously mentioned, this is over and above the minimum requirements of CAP1616, which only requires qualitative analysis during Stage 2.

A Geographic Information System (GIS) has been used to consider the track associated with each design option (including the baseline scenario[s]). The resulting analysis has provided data for use in the IOA assessment showing several relevant elements including, but not limited to:

- Number of people overflown, rounded to the nearest 100.[5]
- Number of residential properties overflown, rounded to the nearest 50.[6]
- Number of planned property developments, rounded to the nearest 50.[7]
- Air Quality Management Areas (AQMAs) overflown. Source: DEFRA
- Track mileage
- Areas of Outstanding Natural Beauty (AONBs) overflown. Source: DEFRA
- National Parks (NPs) overflown. Source: DEFRA

Overflight of AQMAs was analysed within the overflight assessment, although any overflight of these areas above 1,000ft is unlikely to have an impact on local air quality because of mixing and dispersion as detailed in CAP1616, Appendix B, paragraph B74.

It should be noted that there are no AQMAs in the immediate vicinity of EMA and therefore for the purpose of the IOA, it has been assumed that the effect will be negligible due the effects of dispersion and mixing. A full assessment of any potential impact will be conducted during Stage 3 of the ACP.

To enable a clear and consistent comparison, an overflight assessment was conducted on each of the baseline scenario(s). The data collected has enabled a direct comparison to be made within the IOA between each design option and the baseline scenario (today's operation). The results are included within the Full Analysis Tables (see Appendix 9) and have been used to formulate an assessment of the following IOA criteria:

- Noise impact on health and quality of life up to 4,000ft
- Noise impact on health and quality of life up to 7,000ft
- Air quality (Specific to AQMAs)
- Greenhouse Gas impact
- Tranquillity
- Fuel burn

[5] Population figures based on CACI database using 2021 census
[6] Residential figures based on OS Address Base data
[7] Data was collated by CBRE on five-year housing plans. See "Future Housing Sites" in the Glossary for more information.

2.5.2 Climb and descent performance

With reference to departures, the current SIDs departing from EMA (as published within the UK Aeronautical Information Publication (AIP) have varying climb gradients. Analysis of the Noise Track Keeping data has shown that, due to advances in aircraft performance, all aircraft that depart EMA are able to fly the published climb gradient and, in most cases, exceed the published climb gradient.

The design options created as part of this ACP are based on the results of the EMA Fleet Equipage Survey, which included data collected from aircraft operators to understand the performance that could be achieved both now and in the future. The results of this showed that all airlines that responded could achieve a minimum climb gradient of 6% under 2023 operations.

With reference to the baseline scenarios for departures, the 'do nothing' baseline scenario (described in section 3) is based on Noise Track Keeping data. The change sponsor has created a modal (average) lateral path to assess the options against using the Noise Track Keeping data. As such, there is no standardised baseline climb gradient across all baseline scenarios. To ensure a fair comparison is made for each design option, whilst conducting the IOA, the most appropriate (and where possible the closest) modal path has been used as a comparator.

For arrivals options, the AMS sets out initiatives that airspace modernisation must deliver, and this includes the consideration of Continuous Descent Arrivals (CDAs) as means of improving environmental performance. Therefore, in line with the Design Principle Programme, the arrivals options have been designed with the intention of providing CDAs to both runway directions. The descent criteria are aligned to the PANS-OPS recommended range for CDAs, and also sought to apply latest CAA policy on low noise arrivals metrics as detailed in CAP2302. On this basis, the arrivals options assessed in this IOA fall within an upper limit of 3.5° and a lower limit of 1.5°.

Further details on the CDA descent gradients can be found in the DOR section 19.

2.5.3 Track mileage and fuel burn

At this stage of the CAP1616 process, the change sponsor is only required to conduct a qualitative assessment within the IOA; detailed quantitative assessment takes place later in the process as part of the Full Options Appraisal in Stage 3.

Going beyond the minimum requirements of CAP1616, the overflight assessment, described in Paragraph 2.5.1, has allowed an approximate track mileage associated with each option to be derived for comparative purposes. In line with standard aviation practice, this is presented in Nautical Miles (nm) although we have applied a conversion to kilometres (km) for completeness. This analysis has also been carried out on the baseline scenario(s), to enable a direct comparison within this IOA.

In terms of track length, to enable a more meaningful comparison, for departures, the change sponsor has measured track length from the Departure End of Runway (DER) up to 7,000ft for both the 'do nothing' baseline scenarios and the departure options. It is acknowledged by the change sponsor that the existing conventional SIDs for EMA, as published within the UK AIP are currently designed to reach an altitude of 6,000ft AMSL for northerly departures and FL90 for southerly departures with the flight being transferred to another ATC controlling authority during the climb.

With specific reference to the departure options, to distinguish track length between options which have the same climb gradient, the change sponsor has calculated a perpendicular line in relation to the end of the design envelope which all departure options shall be measured to. The

difference between the end of each design option at 7,000ft and this perpendicular line provides the data upon which to base the fuel burn calculation. No such methodology was required to be employed for the comparison of the arrival / transition design option track lengths.

No actual fuel burn metrics have been captured for each design option; instead, the track mileage information has been used as a proxy, on the assumption that the shorter the design option, the less fuel is burnt. This rationale has been utilised for the assessments made during Stage 2 only. Further analysis of fuel burn and the metrics used to define this will be conducted within the FOA and described in more detail during Stage 3 of the CAP1616 process.

2.5.4 Air Quality Management Areas (AQMAs)

CAP1616 requires change sponsors to consider the impact of proposed changes on AQMAs. AQMAs are areas where the relevant local authority considers that air quality is unlikely to meet the Government's national air quality objectives.

Figure 1 below shows the location of AQMAs (shown in pink) within the vicinity of EMA (shown in the red oval).

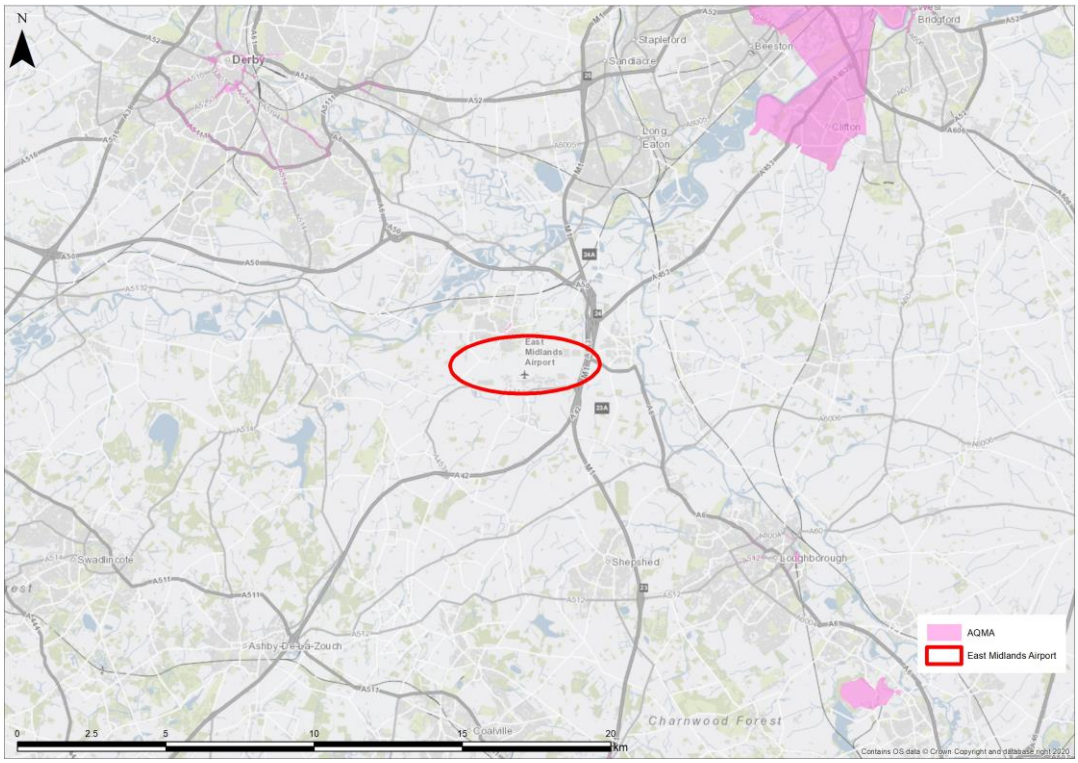


Figure 1 EMA AQMA Map (Source: UK Government)

During the completion of the IOA, the overflight analysis has been used to determine whether a proposed design option overflies an AQMA.

CAP1616, Appendix B, Paragraph B74 states:

"Due to the effects of mixing and dispersion, emissions from aircraft above 1,000 feet (amsl) are unlikely to have a significant impact on local air quality. Therefore, the impact of airspace design on local air quality is generally negligible compared with other factors such as changes in the volume of air traffic, and local transport infrastructures feeding the airport."

Based on the above, the impact of the ACP in terms of local air quality is minimal as there is likely to be limited change to overflight below 1,000ft.

The location of these sites will be investigated, and a further detailed air quality assessment will be undertaken as part of Stage 3.

2.5.5 Tranquillity

As part of a Level 1 ACP, change sponsors are required to consider the impact that the proposal may have on Tranquillity. This scope is limited to AONBs and National Parks (NPs), as specified in CAP1616, Appendix B, Paragraph B76:

"For the purposes of airspace change proposals, 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."

During the stakeholder engagement phases, no additional areas were identified.

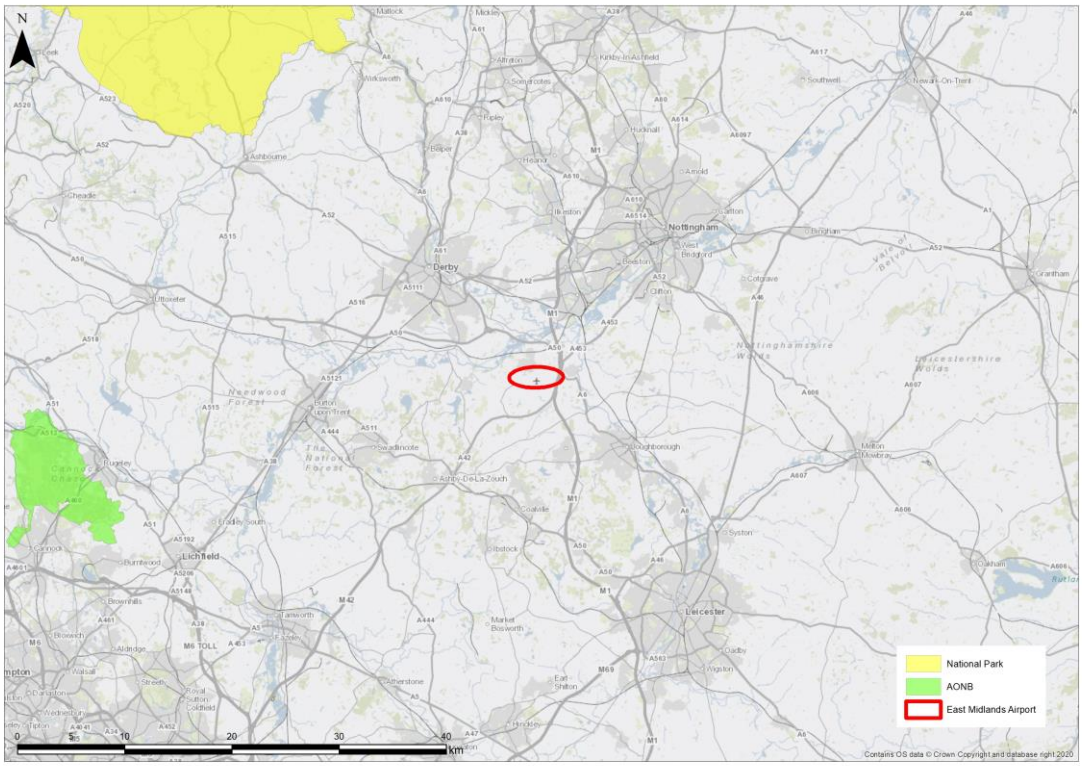


Figure 2 EMA AONB and National Park Map

Figure 2 above shows the registered AONB of Cannock Chase (shown in green) which is located to the west of EMA (shown in the red oval). For assessment purposes within the IOA, the Cannock Chase AONB is assessed as being outside the scope of this ACP as it is located a significant distance away from EMA and any aircraft overflying this area would be expected to be well above 7,000ft. and under the control of NERL, as the UK's en-route ANSP.

The Peak District National Park is located to the north west of EMA (shown in yellow in Figure 2 above). In accordance with CAP1616, Appendix B, Paragraph B78, the change sponsor has considered this area and where possible, taken any adverse effects into consideration. Due to the location of the Peak District National Park, EMA departing and arriving aircraft are unlikely to

overfly the National Park below 4,000ft and as such, the noise impact of the design options is expected to be similar to the 'do nothing' scenario baseline.

2.5.6 Biodiversity

As defined in Table 1 (see section 2.4), CAP1616 requires change sponsors to consider the impact the proposed change may have on biodiversity within the vicinity of the change. CAP1616, Appendix B, Paragraph B80 states:

"In general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not involve ground-based infrastructure".

This statement is particularly relevant to this ACP, as the ACP does not involve any change to ground infrastructure. Nevertheless, as part of the IOA the change sponsor has sought to identify "terrestrial, marine and other aquatic ecosystems" that may be affected, as per CAP1616, Appendix B, Paragraph B79. At this stage, it is not known whether this ACP will have an adverse impact on biodiversity. In-depth analysis shall be conducted at Stage 3, when the range of options under consideration will be reduced and detailed assessment possible, to determine the potential impact on a variety of biodiversity receptors.

Additionally, as stated in CAP1616, Appendix B, Paragraph B80, the change sponsor has considered the impact of the change on European Protected Species as defined in the Conservation of Habitats and Species Regulations 2010[8]. The UK Government interactive map indicates that there are a number of sites within the vicinity of EMA where species such as Great Crested Newts (a European Protected Species) can be found.

Based on the high-level assessments carried out to date, the change sponsor's position is that when compared to the baseline scenarios (today's operation), the proposed changes associated with this ACP are unlikely to have a significant impact on biodiversity; however, this will be fully assessed at Stage 3 of the CAP1616 process.

[8] Conservation of Habitat & Species Regulations 2010 (UK Government)

3 Baseline Definition

3.1 Baseline Overview

In accordance with CAP1616, Appendix E, paragraph E12, a baseline has been established for the IOA, which will be used to inform subsequent environmental assessments. CAP1616, Appendix J defines the baseline as the:

"Scenario in analysis of different options where the impacts of the change not being implemented are analysed (also known as 'do nothing' or 'do minimum' option)"

The baseline is intended to allow the change sponsor to conduct an assessment to set out the current impacts so that a comparison can be made with the impacts of the proposed options. Full analysis of the baseline scenarios is contained within the Full Analysis Tables found in Appendix A1 and on the CAA Airspace Change Portal.

3.2 Baseline Rationale

EMA has established a set of 'do nothing' baseline scenarios, against which the proposed design options have been assessed. Several contextual factors were considered during the selection of the baselines.

3.2.1 DVOR decommissioning

Currently, the airport relies on conventional ground-based Doppler Very High Frequency Omni Range Radio Beacons (DVOR) navigational aids that are reaching the end of their operational life.

The DVORs applicable to operations at EMA are:

- TRENT (TNT) DVOR
- POLE HILL (POL) DVOR
- DAVENTRY (DTY) DVOR
- BROOKMANS PARK (BPK) DVOR

As part of the wider plans to modernise UK airspace, as set out in the Airspace Modernisation Strategy (AMS), the UK's en-route Air Navigation Service Provider (ANSP), NATS En Route Limited (NERL) plan is to decommission 22 of these DVOR beacons to allow the use of more modern satellite-based navigation systems to be utilised. This decommissioning programme is expected to be completed by late 2024.

Solutions were explored to mitigate the risk associated with this decommissioning and service agreements have been made with NATS for DVOR's to remain operational whilst airports deliver the temporary replacement for DVOR usage through application of the process detailed in CAP1781.

The change sponsor therefore intends to follow the process under CAP1781 to allow the substitution of the current routes using PBN (specifically RNAV) on a temporary basis as commercial aircraft flying into EMA are already capable of flying these routes. This process is separate to, and outside of, this ACP, which seeks to implement an enduring solution that is not reliant upon ground-based infrastructure, in accordance with the UK's AMS.

The assumption is that the implementation of CAP1781 will result in no changes in aircraft behaviour. This is based upon:

- CAP1781 which states that RNAV Substitution is intended to maintain existing tracks over the ground for an agreed period, during which the affected airspace is being redeveloped. The process also makes it clear that the CAA approval to use RNAV substitution is based on a demonstration that the aircraft tracks over the ground will be unchanged.
- To provide further assurance, the process requires sponsors to undertake pre and post monitoring of track keeping. This includes the use of existing ground tracks from which to monitor performance and following decommissioning of the DVORs these will be used as the baseline from which to monitor post implementation aircraft performance.
- The Flight Management System (FMS) coding providers have agreed to maintain their coding in accordance with a Data Quality Requirement which ensures any proposed coding changes will be agreed with the sponsor and the CAA.

This CAP1781 process is expected to be completed and implemented by September 2024 which will permit the decommissioning of the DVORs that EMA have a reliance upon. For the purposes of the 'do nothing' baseline that will inform the change sponsor's assessments it is therefore assumed that these RNAV substitutions shall be in place from the point the DVOR is removed until the implementation of this ACP, which is the permanent solution.

Therefore, for the purposes of this ACP, the change sponsor's position is that 'do nothing' is a suitable baseline for comparison in the IOA, notwithstanding that 'do nothing' is not a feasible option for the ACP.

3.3 The 'Do Nothing' Baseline

The full description and rationale for the 'do nothing' option is provided in the DOR section 4.4.1 and 4.4.2, and a summary is provided below.

The 'do nothing' scenario for departures would mean that, when the TNT DVOR is taken out of service, there would be no published procedures for aircraft to fly.

As described above, the change sponsor intends to follow the process under CAP1781 to allow the temporary substitution of the current routes using PBN until the implementation of this ACP. Because the implementation of CAP1781 ensures that there will be no changes in aircraft behaviour compared to today, it is appropriate to be considered as the 'do nothing' baseline.

However, a permanent solution is required to avoid these substitutions being removed from publication after five years. Without a long-term solution, ATC would be responsible for issuing individual instructions to aircraft, which does not align with the AMS and the 'must have' Design Principle Programme. In addition, this removal of standardised instructions to aircraft would not align with:

- Design Principle Technology as it would not make use of the latest aircraft technology.
- Design Principle Noise N3 which requires us where possible to limit and reduce noise disturbance to communities. The 'do nothing' is likely to increase this number, because of the absence of standard departure procedures for aircraft which currently require aircraft to follow pre-determined paths. It would also remove the ability to avoid locations that are especially sensitive to noise under Design Principle Noise N4.

- Design Principle Continuity as it would significantly increase ATC workload which would lead to a reduced traffic flow.

For arrivals, the 'do nothing' scenario assumes the continued use of the existing holds at ROKUP and PIGOT, ATC vectoring aircraft onto final approach and a final approach based upon ILS only. However, this does not provide PBN Approach procedures in accordance with the requirements of CAA AMS and the 'must have' Design Principle Programme.

Therefore, because neither the 'do nothing' departures or arrivals scenarios provide procedures in accordance with the CAA AMS, they do not align with the 'must have' Design Principle Programme or represent feasible options and have not been carried forward as an option for evaluation within the IOA.

However, both are used as a baseline within this IOA to enable stakeholders to understand the impact/effect the 'do something' options would have.

The change sponsor has selected a set of 'do nothing' baseline scenarios for both departures and arrivals/transitions which reflect today's operation.

3.3.1 Departures

For departures, the 'do nothing' scenario baseline consists of modal tracks based upon all existing SIDs available at EMA. Aircraft departing from EMA currently establish themselves on one of the following SIDs to enable connectivity with the enroute network:

- TNT (Runway 09 and Runway 27)
- POL (Runway 09 Day only 0700 to 2200 local)
- DTY (Runway 09 and Runway 27)
- BPK (Runway 09 Night only 0001-0600 local)

However, as is often the case when assessing departure routes defined by ground-based infrastructure, there may be variances between the published routes and the actual routes flown by aircraft. These variances are principally created by the rules and regulations regarding ATC vectoring. Once aircraft reach a certain altitude, which varies between 3,000ft and 6,000ft, ATC are permitted to turn the aircraft off the SID, either to create a more direct route, or to ensure separation from other airborne traffic. However, it could also be attributed to a variety of factors including inclement weather, wind speed and direction, aircraft type, experience of pilot/crew, type of Flight Management System (FMS) on board.

Because of this ATC ability to vector traffic off the SID (once they have climbed above the Noise Preferential Routing altitude), the change sponsor has utilised Noise Track Keeping data to establish modal tracks used by aircraft following these procedures; these modal tracks are shown in Figure 5 and 6 below and will form the basis of the temporary arrangements to be put in place through CAP1781.

For the Runway 27 TNT modal tracks there is a split of traffic, some continuing north west, some continuing in a more northerly direction. This is due to the absence of a POL SID from this runway, which would route traffic to the north. Instead, this track is achieved through ATC vectoring.

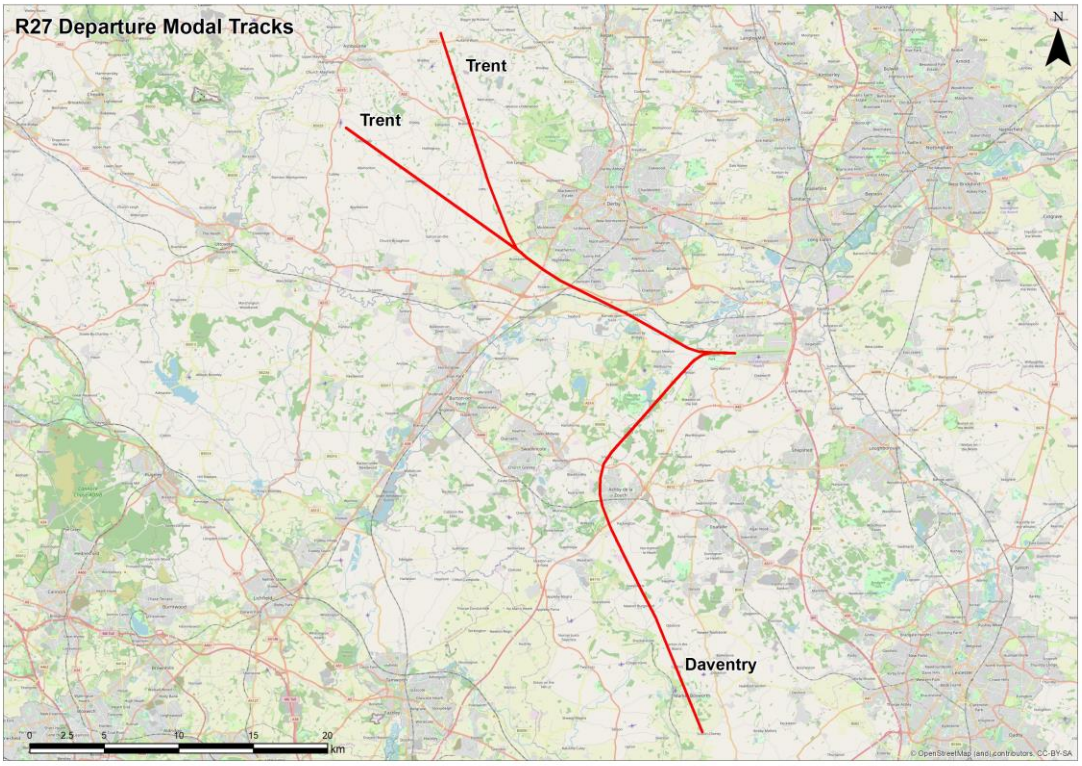


Figure 5 Runway 27 Departure Modal tracks

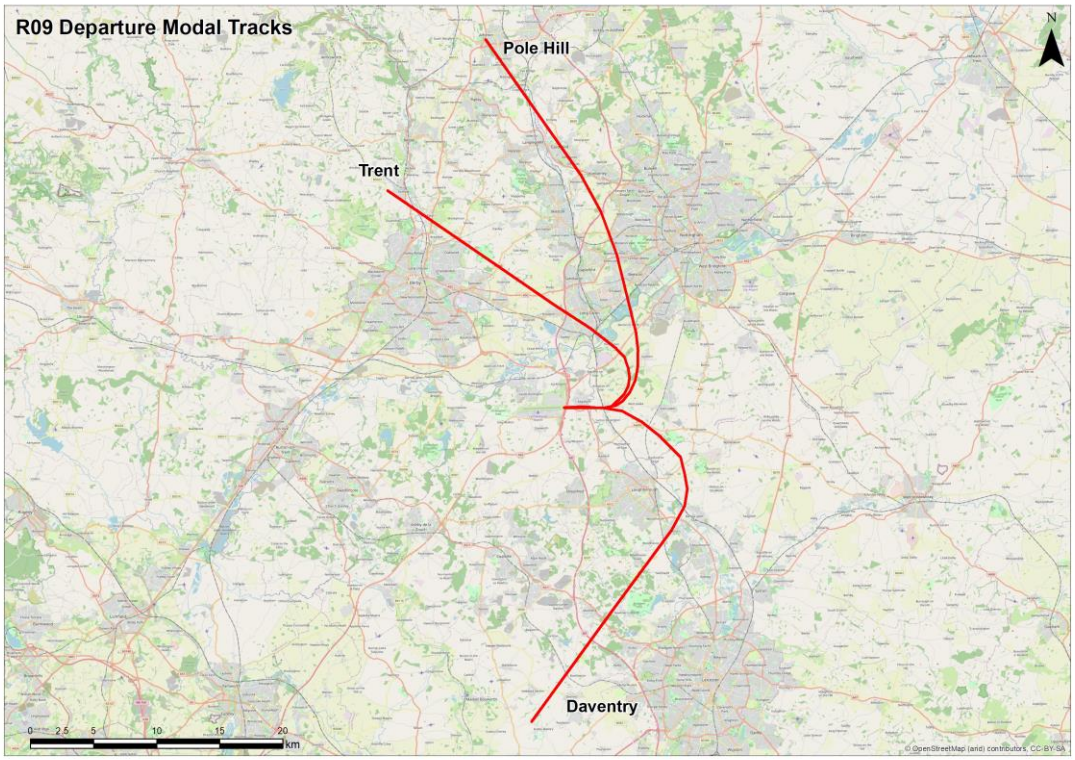


Figure 6 Runway 09 Departure Modal tracks

Furthermore, the modelling of the baseline modal tracks has considered a variety of climb gradients, based on the distance between the DER and the point at which an aircraft would reach 7,000ft. As a result, there is no standardised climb gradient applicable to all the baseline modal tracks. In addition, the change sponsor has chosen to include a defined polygon area which incorporates flights which have been taken off the SID and tactically vectored. In doing so, the change sponsor aims to show complete transparency in using the data relating to tracks flown by aircraft today as a comparator.

For completeness, Figure 7 below shows the baseline modal tracks and radar vectoring areas used by the change sponsor to conduct the overflight analysis in support of the IOA.

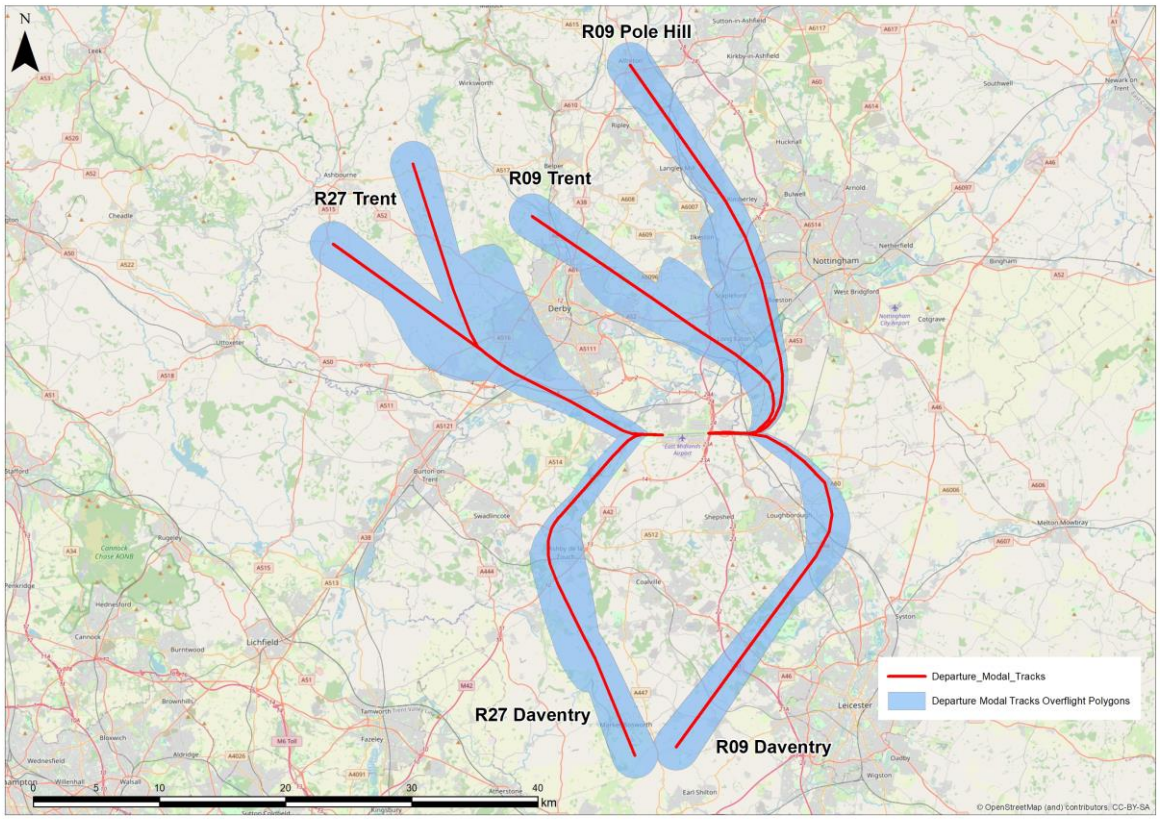


Figure 7 EMA Runway 09 and Runway 27 Departure Baseline Modal Tracks with Radar Vectoring Areas

For the purposes of the overflight analysis in the IOA, the baseline modal tracks have been assessed up to an altitude of 7,000ft with the addition of the radar vectoring areas.

3.3.2 Arrivals/Transitions

Arriving aircraft approach EMA airspace from several UK entry points before routing towards one of the two EMA holding stacks at ROKUP to the north or PIGOT to the south. During busy periods arriving aircraft may be held in one of these oval racetrack-like patterns, separated at 1,000ft intervals until ATC can provide a clearance for the aircraft to continue with its final approach.

To enable the final approach at EMA, ATC at EMA will provide aircraft with radar vectors to establish the aircraft on the ILS for its final approach. Radar vectoring is a technique that is used by ATC to manage traffic flows and involves controllers providing pilots with verbal instructions,

over the radio, based upon the surveillance picture that they are presented with on their radar screen. As this is a manual task, there is some variation in terms of tracks and height over the ground caused by sequencing, and the turning ability and approach speeds of different aircraft types; however, in general, the direction of the tracks remains the same.

Due to the use of this radar vectoring, aircraft currently making an approach to EMA cumulatively fly over a greater area (more widely dispersed); however, the frequency of overflight within a specific location is likely to be lower because of this dispersal.

To provide a consistent approach to the IOA assessment, overflight analysis has been conducted based on the number of people that may be overflown within the existing radar vectoring areas. To achieve this, the change sponsor has carried out work to establish modal tracks within the radar vectoring areas from each direction for each runway configuration, illustrated in Figure 8 (Runway 27) and Figure 9 (Runway 09) below. This allows for consistent assessment within the IOA, when comparing the proposed arrival/transition design options to the 'do nothing' scenario.

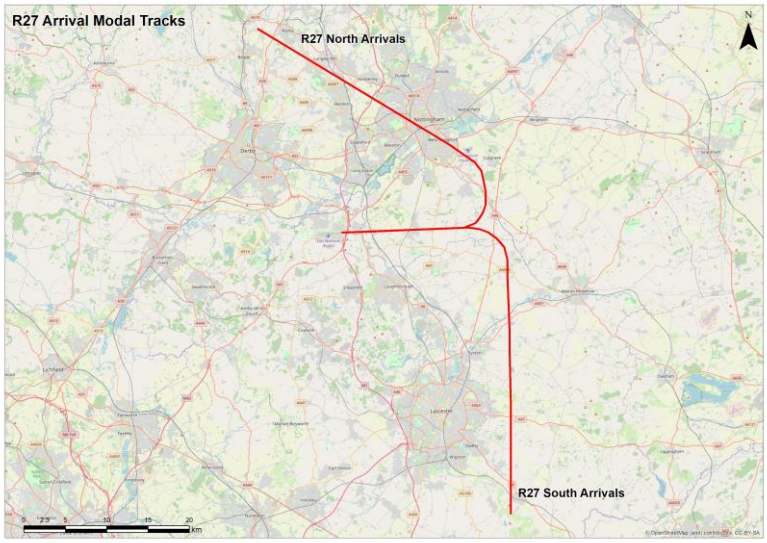


Figure 8 Modal Radar Vectoring Tracks for Runway 09 Arrivals

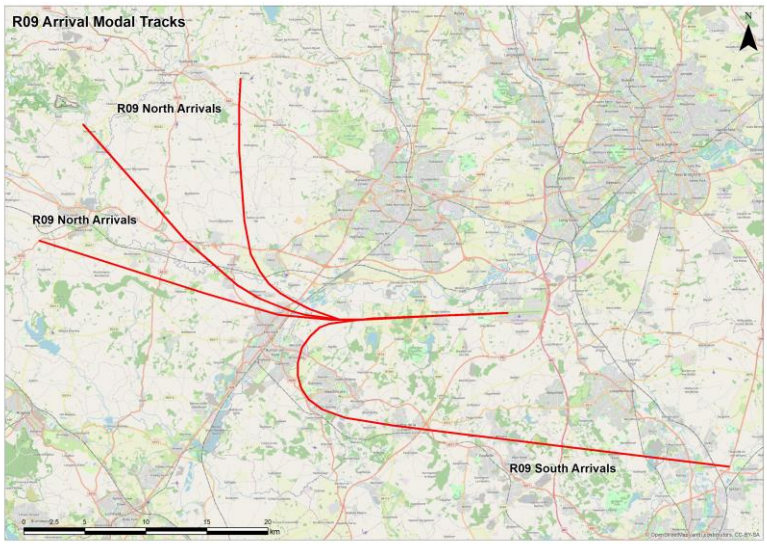


Figure 9 Modal Radar Vectoring Tracks for Runway 27 Arrivals

These ‘modal’ tracks have then been assessed in terms of overflight, with locations that are duplicated by the multiple tracks only being included once. The appropriate ‘modal’ track has been used to assess arrivals from the relevant direction to make a relevant comparison. In addition, the change sponsor has chosen to include a defined polygon area which incorporates areas where arrivals have been tactically vectored, this is illustrated in Figure 10 for both runways. In doing so, the change sponsor aims to show complete transparency in using the data relating to tracks flown by aircraft today as a comparator.

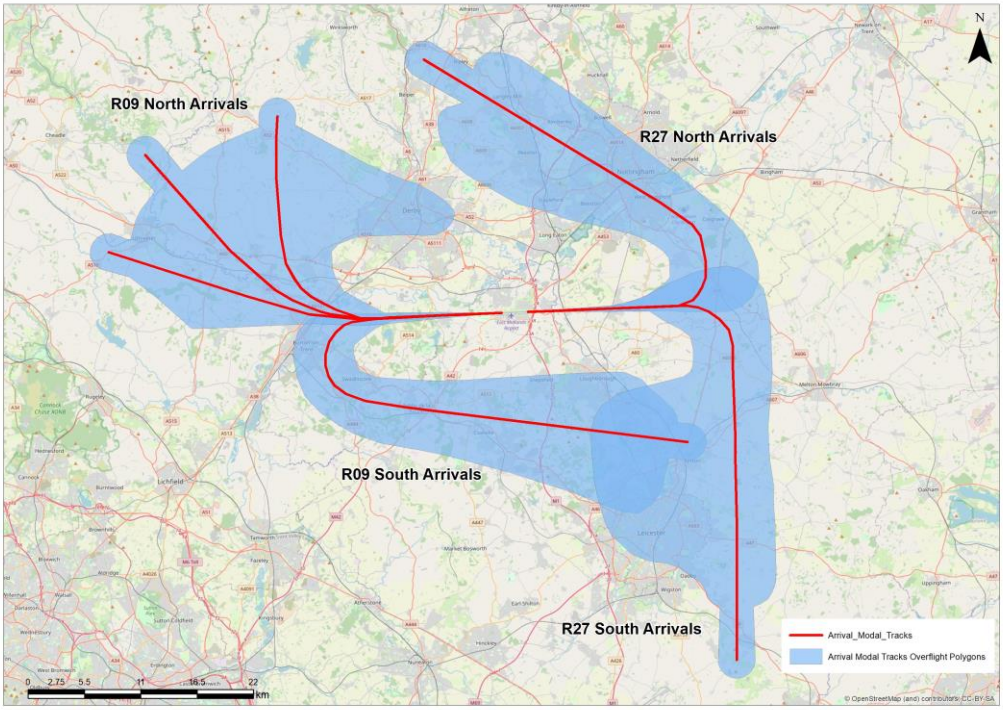


Figure 10 EMA Runway 09 and Runway 27 Arrivals/Transitions Baseline Modal Tracks with Radar Vectoring Areas

3.4 The 'Do Minimum' Option

The full description and rationale for the 'do minimum' options are provided in the DOR sections 4.4.3 and 4.4.4, and a summary is provided below.

The 'do minimum' option for departures would involve replicating the current routes to PBN standard. As the 'do minimum' represents the least technological change from current operations this would involve replicating the current routes to RNAV1 standard. RNAV1 has been chosen because it is the lowest PBN navigation specification useable by all airlines that responded to the EMA Fleet Equipage Survey.

However, if all the 'do minimum' option were to be implemented as a system, the ACP would not provide optimal benefits in relation to the following design principles:

- Noise N1: This requires us to design routes that, where practical, are spread out to reduce the impact of noise, and this includes the concept of noise respite. This comprehensive list of departures contains options that may allow this but the 'do minimum' option would constrain the operation to the current network of routes without this possibility.
- Noise N3: This requires us to limit and where possible reduce noise impact to communities. Many of our options have been created with the concept of reducing noise when compared to today's operation, but as above, the 'do minimum' option would constrain the operation to the current network of routes without this possibility.
- Continuity: This requires us to design airspace that enables the best use of the capacity of the existing runways in line with Government policy. The current SID designs could be optimised to provide an improved route structure, and a more efficient operating network, but the 'do minimum' limits this opportunity to improve runway optimisation.

The 'do minimum' for arrivals would incorporate the use of the existing RNAV holds at ROKUP and PIGOT. Because these are the responsibility of NERL, it is assumed that these holds will remain in their existing location. ATC vectoring would then be used to take aircraft from these holds onto final approach, and this final approach would be based upon procedures designed to RNP APCH standard or an ILS arrival. By providing PBN Approach procedures, this addresses the issues associated with the 'do nothing' arrivals scenario and aligns with the 'must have' Design Principle Programme.

However, no PBN arrival transitions would be replicated as part of a 'do minimum' option. This is because the only procedures capable of replication would be the current Initial Approach Procedures (IAP) created for "ILS/DME without Radar Control". These procedures make use of the PIGOT hold which is outside of the viable design envelope and as a result, has been classified as Viable but Poor Fit within the DOR. This misalignment is based on the distance to the FAF for Runway 09 which results in a gradient below the minimum CDA criteria, and on this basis, it does not align with the mandatory Design Principle Programme.

3.4.1 Departures

Whilst the 'do nothing' scenario has been used as a baseline for assessment within the IOA, it is not a feasible option in the longer term. To provide an informed view of the future, which sets out the minimum changes necessary to respond to the issues in the SoN, a 'do minimum' option for the departures has been considered. These are described in the sections below. Where

applicable, these 'do minimum' options have been assessed against the 'do nothing' baseline within the IOA Full Analysis Tables.

The 'do minimum' option for departures constitutes an RNAV1 replication of the existing conventional SIDs, but with a continuous climb gradient of 6% up to 7,000ft and extended to the common perpendicular line described at Paragraph 2.5.3.

The selection of 6% is based upon the EMA Fleet Equipage Survey and engagement with aircraft operators. These tracks are contained within each of the Runway 09 and Runway 27 design envelopes. Figure 12 below shows an example of the replication that has been designed for the Trent SID for Runway 27.

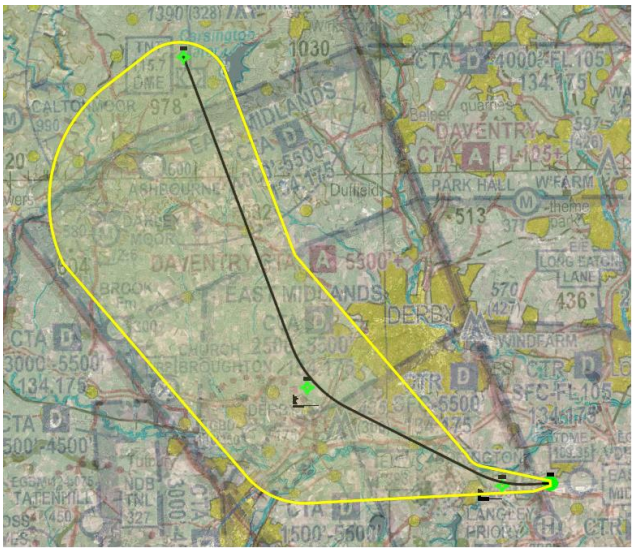


Figure 12 RNAV Replication of Existing Runway 27 Trent SID

Figure 12 above shows the Runway 27 North West design envelope in yellow, and the RNAV1 replication of the current TNT SID. This has been designed in accordance with requirements specified in Procedures for Air Navigation Services – Operations (PANS-OPS), as published by the International Civil Aviation Organisation (ICAO) in Document No 8168.

In accordance with the 'must have' Design Principle Safety, the change sponsor is required to design routes in accordance with these PANS-OPS criteria. Since this is a different design criterion than that in place when the conventional SIDs were originally designed, there may be some lateral difference in tracks over the ground, but this is expected to be modest.

This approach has been expanded to include a replication of all existing SIDs for both Runway 09 and Runway 27 at EMA.

3.4.2 Arrivals/ transitions

As described above, for the arrivals 'do minimum', there are no procedures that could be created as a viable PBN replication as a 'do minimum' option. In addition, since aircraft arriving at EMA are presented from a variety of directions, and the tracks are dispersed over a wide area, it was difficult to establish a single 'do minimum' option that could accurately replicate today's operation.

Section 4.4.4 of the DOR outlines the scenario for the arrivals 'do minimum' as being:

- The retained use of the existing RNAV holds at ROKUP and PIGOT in their current location.
- ATC vectoring aircraft from the holds onto final approach.
- A PBN compliant and ILS based final approach.

The PBN final approach will result in aircraft flying the same track over the ground as the current ILS procedure and will result in there being no difference in tracks between this and the 'do minimum' scenario for arrivals/transitions; therefore the 'do nothing' is used as the comparator in the DPE to evaluate the design options against the design principles and is used as baseline to compare the design options within the IOA.

The arrivals options were compared to the set of modal tracks compiled using historical Noise Track Keeping Data showing where most flights currently overfly. These modal tracks shown at Figures 10 and 11 provide a mechanism to demonstrate today's operation and when combined with the polygon represent the 'do nothing' baseline scenarios.

3.5 'Do Nothing' Baseline vs 'Do Minimum' Option

As specified in CAP1616, Appendix E, Paragraph E21:

"In certain cases, doing nothing is not a feasible option in reality. For example, airspace may need to be changed to reflect the UK's international obligations. In such cases, in addition to the 'do nothing' baseline, 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. Assessing the 'do minimum' option against a 'do nothing' baseline allows communities to understand the effect of the 'do minimum' in relation to current circumstances."

The sub-sections below clarify the differences between the 'do nothing' and 'do minimum' scenarios, to enable a better understanding of the "effect of the 'do minimum' in relation to current circumstances".

3.5.1 Departures

For the purposes of the baseline scenario within the IOA, the 'do nothing' for departures is the modal tracks created based on the existing SIDs. A slight difference in modal tracks flown when compared to the published SIDs is acknowledged due to ATC vectoring and potential differences in the coding used by Flight Management Systems; however, this provides a more accurate representation of what occurs today. The analysis of these has been conducted based on varying climb gradients for each individual baseline modal track, which better reflect today's operations.

Meanwhile, the 'do minimum' is an RNAV1 replication of the existing SIDs (using a continuous climb gradient of 6%). Therefore, if the 'do minimum' is implemented, there may be little change when compared to the lateral track flown by aircraft in today's operation. Due to the strict application of PANS-OPS criteria for PBN procedures which are slightly different to those used for conventional routes, there may be some difference between these lateral tracks. These differences are a product of the type of waypoint used in the procedure and the way that the aircraft interprets and flies the route but cannot be fully determined until the procedure undergoes testing at a later stage. However, any differences are expected to be small and will be explored during Stage 3 and Stage 4 of this ACP.

3.5.2 Arrivals/ transitions

The 'do nothing' scenario for arrivals at EMA would be based upon:

- Use of the existing RNAV holds at ROKUP and PIGOT. These holds would remain in their existing location.
- ATC vectoring aircraft onto final approach from these holds.
- Final approach based upon ILS only.

When considering the 'do nothing' scenarios, the modal tracks and associated polygons are illustrated in Figure 9 and Figure 10. Although it is acknowledged that a small number of aircraft are presented from different locations, the 'do nothing' scenarios are based on these.

The 'do minimum' for arrivals would incorporate the following:

- The retained use of the existing RNAV holds at ROKUP and PIGOT in their current location.
- ATC vectoring aircraft from the holds onto final approach.
- A PBN compliant and ILS based final approach which aligns with requirements of the AMS.

3.6 IOA Baseline Scenario Summary

To aid clarity, Table 2 (that follows) presents the baseline scenarios used for comparison within the IOA.

Baseline	Scenario	Variations
'Do nothing' – departures	The existing SIDs utilising TNT, DTY, and POL.	Modal track of existing Runway 09 TNT SID at a calculated climb gradient plus radar vectoring area.
		Modal track of existing Runway 09 POL SID at a calculated climb gradient plus radar vectoring area.
		Modal track of existing Runway 09 DTY SID at a calculated climb gradient plus radar vectoring area.
		Modal track of existing Runway 27 TNT SID at a calculated climb gradient plus radar vectoring area.
		Modal track of existing Runway 27 DTY SID at a calculated climb gradient plus radar vectoring area.
'Do nothing' – arrivals/transitions	A defined track identified as the most commonly used routing based on existing radar vectoring patterns plus a radar vectoring area.	Modal radar vectoring pattern from a northerly direction to Runway 09
		Modal radar vectoring pattern from a southerly direction to Runway 09
		Modal radar vectoring pattern from a northerly direction to Runway 27
		Modal radar vectoring pattern from a southerly direction to Runway 27

Table 2 IOA Baseline Scenario Summary

4 Qualitative Safety Assessment

4.1 CAP1616 Safety Assessment Requirements

A qualitative Safety Assessment is required for all options identified during Step 2A, and a detailed final safety assessment must be completed by the change sponsor prior to submission in Step 4B. EMA is carrying out the safety assessment activities in accordance with CAP760, the separate guidance provided by the CAA for safety assessment.

The change sponsor will develop a full four-part Safety Case iteratively throughout the CAP1616 process which will be submitted to the CAA at Step 4B.

4.2 Safety Assessment Method

The qualitative safety assessment uses the results of a formal Hazard Identification (HAZID) workshop held on 18th October 2022, during which the hazards, causes and consequences relating to EMA ACP design envelopes/areas were discussed.

Due to the substantial number of options associated with this ACP, the HAZID focused on assessing design envelopes and design areas as opposed to individual route design options. A further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process which will assess the hazards associated with individual routes.

The meetings were attended by ATC Subject Matter Experts (SMEs) from both EMA and NATS, airline representatives, Airspace Project Managers/Consultants, and an Aviation Safety Practitioner, who facilitated the workshop.

The initial HAZID workshop was held on 18th October 2022. Additional HAZID workshops have since been held to assess revisions to the departure envelope to the north west on 21st July 2023 and more recently for the revision to the south east envelope on the 13th October 2023. It was not deemed proportionate to conduct a full workshop, for the amendments to individual envelopes, so the review was conducted by SMEs who concluded that the hazards present to the revised envelopes, were similar to those present in other existing envelopes. This enabled the Safety Case Part 1 to be updated. The non-technical summary is set out at Paragraph 4.3, below.

4.3 Safety Assessment Results – Non-Technical Summary

4.3.1 General

The HAZID identified several dependencies and/or influencing factors that were common to all the IFP design options e.g., loss of surveillance, loss of GNSS signal, corruption of AIP information. These are all well understood within the aviation community and there are various redundancy measures and procedures already in place.

4.3.2 Departures

Design Envelope	High-level Safety Assessment
Runway 09 East	Possible hazards have been identified, some of which are extant and are currently mitigated through existing ATC procedures. Firstly, aircraft departing may conflict with an aircraft conducting the EMA lost communications procedure. This is an extant hazard and ATC would manage the ATC situation tactically at this point allowing priority to the emergency aircraft. Secondly, it was identified that the options within this envelope may conflict with military and or GA aircraft (including Langar parachutes) in Class G airspace, both of which can be mitigated through the design process and potential additional CAS requirements that are being investigated by NERL. Finally, there could be unknown or no interaction possible with the network (i.e., above 7,000ft). This could result in an increase in ATCO workload to ensure that horizontal and/or vertical separation is maintained and avoid potential loss of separation between aircraft. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity requirements are met. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 09 North	Possible hazards have been identified, some of which are extant and are currently mitigated through existing ATC procedures. Firstly, aircraft departing on the SID may leave CAS, leading to a potential conflict with military and or GA aircraft (including Langar parachutes) in Class G airspace. This is an extant hazard and can be mitigated through the design process and potential additional CAS requirements that are being investigated by NERL. Secondly, there could be unknown or no interaction possible between the departing aircraft, the ATC network and the controlling authority (i.e., above 7,000ft) as it may involve flight in Class G 'uncontrolled' airspace. This may result in the potential loss of horizontal and/or vertical separation between aircraft, that in turn could result in an increase in ATCO workload. In addition, if the position of the existing airborne hold (ROKUP) within the ATC network (i.e. above 7,000ft) were to be moved by NERL, this may introduce a potential conflict with this envelope resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in ATCO workload. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity and

	additional airspace requirements are met to ensure network connectivity is possible. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 09 North West	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures. Firstly, aircraft departing from EMA on the SID may conflict with arrivals to Runway 09 routing via ROKUP resulting in a potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Secondly, aircraft flying the SID may conflict with aircraft executing the MAP. This is an extant hazard and would be tactically managed by ATC. These hazards will be further be mitigated through the design process and a further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 09 South	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures. Firstly, aircraft departing on the SID to the south may conflict with arrivals from the south resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation as required. Secondly, aircraft departing EMA on the SID could conflict with aircraft departing Birmingham Airport (BHX) on the LUVUM SID if routing along the western edge of the design envelope. ATC tactical intervention or IFP design parameters may be required to be applied to mitigate this. EMA will continue to work collaboratively with BHX and if necessary NERL, through subsequent stages of this ACP, to refine the design options. It is possible that this work will identify some options that cannot be safely deconflicted from the existing published BHX SIDs which may mean that some options will be discounted. Finally, there could be unknown or no interaction possible between with the network (i.e., above 7,000ft). This could result in an increase in ATCO workload to ensure that horizontal and/or vertical separation is maintained and avoid potential loss of separation between aircraft. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity requirements are met.

	These hazards and mitigations will be captured as part of the safety and risk mitigation process within Stage 3 and Stage 4 of CAP1616 and the Masterplan and in line with CAP760.
Runway 09 West	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures. Firstly, aircraft departing on the SID to the west could conflict with arrivals from the north resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Secondly, confliction with an aircraft conducting an Instrument Approach Procedure (IAP) to Runway 09 could occur resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Aircraft departing on the SID could conflict with aircraft departing BHX on the LUVUM SID. ATC tactical intervention or IFP design parameters may be required to be applied to mitigate this. The change sponsor is maintaining close liaison with both BHX and NERL through trilateral meetings to ensure that network connectivity requirements are met now and for the future. There could also be unknown or no interaction possible with the network (i.e., above 7,000ft) that could result in the potential loss of horizontal and/or vertical separation between aircraft that would result in an increase in ATCO workload. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity requirements are met. Finally, there is the potential for confliction with GA traffic due to GA traffic operating from Derby Airfield possibly infringing CAS. This would be mitigated through ensuring that the departing traffic are at altitudes where the SID terminates above CTA5. These hazards will be further be mitigated through the design process and a further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 East	Possible hazards have been identified, some of which are extant and are currently mitigated through existing ATC procedures. Firstly, aircraft departing on the SID to the east could conflict with EMA arrivals from the north resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Secondly, aircraft departing on the SID may leave CAS, leading to a potential conflict with military and/ or GA aircraft (including Langar

	parachute activity) in Class G airspace. This is an extant hazard and could be mitigated through the design process and potential additional CAS requirements that are currently being investigated by NERL. Finally, there could be unknown or no interaction possible with the network (i.e., above 7,000ft). This could result in an increase in ATCO workload to ensure that horizontal and/or vertical separation is maintained and avoid potential loss of separation between aircraft. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity requirements are met. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 North	A possible hazard has been identified with aircraft departing on the SID to the north that could conflict with arrivals from the north resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. In addition, if the position of the existing airborne hold (ROKUP) within the ATC network (i.e. above 7,000ft) were to be moved by NERL, this may introduce a potential conflict with this envelope resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in ATCO workload. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 North West	A possible hazard has been identified with aircraft departing on the SID to the north west that could conflict with arrivals from the north resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in ATCO workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 South	A hazard relating to an aircraft departing on the SID to the south was identified where an aircraft could conflict with departures from BHX resulting in the potential for loss of lateral and/or vertical separation between aircraft. ATC intervention or IFP design parameters may be required to be applied to mitigate this potential extant hazard. The change sponsor is maintaining close liaison with both BHX and NERL through trilateral meetings to ensure that network connectivity requirements are met now and for the future.

	This hazard will be further be mitigated through the design process and a further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 South East	Possible hazards have been identified, some of which are extant and are currently mitigated through existing ATC procedures. Firstly, aircraft departing on the SID to the south east may conflict with EMA arrivals from the south resulting in the potential loss of horizontal or vertical separation between aircraft and an increase in controller workload. This is an extant hazard and ATC would manage the ATC situation tactically to maintain separation if required. Secondly, there could be unknown or no interaction possible between the departing aircraft and the ATC network and controlling authority (i.e., above 7,000ft) as it may involve flight in Class G 'uncontrolled' airspace. This could result in the potential loss of horizontal and/or vertical separation between aircraft that may result in an increase in ATCO workload. The sponsor would be required to maintain close liaison with NERL through bilateral meetings to ensure that network connectivity and additional airspace requirements are met. Further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 South West	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures. Firstly, aircraft departing on the SID to the south west could conflict with BHX departures flying the LUVUM SID. This could lead to the potential for loss of horizontal and/or vertical separation between aircraft and an increase in ATCO workload. Secondly, conflict with BHX easterly arrivals could occur that could lead to the potential for loss of horizontal and/or vertical separation between aircraft and an increase in ATCO workload. ATC tactical intervention or IFP design parameters may be required to be applied to mitigate these potential hazards. These hazards will be further be mitigated through the design process and a further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 West	For this new envelope, possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures. Firstly, aircraft departing on the SID to the west could conflict with BHX departures flying the existing published LUVUM SID. This could lead to the potential for loss of horizontal and/or vertical separation between aircraft and an increase in ATCO workload.

	Secondly, conflict with BHX easterly arrivals could occur that could lead to the potential for loss of horizontal and/or vertical separation between aircraft and an increase in ATCO workload. ATC tactical intervention or IFP design parameters may be required to be applied to mitigate these potential hazards. Finally, there could be unknown or no interaction possible with the network (i.e., above 7,000ft). This could result in an increase in ATCO workload to ensure that horizontal and/or vertical separation is maintained and avoid potential loss of separation between aircraft. As well as ATC tactical intervention to mitigate the above hazards, the change sponsor is maintaining close liaison with both BHX and NERL through trilateral meetings to ensure that network connectivity requirements are met now and for the future. These hazards will be further be mitigated through the design process and a further assessment will be conducted at Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Table 3 EMA Departures High-level Safety Assessment

4.3.3 Arrivals/Transitions

Design Area	High-level Safety Assessment
Runway 09 North Transition	A hazard relating to arrivals from the north was identified where there is the potential for confliction with the new EMA proposed SIDs to the north and north west causing a loss of horizontal and/or vertical separation. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 09 South Transition	A hazard relating to arrivals from the south was identified where there is the potential for confliction with the new EMA proposed SIDs to the south and south west causing a loss of horizontal and/or vertical separation. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Runway 27 North Transition	A hazard relating to arrivals from the north was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a northerly or easterly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runway 27 South Transition	A hazard relating to arrivals from the south was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a southerly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stage 3 and Stage 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Table 4 EMA Arrivals/Transitions High-level Safety Assessment

5 Noise Methodology

5.1 Overview

CAP1616 requires change sponsors to assess the potential noise impact of any proposal being put forward, using a range of indicators. The level of assessment expected varies according to the scale of the changes being proposed and the stage of the change process that has been reached.

At this stage, Stage 2, the number of options to be assessed is considerable and the level of refinement immature. CAP1616 therefore does not require the change sponsor to go into a full level of detail for every design option on the comprehensive list of viable options. Instead, the scale of assessment should be proportionate, and the appraisal must as a minimum, contain qualitative assessments of the different options.

In the IOA, overflight of population and residential buildings has been used to determine whether a specific design option has the potential to impose a positive or negative impact. However, whilst overflight is a helpful and appropriate proxy at this relatively early stage, it is accepted that overflight is not the appropriate metric to establish the impact of noise exposure on people. A full environmental assessment, including noise contours, will be created at Stage 3 of the ACP when the number of design options is reduced. The production of L_{Aeq} contours will allow stakeholders to better understand the potential impact of the proposed changes.

5.2 Noise Modelling Category

CAP2091 describes the 'minimum acceptable level of sophistication of noise modelling' that can be used to provide the CAA with the outputs they require to carry out certain of their statutory duties, including airspace change.

Five noise modelling categories are established which are Category A to Category E. Category A being the most sophisticated and Category E, the least.

As part of the Stage 2 submission, CAP2091 requires the change sponsor to set out and justify the noise modelling category that will be adopted. This will be a component of the analyses that will be carried out in subsequent stages of this ACP.

The change sponsor has concluded that Category B noise modelling is applicable and will be used. The rationale behind the change sponsor's decision can be found in Appendix A2 of this document.

5.3 Design Principle Application

Overflight metrics have been used within the IOA to provide an indication of the number of people overflown by each design option, compared to the baseline. To achieve this, the same analysis conducted in the DPE has been used in the IOA. With regards to qualitatively assessing potential noise impact, the change sponsor has utilised populations and households overflown. In addition, planned property developments and any increase in population has been added to produce an overall estimate of total population overflown, to enable a clear comparison to the baseline scenario. The change sponsor has used the definition of overflight in CAP1498 to conduct this assessment.

CAP1498 recognises that an aircraft does not have to pass directly overhead, to be considered an overflight. Instead, overflight should be defined to include aircraft that pass over and to the side of an observer. The distance that an aircraft can be to the side and still considered an overflight is set using an elevation angle. An aircraft flying directly overhead would be at an elevation angle of 90°. An aircraft on the ground would be at an elevation angle of 0°.

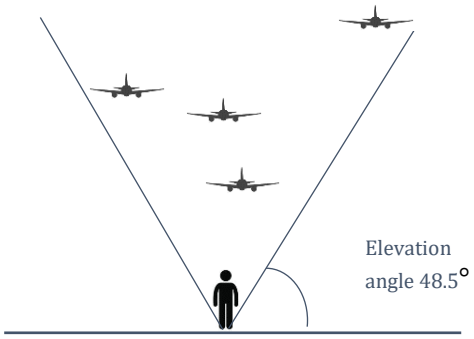


Figure 13 48.5° Overflight Cone

CAP1616 recommends the use of 48.5° as an elevation angle. This is because for an aircraft to give a noise level approximately 3dB lower than if it had flown directly overhead, it would need to be at an elevation angle of 48.5°. A difference of 3dB is widely accepted as the smallest difference between two noise levels that the average person can perceive.

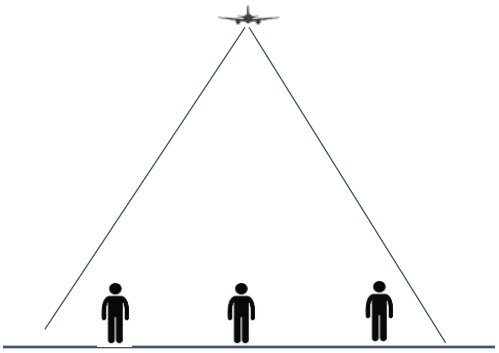


Figure 14 Overflight Cone – from aircraft perspective

Alternatively, if we look at this from an aircraft's perspective. All locations within the cone are 'overflown'. The change sponsor has taken each individual design option from the comprehensive list of viable options and assessed it against the above overflight definition.

6 Initial Option Appraisal Results

6.1 Introduction

This section provides additional clarification to assist the reader in understanding the rationale behind the IOA results, which are summarised in the full IOA Analysis Table and can be found on the CAA Airspace Change Portal - IOA Appendix A Full Analysis Table. It is recommended that any reader reads this document first, before proceeding to read the Full Analysis Table. This will provide context and an explanation of the terminology used.

6.2 Options Appraised

The IOA assessed and classified the individual options which were progressed from the DPE.

6.3 IOA Analysis Tables

Design options were assessed as peer groups, that is within groups of design options (design envelopes) that would perform the same function if they were ultimately included in an operating network, against the defined 'do nothing' scenario baseline. This is considering each criterion defined in CAP1616 (as shown in Table 1)

Design options within the same design envelope were subsequently accepted or rejected based on the appraisal requirements as described in section 2 of this IOA relative to the 'do nothing' baseline for that design envelope and, indirectly, to the other options within the relevant design envelope as described in section 7.

This exercise was completed using a tabular format: an assessment of each design option is shown against each criterion set against the baseline. These tables are located on the CAA Airspace Change portal, Initial Options Appraisal - Appendix A - Full Analysis Table - V2.

Towards the bottom of each table is a summary of analysis that highlights how each design option performs against the 'do nothing' baseline scenario.

For clarity, the results are presented in multiple IOA Analysis tables. For departures, each design envelope is reported within a separate table. Arrivals have been assessed by individual runway, position of the Initial Approach Fix (IAF). All relevant documents have been uploaded to the CAA Airspace Change Portal.

An extract of the full analysis of all the options is shown at Appendix A19.

7 Shortlisting of Design Options

7.1 Shortlisting Criteria

Following the completion of the IOA assessment, a process of shortlisting of the design options to be carried forward to Stage 3 has taken place. This shortlisting process considered each option and awarded a classification as either the Preferred, Favourable, Acceptable, Alternate or Rejected option. Design options awarded a classification of Preferred, Favourable, Acceptable or Alternate will be further considered and assessed during Stage 3. The option classifications are defined in paragraph 7.2 below.

The Government's Altitude Based Priorities are set out in the Air Navigation Guidance 2017. This guidance explains that the Government seeks to limit and where possible reduce the total adverse effects on people, with greatest priority accorded to those impacted by aircraft operations at altitudes of up to 4,000 ft. Each design option has been assessed against the 'do nothing' scenario baseline and its performance has been assessed in terms of overflight and effect on total overall population at up to 4,000ft, followed by up to 7,000ft to determine which options perform better in the context of the Air Navigation Guidance 2017 and merits further assessment as a result.

7.2 Option Classification

The classification of options is based upon the shortlisting methodology as defined in paragraph 7.3 and the professional judgement of the assessor/change sponsor. Consideration was given to each design option's overall performance against the IOA assessment criteria, as defined in Table 1, focussing primarily on UK Government's Altitude Based Priorities articulated within the Air Navigation Guidance 2017. This process provides the change sponsor with sufficient flexible and varied design options within each design envelope for departures and arrivals to progress to Stage 3.

The option classification status is defined in Table 5 below.

Option Classification	
Preferred	This option is preferred as it is best performing within the departures design envelope or transitions from the IAF.
Favourable	This option is considered favourable as it is second-best performing within the departures design envelope or transitions from the IAF.
Acceptable	This option is considered acceptable as it is third-best performing within the departures design envelope or transitions from the IAF.
Alternate (Arrivals only)	As the Preferred, Favourable and Acceptable arrival options were either all 'Direct' or 'Indirect', this option has been included as the next best performing option and provides the change sponsor with the potential to achieve an element of noise respite in the case of arrivals.
Rejected	This option is rejected as it is not preferred, not considered favourable nor considered acceptable within the departures design envelope or transitions from the IAF.
Baseline/Previously Rejected	Option included for completeness but, in the case of previously rejected options, not subject to IOA shortlisting.

Table 5 IOA Options RAG Status

7.3 Shortlisting Methodology

The following methodology (steps) was adopted to shortlist the design options that will be carried through to Stage 3:

1. Identify the design options which affect the fewest number of people (impact on health and quality of life) up to 4,000ft to obtain the top three options, preliminarily identified as Preferred, Favourable and Acceptable options.
2. Identify the design options which affect the fewest number of people (impact on health and quality of life) up to 7,000ft.
3. Consider how the "preliminarily Preferred, Favourable and Acceptable options" from step 1 perform against those identified in step 2.
    a. If an option preliminarily identified as Preferred option in step 1 performs poorly in the identification in step 2 (falls outside the top four), the option was subsequently rejected. The preliminarily identified options as Favourable option and Acceptable option are then re-identified in the classification. Favourable becomes Preferred. Acceptable becomes Favourable. The option ranked fourth during step 1, then moves up into the Acceptable position at step 3.
    b. Repeat for Favourable and Acceptable options.
4. Preliminary rankings were achieved using the methodology described above. In line with the ANG 2017 paragraph 3.3 Altitude Based Priorities, the methodology seeks to

minimise the impact of aviation noise up to 7,000ft. The IOA has assessed emissions and a range of other factors (as set out at paragraph 6.3). Therefore, as a final step in the shortlisting methodology, each of the Preferred, Favourable and Acceptable options was considered against alternatives within the same departure envelope or transitions FAF altitude group to ensure that impacts assessed in relation to any other criteria did not change the preliminary rankings. It should be noted that at this stage, the change sponsor has not identified any shortlisted options that are considered likely to result in a disproportionate increase in CO_2 emissions (using track length as a proxy).

5. Once the process was complete for each departure envelope an option classification was entered onto the IOA Assessment table.

6. For arrivals only, once the process was complete for each transition, the results were analysed to assess whether the Preferred, Favourable and Acceptable options were all Direct or Indirect options as described in the DOR section 19.7. In the case of all options being Direct options, an Alternate option was chosen based on the next best performing option Indirect option and vice-versa. In this instance, four options would be taken forward to Stage 3 and would be entered onto the IOA Assessment table. This final step was conducted to create alignment to the Design Principle Noise N1 and gives the sponsor the opportunity to seek options that can provide noise respite during the ACP process.

7.4 Systemisation of Shortlisted Options

At this stage of the CAP1616 process, the change sponsor has assessed the design options in isolation against the baseline. Following the definition of the preferred design option(s) within the shortlist, as part of the wider FASI programmes, the next step will be for the change sponsor to undertake a systemised assessment of the design options that have been carried forward from the IOA. This will take place during Stage 3 and will likely involve examining combinations of design options to determine whether they are viable as a system and how they integrate with other changes proposed within both FASI programmes that would affect the Manchester Terminal Manoeuvring Area (MTMA) and the airspace to the south within the FASI-S project. Essentially, this will determine which design options 'fit together' best as part of a wider suite of options, including combinations of departures and arrivals/transitions. These are the options that will then be taken forward to Stage 3 for full appraisal and public consultation. This will be determined in coordination with ACOG, other ACP sponsors including NERL and with input as necessary from other stakeholders.

To allow for the systemisation activity to take place in Stage 3, with a full range of options, the change sponsor has decided that where possible they would take through three options (Preferred, Favourable and Acceptable, as defined in Paragraph 7.2 above) from each design envelope for departures from EMA, even if they were assessed to perform worse than the baseline. For transitions, three options (Preferred, Favourable and Acceptable, as defined in Paragraph 7.2 above) would be taken forward. Where the three options were all Direct or Indirect, an Alternate option aimed at providing the potential for noise respite to be achieved has been included, even if it was assessed to perform worse than the baseline.

All options taken forward will then be subject to further detailed analysis that will be conducted during the FOA at Stage 3.

7.5 Summary of Shortlisting Results

Table 6 below presents the summary of the shortlisting of the Arrival and Departure design options and the option classification for each design option. Those classed as Preferred (P), Favourable (F) and Acceptable (A) will become the final shortlist of options forward to be taken forward to Stage 3.

P, F, A (Runway 27N Arrivals)			
IAF	D/I	Name	Classification
ROKUP	Direct	R27_A_N_O1	PREFERRED
ROKUP	Direct	R27_A_N_O2	REJECTED
ROKUP	Indirect	R27_A_N_O3	FAVOURABLE
ROKUP	Indirect	R27_A_N_O4	ACCEPTABLE
DIPSO	Direct	R27_A_N_O5	REJECTED
DIPSO	Direct	R27_A_N_O6	REJECTED
DIPSO	Direct	R27_A_N_O7	FAVOURABLE
DIPSO	Direct	R27_A_N_O8	PREFERRED
DIPSO	Indirect	R27_A_N_O29	REJECTED
DIPSO	Indirect	R27_A_N_O30	ACCEPTABLE
IAF 1	Direct	R27_A_N_O17	ACCEPTABLE
IAF 1	Direct	R27_A_N_O18	REJECTED
IAF 1	Indirect	R27_A_N_O19	FAVOURABLE
IAF 1	Indirect	R27_A_N_O20	PREFERRED
IAF 2	Direct	R27_A_N_O13	ACCEPTABLE
IAF 2	Direct	R27_A_N_O14	REJECTED
IAF 2	Indirect	R27_A_N_O21	PREFERRED
IAF 2	Indirect	R27_A_N_O22	FAVOURABLE
IAF 3	Indirect	R27_A_N_O11	FAVOURABLE
IAF 3	Indirect	R27_A_N_O12	PREFERRED
IAF 3	Direct	R27_A_N_O23	REJECTED
IAF 3	Direct	R27_A_N_O24	ACCEPTABLE
IAF 4	Direct	R27_A_N_O9	FAVOURABLE
IAF 4	Direct	R27_A_N_O10	REJECTED
IAF 4	Indirect	R27_A_N_O25	PREFERRED
IAF 4	Indirect	R27_A_N_O26	ACCEPTABLE

IAF 5	Direct	R27_A_N_O15	FAVOURABLE
IAF 5	Direct	R27_A_N_O16	REJECTED
IAF 5	Indirect	R27_A_N_O27	ACCEPTABLE
IAF 5	Indirect	R27_A_N_O28	PREFERRED

P, F, A (Runway 27S_Arrivals)			
IAF	D/I	Name	Outcome
JUNCK	Direct	R27_A_S_O1	FAVOURABLE
JUNCK	Direct	R27_A_S_O2	PREFERRED
JUNCK	Indirect	R27_A_S_O4	ACCEPTABLE
JUNCK	Direct	R27_A_S_O7	REJECTED
JUNCK	Direct	R27_A_S_O8	REJECTED
JUNCK	Indirect	R27_A_S_O9	REJECTED
LEICE	Indirect	R27_A_S_O5	ACCEPTABLE
LEICE	Indirect	R27_A_S_O6	FAVOURABLE
LEICE	Indirect	R27_A_S_O11	REJECTED
LEICE	Indirect	R27_A_S_O12	PREFERRED
LEICE	Direct	R27_A_S_O23	REJECTED
LEICE	Direct	R27_A_S_O24	ALTERNATE
EYEHO	Indirect	R27_A_S_O13	ACCEPTABLE
EYEHO	Indirect	R27_A_S_O14	PREFERRED
EYEHO	Direct	R27_A_S_O21	REJECTED
EYEHO	Direct	R27_A_S_O22	FAVOURABLE
STAPL	Direct	R27_A_S_O15	ACCEPTABLE
STAPL	Direct	R27_A_S_O16	FAVOURABLE
STAPL	Indirect	R27_A_S_O19	REJECTED
STAPL	Indirect	R27_A_S_O20	PREFERRED

P, F, A (Runway 09N Arrivals)			
IAF	D/I	Name	Outcome
ROKUP	Direct	R09_A_N_O1	PREFERRED
ROKUP	Direct	R09_A_N_O2	ACCEPTABLE
ROKUP	Indirect	R09_A_N_O3	REJECTED
ROKUP	Indirect	R09_A_N_O4	ALTERNATE
ROKUP	Direct	R09_A_N_O4A	FAVOURABLE
DIPSO	Indirect	R09_A_N_O5	REJECTED
DIPSO	Indirect	R09_A_N_O6	REJECTED
DIPSO	Direct	R09_A_N_O7	PREFERRED
DIPSO	Direct	R09_A_N_O8	ACCEPTABLE
DIPSO	Direct	R09_A_N_O8A	FAVOURABLE
DIPSO	Indirect	R09_A_N_O29	REJECTED
DIPSO	Indirect	R09_A_N_O30	ALTERNATE
IAF1	Indirect	R09_A_N_O17	FAVOURABLE
IAF1	Indirect	R09_A_N_O18	REJECTED
IAF1	Direct	R09_A_N_O19	PREFERRED
IAF1	Direct	R09_A_N_O20	REJECTED
IAF1	Direct	R09_A_N_O20A	ACCEPTABLE
IAF2	Indirect	R09_A_N_O13	REJECTED
IAF2	Indirect	R09_A_N_O14	ALTERNATE
IAF2	Direct	R09_A_N_O21	PREFERRED
IAF2	Direct	R09_A_N_O22	ACCEPTABLE
IAF2	Direct	R09_A_N_O22A	FAVOURABLE
IAF3	Direct	R09_A_N_O11	PREFERRED
IAF3	Direct	R09_A_N_O12	ACCEPTABLE
IAF3	Direct	R09_A_N_O12A	FAVOURABLE
IAF3	Indirect	R09_A_N_O23	REJECTED
IAF3	Indirect	R09_A_N_O24	ALTERNATE
IAF4	Direct	R09_A_N_O9	PREFERRED
IAF4	Direct	R09_A_N_O10	ACCEPTABLE
IAF4	Direct	R09_A_N_O10A	FAVOURABLE
IAF4	Indirect	R09_A_N_O25	REJECTED
IAF4	Indirect	R09_A_N_O26	ALTERNATE
IAF5	Direct	R09_A_N_O15	PREFERRED

IAF5	Direct	R09_A_N_O16	FAVOURABLE
IAF5	Indirect	R09_A_N_O27	REJECTED
IAF5	Indirect	R09_A_N_O28	ACCEPTABLE

P, F, A (Runway 09S Arrivals)			
IAF	D/I	Name	Outcome
JUNCK	Direct	R09_A_S_O1	PREFERRED
JUNCK	Direct	R09_A_S_O2	ACCEPTABLE
JUNCK	Indirect	R09_A_S_O3	REJECTED
JUNCK	Indirect	R09_A_S_O4	REJECTED
JUNCK	Indirect	R09_A_S_O7	ALTERNATE
JUNCK	Indirect	R09_A_S_O8	REJECTED
JUNCK	Direct	R09_A_S_O9	REJECTED
JUNCK	Direct	R09_A_S_O10	REJECTED
JUNCK	Direct	R09_A_S_O18	FAVOURABLE
LEICE	Direct	R09_A_S_O5	PREFERRED
LEICE	Direct	R09_A_S_O6	FAVOURABLE
LEICE	Indirect	R09_A_S_O11	ACCEPTABLE
LEICE	Indirect	R09_A_S_O12	REJECTED
EYEHO	Direct	R09_A_S_O13	PREFERRED
EYEHO	Direct	R09_A_S_O14	FAVOURABLE
EYEHO	Indirect	R09_A_S_O23	ACCEPTABLE
EYEHO	Indirect	R09_A_S_O24	REJECTED
STAPL	Direct	R09_A_S_O15	PREFERRED
STAPL	Direct	R09_A_S_O16	FAVOURABLE
STAPL	Indirect	R09_A_S_O21	ACCEPTABLE
STAPL	Indirect	R09_A_S_O22	REJECTED

P, F, A (Runway 09 Departures)		
Departure Direction	Runway 09	Outcome
North	R09_D_N_O1	REJECTED
North	R09_D_N_O1A	FAVOURABLE
North	R09_D_N_O2	REJECTED
North	R09_D_N_O3	REJECTED
North	R09_D_N_O4	PREFERRED
North	R09_D_N_O5	ACCEPTABLE
North	R09_D_N_O6	REJECTED
East	R09_D_E_O1	REJECTED
East	R09_D_E_O3	ACCEPTABLE
East	R09_D_E_O4	FAVOURABLE
East	R09_D_E_O5	PREFERRED
South	R09_D_S_O1	ACCEPTABLE
South	R09_D_S_O1A	REJECTED
South	R09_D_S_O3	REJECTED
South	R09_D_S_O6	PREFERRED
South	R09_D_S_O8	FAVOURABLE
South	R09_D_S_O10	REJECTED
South	R09_D_S_O13	REJECTED
South	R09_D_S_O14	REJECTED
South	R09_D_S_O16	REJECTED
West	R09_D_W_O1	REJECTED
West	R09_D_W_O2	FAVOURABLE
West	R09_D_W_O3	REJECTED
West	R09_D_W_O5	REJECTED
West	R09_D_W_O6	ACCEPTABLE
West	R09_D_W_O7	PREFERRED
North West	R09_D_NW_O1A	REJECTED
North West	R09_D_NW_O2	PREFERRED
North West	R09_D_NW_O3	REJECTED
North West	R09_D_NW_O4	REJECTED
North West	R09_D_NW_O5	ACCEPTABLE
North West	R09_D_NW_O6	REJECTED
North West	R09_D_NW_O8	REJECTED
North West	R09_D_NW_O9	FAVOURABLE
North West	R09_D_NW_O10	REJECTED

P, F, A (Runway 27 Departures)		
Departure Direction	Runway 27	Outcome
North	R27_D_N_O1	PREFERRED
North	R27_D_N_O2	REJECTED
North	R27_D_N_O3	REJECTED
North	R27_D_N_O4	REJECTED
North	R27_D_N_O5	FAVOURABLE
North	R27_D_N_O6	ACCEPTABLE
North	R27_D_N_O7	REJECTED
North	R27_D_N_O8	REJECTED
South	R27_D_S_O1	REJECTED
South	R27_D_S_O1A	REJECTED
South	R27_D_S_O2	REJECTED
South	R27_D_S_O4	PREFERRED
South	R27_D_S_O5	REJECTED
South	R27_D_S_O6	REJECTED
South	R27_D_S_O7	ACCEPTABLE
South	R27_D_S_O8	REJECTED
South	R27_D_S_O9	REJECTED
South	R27_D_S_O10	FAVOURABLE
South	R27_D_S_O11	REJECTED
West	R27_D_W_O3	REJECTED
West	R27_D_W_O4	FAVOURABLE
West	R27_D_W_O5	PREFERRED
West	R27_D_W_O6	ACCEPTABLE
North West	R27_D_NW_O10	FAVOURABLE
North West	R27_D_NW_O11	ACCEPTABLE
North West	R27_D_NW_O13	REJECTED
North West	R27_D_NW_O14	REJECTED
North West	R27_D_NW_O15	PREFERRED
South East Options 1-7	R27_D_SE_O2	REJECTED
South East Options 1-7	R27_D_SE_O4	ACCEPTABLE
South East Options 1-7	R27_D_SE_O5	FAVOURABLE
South East Options 1-7	R27_D_SE_O7	PREFERRED

South East Options 12-18	R27_D_SE_O15	FAVOURABLE
South East Options 12-18	R27_D_SE_O16	PREFERRED
South East Options 12-18	R27_D_SE_O18	ACCEPTABLE
South West	R27_D_SW_O4	PREFERRED
South West	R27_D_SW_O9	FAVOURABLE

Table 6 Shortlist Results

8 Next Steps

8.1 Developing and Assessing Operating Networks

Consistent with the requirements of Step 2A of CAP1616, we have undertaken a design process to identify a comprehensive list of design options. In Step 2A, these design options have been evaluated against the design principles that we identified through stakeholder engagement in Stage 1. This work is reported separately in the DOR and the DPE. Those that best align with the design principles were carried forward in the process to Step 2B.

Design options carried forward to Step 2B have been subject to an initial appraisal. The findings of that appraisal are set out in the IOA and the accompanying assessment tables. The IOA has enabled us to identify a shortlist of design options.

The shortlist of design options has benefited from extensive engagement with stakeholders, including the general public. Among these stakeholders were other sponsors of airspace change including NATS as the en-route airspace provider, airlines and other airports with whom EMA may interact. Therefore, there is confidence that our shortlist and proposals are flexible enough to provide compatibility with proposals emerging from other change sponsors, in so far as they are known at this time.

We will continue to work with other change sponsors, including NATS, to ensure that, consistent with the UK's Future Airspace Strategy, we realise the benefits of modernising airspace arrangements. This will include:

- Further work to understand and resolve interdependencies and design conflicts with NATS and adjacent airports as part of the Cumulative Assessment Framework (CAF) process, particularly routes to the west, south west and south east.
- Supporting NATS in any work to create new CAS to the east of EMA.
- Detailed design work to combine individual EMA design options into networks of routes as part of the wider network system.
- Providing information to NATS to inform their development simulations for the MTMA, which will test these emerging system concepts.
- Working with NATS and other design teams involved with the FASI project to define EMA routes to and from the south.

This work will also allow us to combine our options into operating networks. Defining networks of routes that support operations to and from EMA will allow us to undertake the more detailed assessment at Stage 3 and allow us to understand the extent to which we are able to provide noise respite and relief to those that are most impacted. The introduction of PBN which, consistent with the requirements of the AMS, is integral to our proposals, will increase the accuracy with which aircraft fly and is likely therefore to lead to greater concentration on any single flight path. In exploring different combinations of routes and their role in a network, we will be guided by the Government's objective to minimise the total adverse effects on people on routes below 4,000ft.

8.2 Options Appraisal

The IOA that we have completed is the first of three appraisals required under CAP1616. The operating networks that result from the steps we set out at 8.1 will allow us to undertake the more detailed Full Options Appraisal (FOA) required at Stage 3. This further assessment will make much greater use of quantitative data. As the FOA will consider fewer options, it will allow us to explore local factors including tranquillity and biodiversity in greater detail than has been possible to date, though this more detailed assessment will benefit from the data we have collated and reported at Stage 2.

Whilst the IOA considered the characteristics of each design option, the FOA will also consider operating networks. This assessment will require an estimate of the numbers and types of aircraft that will fly each route in a network. To facilitate this assessment, we will prepare detailed air traffic forecasts.

The assessment of operating networks will also allow greater consideration of some important factors, reflected in our design principles and for which the assessment in the IOA was limited due to routes not being developed as a system, or combined with the designs of the en-route network and adjacent airports. These include noise, emissions, capacity and safety. In defining the full range of criteria that we assess in the FOA we will be guided by CAP1616 and will take account of the information in Appendices B and E.

Our approach to the FOA and the way we will consider and collect the key information is set out in greater detail in the IOA at section 8.7.

8.3 Policy for the Design of Controlled Airspace Structures

On 12th October 2023, the CAA published an updated version of SARG Policy 126 (Policy for the Design of Controlled Airspace Structures), replacing the former policy statement dated 11 August 2022. This policy provides technical design criteria for controlled airspace structures and has been used to inform both the creation of the comprehensive design options, and to assess these options within the DPE and IOA process. The updated policy statement has a number of changes, including reductions to the design criteria and separation standards that ensure containment of instrument flight procedures, and which therefore may have a bearing on the design options created as part of this ACP.

The EMA Stage 2 submission including the DPE and the IOA assessed alignment of the design options with the August 2022 policy on the design of controlled airspace structures, which was in force at the time those assessments were carried out. As this policy was so recently superseded, the change sponsor has therefore undertaken a preliminary review of the updated October 2023 policy and the design options. It has concluded that, although the changes may impact a number of arrivals options and departure options, no design options would be prematurely discounted as a result of not having applied SARG Policy 126. It was concluded that the application of the up-to-date policy in substitution for the 2022 policy would not materially change any of the outcomes in the DPE and IOA. Consequently, it is unnecessary to revise the EMA Stage 2 submission.

This EMA Stage 2 Gateway submission is therefore based on the previous iteration of the SARG Policy 126, dated 11 August 2022. However, further work to confirm alignment with the new 12 October 2023 policy will be conducted within Stage 3a and beyond. Similarly, all future work will be conducted in line with this revised October 2023 policy – or any successor.

8.4 Controlled Airspace

As there is the potential for routes to be refined or amended, as referred to above, it would be premature to define future Controlled Airspace (CAS) requirements at this stage. As such, we will identify CAS requirements for groups of options during Stage 3. All stakeholders will be provided with an indication of the CAS requirements within our Step 3C Consultation material, and the comments received will be taken into account and considered as part of the consultation analysis activities in Step 3D. More details of this approach are provided in the DOR at section 4.5.

8.5 RNAV Substitution of Existing Routes

The proposals being developed by MAG and other sponsors within the MTMA cluster are complex and will not be implemented for several years. Given the intention to rationalise the network of DVORs across the UK, it will be important that aircraft are able to continue to operate safely and efficiently in the intervening period between this rationalisation and the new arrangements being introduced. EMA intend to use the CAP1781 process provided by the CAA to provide a temporary solution using RNAV substitution, which will maintain the current network of routes with no change in aircraft behaviour, pending the full implementation of this airspace change. CAP1781 allows new technology - RNAV – to be used to maintain existing departure routings (SIDs). To support this, we will work with airlines to ensure they implement any required technical changes to their systems. The CAP1781 process has begun and will run in parallel to this airspace change. We expect to conclude this separate change process in 2024.

8.6 Updating Stakeholders

The completion of the work required at Stage 2 has developed and refined the design options available at EMA, as well as expanding the understanding of stakeholders' views on those options. While it is not a requirement of the CAP1616 process, all stakeholders will be provided with the information submitted to the CAA at the conclusion of Stage 2 and given the opportunity to discuss the content and ask questions. This will include details of the feedback gathered at phase two of engagement, the revised design options and the assessments undertaken as part of Step 2B. This will ensure that they remain informed of the development of the ACP at EMA ahead of the full public consultation exercise at Stage 3.

8.7 Information to Collect as Part of FOA at Stage 3

Within this IOA the sponsor has described the options that are being taken forward to Stage 3. Work within Stage 3 will involve the combination of individual routes into operating networks. This will support ongoing engagement and, in turn, will allow for a more detailed evaluation against the design principles including those for Noise, Capacity and Emissions as part of the Stage 3 Full Options Appraisal (FOA)

It is acknowledged that, within this FOA, further information will be required, and the table below details that information and outlines how we plan to collect it at this time. However, our Stage 3 FOA will contain full details of the methodology used when generating the supporting data.

Information for Stage 3 Full Options Appraisal	How it is planned to collect the information
A quantified baseline year (pre-implementation and 10 years post implementation, including 10-year traffic forecast)	By combining individual routes, we will develop one or more operating networks. We will then assess these operating networks against a range of criteria, including those set out in Appendix E of CAP1616. The assessment of some criteria will require us to estimate the numbers and types of aircraft that will fly each route within the network. To facilitate this assessment and to inform our consultation materials, we will develop air traffic forecasts. Our air traffic forecasts will be prepared by independent experts. They will first be based on a 'bottom-up' aviation market intelligence approach (normally 0-5yr) and completed with a 'top-down' GDP forecast for the wider economy (>5yrs). Accordingly, the forecasts contain both insight from airport subject matter experts and input from our airline customers. The forecasts will provide a range of relevant data, including constrained annual passenger numbers, freight volumes, maximum take-off weight (MTOW) assumptions and air transport movement data with future fleet change built in. They will include the necessary aircraft operating schedules in sufficient detail to support all the necessary environmental modelling, and to guide consultation materials. Once this work is complete, we will agree network route allocations with NERL to ensure all traffic within the forecast is allocated to the correct network traffic flow and UK airspace exit points. This will ensure that environmental modelling allocates accurate forecast traffic volumes for each route. The forecasts will be prepared for the anticipated year of implementation and taking account of expected intensification of operations at EMA, ten years after implementation. Consistent with the requirements of CAP1616, they will also provide data for each intermediate year. Our selection of the study years for our forecast and the FOA they inform will be guided by the masterplan for the MTMA deployment cluster. Consistent with the requirements of CAP1616, each of the operating networks that we consider in the FOA will be compared to a baseline scenario of 'do nothing'. CAP1616 recognises that in some instances 'do nothing' is not a viable option and in these instances a do minimum scenario should also be prepared. This is the case at EMA and therefore air traffic forecasts model will be prepared to allow for each of our network

	options, our 'do something' scenarios and for the baseline scenarios of 'do nothing' and 'do minimum'. The scenarios for which we will prepare an air traffic forecast model may be summarised as: • 'Do nothing' - the actual routes currently flown, incorporating the assumption that CAP1781 would be taken advantage of and potentially extended beyond its current assumed expiration • 'Do minimum' - the replication of the current procedures to PBN standard and the necessary infrastructure improvements to facilitate best use of available runway capacity. • 'Do something' – the network design options considered in the FOA, incorporating the necessary supporting physical infrastructure.
Primary noise metric data (LAeq contours)	At Stage 3 we will fully quantify the LAeq contours associated with the proposed system to CAP2091 standards. To do this, we will use the movement forecast (see above) alongside the forecast future fleet mix to model expected noise levels. The noise model will account for the expected dispersion around the route centrelines. We expect that track conformance and dispersion will be informed by simulations run by both EMA and NERL. This noise model will output the LAeq contours for the baseline 'pre-implementation scenario' and the options, with associated population data and contour size information. This will enable assessment of significant noise impacts. LAeq data will be input into the government's TAG assessment spreadsheet, to provide a monetised cost/benefit for any significant noise impacts.
Secondary noise metric data: Quantitative Nx contours, population counts and size (km2) that take into account the frequency of overflight	At Stage 3 we will fully quantify the secondary metrics up to 7,000ft. To do this, we will use the movement forecast (see above) alongside the forecast future fleet mix to model expected noise levels. The noise model will also account for the expected dispersion around the route centrelines. This noise model will output the Nx and overflight contours, population, and size, which will evidence noise effects between 0-7,000ft.
Secondary noise metric data: Quantitative overflight contours, population counts and size (km2) that take into account the frequency of overflight	

Cumulative Impact	We will continue to work with ACOG to develop and implement the process for defining and quantifying Cumulative Impact. This process is still under development, and not fully agreed with the CAA, so exact details and metrics cannot yet be determined.
CAS requirements to accommodate the options and impact to general aviation.	Following development of the options proposed to be taken to FOA/Consultation, an analysis of CAS requirements will be developed in collaboration with neighbouring airports and NERL. This will allow us to quantify the types and volume of CAS required for the options and compare this against the existing airspace structure.
Fuel Burn and CO2 emissions data (including greenhouse gases)	We will generate detailed Fuel Burn and CO2 analysis. This will need to be informed by both fast time and real time simulation activities to understand how the revised airspace operates as a system, and the amount of ATC vectoring that is required to maintain safe separation and maintain capacity. This work may be conducted in collaboration with NERL who are designing the airspace above 7,000ft, and will consider the movement forecast, and the expected future fleet mix. Data from this analysis will be input into the Government's TAG spreadsheet and used to generate a monetised output.
Air Quality	A further qualitative assessment on air quality impacts to determine the air quality impacts from the proposed changes at EMA. The results of these qualitative assessments will be used to determine if there is a need for a full, quantitative assessment of any change proposals. If detailed assessments are required, they will be carried out to determine quantitative impacts.
Safety	Safety analysis work will continue to be undertaken in line with the requirements of CAP1616 and all other national and local safety regulations. EMA will also continue to work with ACOG to develop the Safety Assurance Strategy as part of the Airspace Masterplan. At Stage 3, commensurate with the Full Options Appraisal, a Full Options Safety Case Part 2 Report will be developed and submitted to the CAA to satisfy the requirement for a Safety Assessment at this stage.

	This document will report on the ability of each design option to meet the applicable derived Safety Requirements defined at Step 2B.
Tranquillity and Biodiversity	Impacts on tranquillity and Biodiversity will be assessed at Stage 3. The assessments will be sub-sets of the Noise and Air Quality modelling work respectively. Areas that will be assessed for tranquillity will include statutory designated land i.e. National Parks and AONBs. These will be mapped alongside the proposed route changes and any impact will be assessed once the noise contours are produced. Bio-diversity impact is contingent on understanding the impacts of changes in particulate matter and nitrogen concentrations. Should a quantitative Air Quality assessment be deemed necessary (see above) then that impact analysis will consider areas that could be sensitive to change. The areas that would be considered within any bio-diversity assessment would include the statutory environment sites (e.g. SSSIs, SPAs and SACs).
ATC operational, deployment and training costs	Once the options for consultation have been finalised, we will investigate with our ATC Manager to quantify any ATC deployment or training costs associated with the options.
TAG and a Net Present Value Table	Any monetised outputs following the assessments outlined above will be input into a Net Present Value (NPV) table.

Table 6 Information to collect as part of Full Options Appraisal (FOA) at Stage 3

9 Glossary

ACOG	Airspace Change Organisation Group formed in 2019 as a fully independent organisation within NATS under the direction of the UK Government Department for Transport and Civil Aviation Authority, who are the co-sponsors of the AMS.
ACP	Airspace Change Proposal.
ADWR	Airspace Development Workshop Record - the output from bilateral discussions with NERL to record and inform their comprehensive list of options for the network that interfaces with EMA traffic.
AgI	Above ground level.
AIAA	Area of Intense Aerial Activity – Airspace within which aircraft, singly or in combination with others, regularly participate in unusual manoeuvres, not constrained by a formal route network.
AIP	The UK Aeronautical Information Publication - a document published by the UK CAA which contains information essential to air navigation. (www.aurora.nats.co.uk/htmlAIP/Publications/2022-07-14-AIRAC/html/index-en-GB.html).
Altitude Based Priorities	The ANG sets out a framework of 'Altitude Based Priorities', to be taken into account when considering the potential environmental impact of airspace changes.
AMS	Airspace Modernisation Strategy (CAP1711) - this is the Government's strategy and plan for the use of UK airspace, including the modernisation of airspace (www.caa.co.uk/cap1711). The original AMS was published in December 2018 and a refreshed version in January 2023. All references to the AMS are to this January 2023 version.
AMSL	Above mean sea level.
ANCON	The UK civil Aircraft Noise Contour Model. A computer model developed and maintained by the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority which calculates contours of aircraft noise exposure levels around airports.
ANG	Air Navigation Guidance 2017 - Guidance to the CAA (from DfT) on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management. (www.gov.uk/government/publications/uk-air-navigation-guidance-2017).
ANSP	Air Navigation Service Provider - an organisation which operates the technical system, infrastructure, procedures, and rules of an air navigation service system, which includes air traffic control.
AONB	Area of Outstanding Natural Beauty - an area of countryside which has been designated for conservation because of its significant landscape value, recognising its national importance.

AQMA	Air Quality Management Area - designated by a local authority and subject to a Local Air Quality Management Plan.
ATC	Air Traffic Control - service from an air navigation service provider providing guidance to aircraft through Controlled Airspace.
ATCC	Air Traffic Control Centre. There are two air traffic control centres in the UK both operated by NERL. The London ATCC deals with aircraft operating to the south of EMA and the Scottish ATCC deals with flights to the north of EMA.
ATCO	Air Traffic Control Officer – air traffic controllers who monitor the flow of aircraft into and out of the airport airspace by providing instructions and information to pilots, so that they fly safely and efficiently. ATCOs manage flights at both airports and within the en-route (upper) airspace network.
ATM	Air Transport Movement - an aircraft operation for commercial purposes, as opposed to a flight for recreational or personal reasons.
ATS	Air Traffic Services.
ATZ	Aerodrome Traffic Zone – An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.
BKY	Abbreviation for the Barkway DVOR navigation beacon and routes that use that as a navigation point.
BHX	The three letter IATA code for Birmingham Airport.
Biodiversity	The variability among living things from all ecosystems (including terrestrial, marine, and aquatic amongst others) and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems.
CAA	Civil Aviation Authority - the aviation industry's regulator.
CAP	Civil Aviation Publication - a document published by the UK CAA which can provide information, guidance or policy depending on the subject covered. The list of all CAPs is published on the CAA website (www.caa.co.uk/our-work/publications).
CAP1385	The CAA's PBN enhanced route spacing guidance (www.caa.co.uk/cap1385).
CAP1498	The CAA's Definition of Overflight - this defines overflight as it relates to airspace regulation and provides an overflight metric which may be used to quantitatively compare different airspace options (www.caa.co.uk/cap1498).
CAP1616	The CAA's airspace change guidance document - it sets out the regulatory process which all airspace change proposals must follow (www.caa.co.uk/cap1616).
CAP1616a	A technical annex to CAP1616 - guidance on the regulatory process for changing airspace design including community engagement requirements. This annex outlines relevant methodologies for use in environmental assessments relating to airspace change (www.caa.co.uk/cap1616a).

CAP1711	Airspace Modernisation Strategy - this is the Government's strategy and plan for the use of UK airspace, including the modernisation of airspace (www.caa.co.uk/cap1711).
CAP1781	The CAA's DVOR/DME/NDB Rationalisation - guidance for the use of RNAV Substitution (www.caa.co.uk/cap1781).
CAP1926	General Requirements and Guidance Material for the use of RNAV Substitution (www.caa.co.uk/cap1926) and which supports airlines in the implementation of RNAV substitution under CAP1781
CAP1991	Procedure for the CAA to review the classification of airspace (www.caa.co.uk/cap1991).
CAP2091	CAA Policy on Minimum Standards for Noise Modelling -document defines categories of noise modelling sophistication and sets out requirements of the minimum category which different stakeholder or sponsor groups should use when providing noise calculations to the CAA. (www.caa.co.uk/cap2091).
CAP2156A	Airspace change Masterplan - CAA acceptance criteria: the criteria against which the CAA will make the decision whether to accept the airspace change Masterplan into the Airspace Modernisation Strategy (www.caa.co.uk/cap2156A).
CAP2302	A Low Noise Arrival CAP2302 - a report that makes recommendations to implement low noise arrivals (www.caa.co.uk/cap2303).
CAP493	Manual of Air Traffic Services - contains procedures, instructions and information which are intended to form the basis of air traffic services within the United Kingdom (www.caa.co.uk/cap493).
CAP725	The CAA's airspace change process guidance document that preceded CAP1616 (www.caa.co.uk/cap725).
CAP760	CAA's Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases (www.caa.co.uk/cap760).
CAP778	The CAA's Policy and Guidance for the Design and Operation of Departure Procedures in UK Airspace (www.caa.co.uk/cap778).
CAA Controlled Airspace Containment Policy Statement	The CAA Controlled Airspace Containment Policy Statement (January 2014 superseded in August 2022) sets out the minimum criteria applicable to containment of instrument flight procedures for airports already within Controlled Airspace (CAS). Annex B provides the design criteria that have been applied to the arrival and departure routes in this ACP. (https://publicapps.caa.co.uk/docs/33/Policy%20for%20the%20Design%20of%20Controlled%20Airspace%20Structures%20110822.pdf).
CAS	Controlled Airspace is airspace within which air traffic services are provided. There are different classifications which define the air traffic control service provided and the requirements of aircraft flying within it. All commercial (passenger) flights fly within Controlled Airspace.
CATI & CATIIIB (approaches)	Categories of precision approach and landing (including Instrument Landing System (ILS) and Autoland) operations are defined according to the applicable Decision Altitude/Height and Runway Visual Range/visibility. A category I (CATI) approach requires a higher decision height and better visibility than a category IIIB (CATIIIB) approach. The technical apparatus

	for CATIIIB approaches allow an airport to maintain operations in very poor visibility.
CCO	Continuous Climb Operations - allows departing aircraft to climb continuously, which reduces the level of noise heard on the ground, reduces fuel burn and emissions.
CDA	Continuous Descent Approach - allows arriving aircraft to descend continuously which reduces the level of noise heard on the ground, reducing fuel burn and emissions.
CF	Course to Fix - a path that terminates at a fix with a specified course at that fix.
Change sponsor	An organisation that proposes, or sponsors, a change to the airspace design in accordance with the CAA's airspace change process.
CHASE	The northerly of the two holds used for arrivals at Birmingham Airport.
Class G airspace	Class G airspace is also referred to as uncontrolled airspace and is airspace where an ATC service is not deemed necessary or cannot be provided for practical reasons. This means there are no restrictions on which aircraft can enter it, what equipment the aircraft must carry, or the routes taken by the aircraft.
Comprehensive list	The full list of design options that are viable designs as required by Stage 2 of the CAP1616 process and which are detailed in the Design Options Report.
CONOPS	Concept of Operations - a document that outlines how we want the airspace system to work in the future and the standards that we will use.
CO_2	Carbon dioxide, one of the gases produced when burning aviation fuel.
COVID-19	Coronavirus disease 19 is a contagious disease caused by a virus that was identified in 2019 and which resulted in a pandemic in the year 2020.
CP	Country Park - areas of land designated and protected by local authorities to provide access to the countryside.
Cumulative Impact	Where an environmental topic/receptor is affected by impacts from more than one source/project at the same time and the impacts act together.
CTA	Control Area - the controlled airspace that exists in the vicinity of an airport.
dB	Decibels - a unit used to measure noise levels.
DEFRA	Department for the Environment, Food and Rural Affairs (UK Government).
DER	Departure End of Runway - a term that, when used in PANS-OPS 8168, determines the start point for the design of a departure procedure.
Design envelopes	Broad areas where it is possible to design routes and which are the areas where we have created design options for arriving and departing aircraft.

Design option	An output from the route design process that responds to the design principles and the Statement of Need (SoN). Design options are a requirement of the CAP1616 process. During the engagement carried out at Stage 2, design options were also referred to as route options.
Design principles	The principles encompassing the safety, environmental and operational criteria, and the strategic policy objectives that the change sponsor seeks to achieve in developing the airspace change proposal. They are an opportunity to combine local context with technical considerations and are therefore drawn up through discussion with affected stakeholders. The design principles at East Midlands Airport were established during Stage 1 of the CAP1616 process.
DF Coding	Direct to Fix coding - type of waypoint used in the design of PBN procedures.
DfT	Department for Transport.
DME	Distance Measuring Equipment - a ground-based beacon that allows aircraft to measure their precise distance from its location, often used to define a turn point.
DOE	Design Options Evolution - shows the evolution of the design options through Stages 2A and 2B of the CAP1616 process. Included as Appendix A to the Stage 2 Summary Document.
DOR	Design Options Report - this responds to the requirements of CAP1616 to develop a comprehensive list of options that address the SoN and that align with the design principles. It details the design process and the output of that process in the form of design options for both departures and arrivals.
DPE	Design Principle Evaluation - the document that undertakes an evaluation of the Viable and Good Fit options described in this report against the design principles.
DTY	Abbreviation for the Daventry DVOR navigation beacon and routes that use that as a navigation point.
DVOR	Doppler VHF Omni-directional Range - ground-based radio navigation beacon used by pilots to assist in aircraft navigation.
EASA	European Union Aviation Safety Agency.
Education (facilities)	For our analysis we have used the 'Ordnance Survey Address Base' count of educations facilities, details of which they receive from the local government contributing authority. These include all educational services including College, Further Education, Higher Education, Children's Nursery / Crèche, Preparatory / First / Primary / Infant / Junior / Middle School, Non State Primary / Preparatory School, Secondary / High School, Non State Secondary School, University, Special Needs Establishment and Other Educational Establishments.
EU	The European Union - an economic and political union of 27 countries.
EMA	The three letter IATA code for East Midlands Airport.
ERCD	The Environmental Research and Consultancy Department of the Civil Aviation Authority.

FAF	Final Approach Fix - The point at which the aircraft starts its final approach to land.
FASI-N	Future Airspace Strategy Implementation – North: The programme of airspace changes across the northern part of the UK, including East Midlands Airport, that is implementing the Governments Airspace Modernisation Strategy.
FASI-S	Future Airspace Strategy Implementation – South: The programme of airspace changes across the southern part of the UK including London that is implementing the Governments Airspace Modernisation Strategy. Whilst the East Midlands Airport ACP will de deployed as part of FASI-N programme, the route structures to and from EMA to the south result in the need to align with the network being developed as part of FASI-S.
FIR	Flight Information Region - airspace delegated to a country by ICAO. In the UK there are two FIRs, London and Scottish.
FL	FL means 'Flight Level' and uses the standard international pressure (1013.2 hPa) to express altitude in hundreds of feet. For example, FL90 equates to 9,000ft calculated according to the 'constant' pressure altitude, rather than local pressure (QNH).
Flat segment	A defined period of level flight as required by a PANS-OPS PBN Approach procedure.
Flight path	The routes taken by aircraft within airspace.
Flight Level	A means to separate aircraft (above the transition altitude) by using a standard pressure setting for all aircraft.
FMS	Flight Management System - a specialised computer system that automates a wide variety of in-flight tasks, and which encompasses a data base to allow SID and arrivals routes to be pre-programmed and flown.
FOA	Full Options Appraisal - the options appraisal carried out at Stage 3 of the CAP1616 process.
Focus group	Group of representative stakeholders brought together to discuss proposals and offer feedback.
Ft	Feet.
GA	General Aviation - defined by ICAO as 'all civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire'.
GANP	The ICAO Global Air Navigation Plan provides a global strategy to modernise the air traffic management system. The GANP provides the foundation for the delivery of the UK AMS (CAP1711). (https://www.icao.int/airnavigation/documents/ganp-2016-mobile.pdf).
GBAS	Ground Based Augmentation System - augments the existing GPS by providing corrections to aircraft in the vicinity of an airport to improve the accuracy of, and provide integrity for, the aircraft's GPS navigational position.
GDPR	The General Data Protection Regulations.

GIS	Geographic Information System.
GNSS	Global Navigation Satellite System - a term used to describe a system that uses satellites for position fixing.
GPS	Global Positioning System - a satellite-based radio navigation system owned by the United States government and operated by the United States Space Force.
HAZID Workshop	Hazard Identification workshop – the first part of the safety assurance process which identifies the safety requirements and potential interactions that may have a safety impact. It is held with air traffic control experts as well as airline representatives operating from East Midlands Airport.
IAF	Initial Approach Fix - the start of the approach phase of flight. For the East Midlands arrival design options, the IAF is at 7,000ft.
IF	Intermediate Fix – a defined point on an arrival procedure, where the aircraft speed and configuration are adjusted, shortly before the aircraft starts the final approach.
IATA	The International Air Transport Association - a trade association that supports aviation with global standards for airline safety, security, efficiency and sustainability.
ICAO	International Civil Aviation Organisation - an agency of the United Nations
IFP	Instrument Flight Procedure.
ILS	Instrument Landing System - a radio navigation system that provides vertical and horizontal guidance to arriving aircraft to help them land safely, especially in bad weather.
Instrument Approach Procedures (IAPs)	A series of predetermined manoeuvres for the orderly transfer of an aircraft operating under instrument flight rules from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually.
Intermediate segment	The element of the approach between the IF and FAF where the descent gradient is either minimised or where a portion of level flight is designed into the procedure to assist with aircraft stabilisation.
IOA	Initial Options Appraisal - the document that is the first iteration of the three option appraisals required by CAP1616 - the design options appraised within the IOA are the outputs from the DPE.
KIAS	Knots of indicated airspeed - the number shown on the airspeed indicator.
km	Kilometres.
KTS	Knots – nautical miles per hour.
LAeq	Equivalent continuous sound level, or Leq/LAeq, is the average sound level for a specific location, over a given period.
LBA	The three letter IATA code for Leeds Bradford Airport.
LDA	Localiser Directional Aid - an assisted approach not aligned with the landing runway, used in places where terrain or other factors prevent the localiser antenna from being aligned with the runway that it serves.

LOAEL	Lowest Observed Adverse Effect Level - below this level, there is no detectable effect on health and quality of life due to the noise.
LNAV	Lateral Navigation - a term for lateral (left/right) navigation used within Performance Based Navigation.
LPL	The three letter IATA code for Liverpool John Lennon Airport.
LTMA	London Terminal Manoeuvring Area – the designated area of Controlled Airspace that deals with air traffic in the London area.
m	Metres.
MAGIC map	Interactive map managed by DEFRA containing authoritative geographic information about the natural and built environment from across Government.
MAP	Missed Approach Procedure - on occasion, inbound aircraft are unable to land successfully on their first approach and perform an action known as a 'Go-Around'. The Missed Approach Procedure outlines a mechanism to route the aircraft, without conflict with departing or arriving aircraft, and re-establish it on to the arrivals path for another approach.
MAN	The three letter IATA code for Manchester Airport.
Masterplan	The strategic plan for the coordinated national programme of airspace change, created by the ACOG under the direction of the CAA and DfT. The criteria the CAA will apply to accept the Masterplan are contained in CAP2156a (www.caa.co.uk/cap2156A).
Medical (facilities)	For our analysis we have used the 'Ordnance Survey Address Base' count of 'Medical', details of which they receive from the local government contributing authority. These include Dentist, General Practice Surgery / Clinic, Health Centre, Health Care Services, Hospital, Hospice, Medical / Testing / Research Laboratory, Professional Medical Service, Assessment / Development Services. Not all of these are 'noise sensitive' receptors and in Stage 3 those which are not 'noise sensitive' will be removed from future analysis.
Mean track	For noise modelling purposes, an average track over the ground, derived from radar data samples.
Modal average path	The path over the ground most commonly flown, derived from radar data samples.
MSD	Minimum Stabilisation Distance - a design criteria within PANS-OPS 8168 that ensures aircraft stability when flying a procedure.
MTMA	Manchester Terminal Manoeuvring Area - the designated area of Controlled Airspace that deals with traffic to the north of East Midlands Airport.
NATS	The air navigation service provider for the UK, formerly National Air Traffic Services. NATS 'En Route' manage the traffic in the upper airspace.
NDB	Non-Directional Beacon - a ground based radio beacon that emits a signal in every direction, used as an instrument approach aid for some airport procedures, including contingency procedures at EMA.
NERL	NATS En Route Ltd - the part of NATS that delivers en route air traffic control.

nm	Nautical miles.
NNR	National Nature Reserves - designated under the National Parks and Access to the Countryside Act 1949 and the Wildlife and Countryside Act 1981 to protect important habitats, species or geology.
Noise abatement	Activity to reduce the emission of noise from a given source (aircraft operations).
Noise-sensitive receptors	Specific locations or developments identified as likely to be adversely affected by noise from or due to aircraft operations. Individual locations will have varying degrees of sensitivity (measured noise exposure levels) depending upon their use. These provide a useful reference to the design principles N1, N2 and N3 where the number of people affected by noise, noise effects and noise sensitive areas are referenced.
NP	National Park - designated areas under the National Parks and Access to the Countryside Act 1949 to protect landscapes because of their special qualities.
NPR	Noise Preferential Route – initial flight path corridor around the SID that departing aircraft are required to remain within until they reach a minimum height of 5,000ft. Each NPR at EMA is 2.4km wide (1.2m either side of the SID).
NWMTA	North Wales Military Training Area: A designated area of airspace used extensively by the RAF for military training flights and which restricts use by civil air traffic.
Overflight	According to CAP1498, the definition of overflight is 'an aircraft in flight passing an observer at an elevation angle (approximately the angle between the horizon and the aircraft) that is greater than an agreed threshold, and at an altitude below 7,000ft.'
PANS-OPS	An ICAO document that stands for Procedures for Air Navigation Services Document 8168 that outlines the rules and criteria for designing aircraft flying procedures - commonly shortened to PANS-OPS.
PBN	Performance Based Navigation - a range of specifications that requires aircraft to navigate to specific accuracy standards, mainly by using satellite-based navigation systems. It is designed to improve track-keeping accuracy for departing and arriving aircraft. The transition to PBN is a UK and international policy requirement and a foundation of the AMS and this ACP.
PBN IR	The PBN IR introduces the gradual implementation of PBN flight procedures to support safer, greener, and more efficient aircraft operations. The regulation is binding in its entirety and directly applicable in all EU Member States.
Peak District	The Peak District - an upland area in England at the southern end of the Pennines. Mostly in Derbyshire, it extends into Cheshire, Greater Manchester, Staffordshire, West Yorkshire and South Yorkshire.
PDG	Procedure Design Gradient.
PIGOT	The southerly of the two existing holding stacks used for arriving aircraft at EMA. It is situated south east of Leicester.

Places of Worship	For our analysis we have used the 'Ordnance Survey Address Base' count of 'Places of Worship', details of which they receive from the local government contributing authority. These include any Abbey, Baptistry, Cathedral, Church, Chapel, Citadel, Gurdwara, Kingdom Hall, Methodist, Mosque, Minster, Stupa, Succah, Synagogue, Tabernacle or Temple.
Planned Property Developments	Property developments with a reasonable prospect of being developed based on Local Plan allocations and Local Authority five-year Housing Land Supply Assessment data. During engagement we have used the term 'Future Housing Sites' to represent the broader phrase of planned property development as we are not aware of other future noise sensitive developments that would sit within this category. Data was collated by CBRE and supplied to East Midlands Airport in December 2022.
Point Merge	Is based on a specific precision-area navigation (P-RNAV) route structure, consisting of a point (the merge point) and pre-defined legs (the sequencing legs) equidistant from this point. The sequencing is achieved with a 'direct-to' instruction to the merge point at the appropriate time.
Q&A	Question and Answer - a list of questions (and their answers) that help the reader understand the subject material.
RAG	Red, amber, green - a means of assessing a project's status using the traffic light colours.
RF	Radius to Fix (RF) is a constant radius PBN turn around a defined turn centre which produces a highly accurate track over the ground.
RNAV1	Area Navigation 1 is one of the specifications within PBN. Aircraft must maintain specific navigational accuracy within the flight. The '1' suffix refers to the accuracy requirement in the procedure, in this case aircraft must fly within +/-1 nautical mile of the centreline of the designed route.
RNP APCH	Required Navigation Performance Approach - a type of RNP procedure used in the descent phase of flight.
RNP-AR	Required Navigation Performance-Authorisation Required – a specialist type of PBN arrivals procedure, which requires suitably equipped aircraft, and crews to be trained in its use.
RNP1	Required Navigation Performance - one of the specifications under PBN. Aircraft must maintain specific navigation accuracy, and in RNP are aided by on-board performance monitoring and alerting. It provides slightly more predictable track-keeping when compared to RNAV1. The '1' suffix refers to the accuracy requirement in the procedure, in this case aircraft must fly within +/-1 nautical mile of the centreline of the designed route.
RNP1+RF	Required Navigation Performance with Radius to Fix turns.
ROKUP	The northerly of the two existing holding stacks used for arriving aircraft at EMA. It is situated close to Belper.
Route option	A term used in engagement to describe the design options that have been created in this step of the Airspace Change Process.

SAC	Special Area of Conservation - Designated under the Conservation of Habitats and Species Regulations 2017 as making a significant contribution to the conserving of the habitats of protected species.
Safety Case	A written demonstration of evidence and due diligence provided by a corporation to demonstrate the ability to operate safely and effectively control hazards.
SARG	Safety and Airspace Regulation Group which drives UK Civil Aviation Authority (CAA) safety standards including overseeing aircraft, airlines and air traffic controllers. They are also responsible for the planning and regulation of UK airspace.
Secretary of State	The title typically held by Cabinet Ministers in charge of Government Departments.
SESAR	The Europe-wide Single European Sky Air Traffic Management Research programme - a joint undertaking is an institutionalised European partnership between private and public sector partners set up to accelerate through research and innovation the delivery of the Digital European Sky (www.sesarju.eu).
SID	Standard Instrument Departure - pre-determined flight path set by Air Traffic Control that aircraft follow when departing an airport.
SME	Subject Matter Expert(s) is a person (are people) who has (have) accumulated great knowledge in a particular field or topic.
SoN	Statement of Need - the means by which the change sponsor sets out what airspace issue or opportunity it is seeking to address and what outcome it wishes to achieve, without specifying solutions, technical or otherwise. East Midlands Airport's SoN can be found online (https://airspacechange.caa.co.uk/documents/download/773).
SPA	Special Protection Area - protected areas for birds classified under the Wildlife and Countryside Act 1981 and protected under the Conservation of Habitats and Species Regulations 2017.
SSSI	Sites of Special Scientific Interest - areas of importance designated and protected by Natural England under the Wildlife and Countryside Act 1981 to recognise the land's wildlife, geology or landform is of special interest.
STAR	Standard Terminal Arrival Route - a pre-determined flight path set by Air Traffic Control that aircraft follow when arriving at an airport.
Step 1B Design Principles Report	A document that formed part of East Midlands Airport's Stage 1 submission to the CAA (https://airspacechange.caa.co.uk/documents/download/5447).
T-Bar	A name given to a type of RNAV final approach procedure. There is a final approach based on an extended centreline from the runway and then perpendicular to that, two Initial Approach Segments are connected to form a 'T' shape.
Technical Coordination Group	Created by ACOG the Group regularly meet to discuss and resolve policy and technical issues affecting airspace design across all airports.
TNT	Abbreviation for the Trent DVOR navigation beacon and routes that use that as a navigation point.

TODA	Take off Distance Available - the length of the paved surface of the take-off runway plus the length of the clearway.
TOS	Traffic Orientation Structure ensures smooth traffic flows and decrease the safety risks associated with crossing traffic.
Track to fix	A Track to Fix (TF) leg is used in PBN procedures to create a line between two waypoints. It is defined by the flight track to the following waypoint and Track to a Fix leg are sometimes called point-to-point legs for this reason.
Tranquillity	There is no universally accepted definition of tranquillity and therefore no accepted metric by which it can be measured. In general terms it can be defined as a state of calm. The consideration of impacts upon tranquillity for airspace change is with specific reference to National Parks and Areas of Outstanding Natural Beauty (AONB), plus any locally identified 'tranquil' areas that are identified through community engagement and are subsequently reflected within an airspace change proposal's design principles.
Transition	The part of the arrival route from the IAF at 7,000ft where aircraft are descending prior to joining the final approach at the FAF.
Transition Altitude	The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes. Above this, the reference is to a Flight Level.
Transport Act 2000	The Transport Act 2000 is an Act of the Parliament of the United Kingdom. The Act provided for a number of measures across the transport industry. In the aviation sector, the Act set a framework for creation of a public-private partnership of National Air Traffic Services.
Uncontrolled airspace	Uncontrolled airspace is airspace where an ATC service is not deemed necessary or cannot be provided for practical reasons. This means there are no restrictions on which aircraft can enter it, what equipment the aircraft must carry, or the routes taken by the aircraft. In airspace classification terms this is also referred to as Class G airspace.
Unviable	Options which would not comply with the rules or for flight procedure design, specifically the requirements of ICAO PANS-OPS 8168, or if they are not compliant with these rules, did not have a supporting safety justification.
VHF	Very High Frequency.
Viable and Good Fit	Options that are viable to design and which would be expected to meet the three design principles with which all design options 'must' comply (design principles Safety, Programme, and Continuity).
Viable but Poor Fit	Options that are viable to design, but which would not be expected to meet the requirements of the design principles Safety, Programme and Continuity.
VNAV	Vertical Navigation - a term for vertical (up/down) navigation used within Performance Based Navigation.
VRP	Visual reference point.

10 Appendices

Appendix A1 - Initial Options Appraisal Full Analysis Tables

Figure 15 below shows an example extract of an IOA Full Analysis Table completed for Runway 27 North Arrivals via IAF1.

				IAF 1	IAF 1	IAF 1	IAF 1
				Direct	Direct	Indirect	Indirect
			'DO NOTHING' BASELINE	R27_A_N_O17	R27_A_N_O18	R27_A_N_O19	R27_A_N_O20
			For arrivals from the north, the 'do nothing' scenario in terms of today's operation is based around the existing ROKUP Hold. A modal track has been derived to provide an accurate representation of what occurs today. The 'do nothing' scenario for arrivals consists of modal tracks that have been created based upon current operations where most arrivals are radar vectored by air traffic controllers from the Hold. In addition to the modal track, a polygon has also been created that represents an area where current operations and approaches are dispersed due to radar vectoring and potentially may affect people on the ground. The overflight analysis is conducted on this transition was based on the modal track created using Noise and Track Keeping data from an altitude of 7,000ft with the addition of a radar vectoring area where appropriate. The track length has been calculated on the distance from the start of the modal track to the Arrival end (Touchdown point) of the runway.	The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south-east following the line of the M1 motorway, passing between Hucknall and Kimberley. It then makes a slight left turn passing over central Nottingham and continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for Runway 27 approaches. The descent gradient to the FAF is 2.3° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route as Option 17 but routes further east before joining the final approach. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south-east following the line of the M1 motorway, passing between Hucknall and Kimberley. It then makes a slight left turn passing over central Nottingham and continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for Runway 27 approaches. The descent gradient to the FAF is 2.08° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south passing over Heanor and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south-east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for Runway 27 approaches. The descent gradient to the FAF is 1.82° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 19 but routes further east before joining the final approach. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south passing over Heanor and routing west of Ilkeston and Nottingham and then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for Runway 27 approaches. The descent gradient to the FAF is 1.67° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.
Group	**Impact**	**Level of Analysis**	**Runway 27**	**Runway 27**	**Runway 27**	**Runway 27**	**Runway 27**
Communities	Noise impact on health and quality of life	Initial Options Appraisal: Qualitative	For comparison purposes in the IOA, in terms of potential noise impact, initial quantitive analysis has identified that the ROKUP 'do nothing' scenario for Runway 27 is estimated to overfly the following. From 7,000ft: is estimated to overfly approximately 221,550 households with an approximate population of 436,600. Taking account of 18,000 planned property developments, this option is estimated to overfly and impact a total population of 472,100. From 4,000ft: is estimated to overfly approximately 58,550 households with an approximate population of 122,600. Taking account of 7,500 planned property developments, this option is estimated to overfly and impact a total population of 138,300.	From 7,000ft, this option is estimated to overfly approximately 78,200 households with an approximate population of 157,400. Taking account of 4,850 planned property developments, this option is estimated to overfly and impact a total population of 167,100. The potential noise impact on health and quality of life from 7,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario. From 4,000ft, this option is estimated to overfly approximately 14,750 households with an approximate population of 28,200. Taking account of 2,750 planned property developments, this option is estimated to overfly and impact a total population of 33,500. The potential noise impact on health and quality of life from 4,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario.	From 7,000ft, this option is estimated to overfly approximately 69,550 households with an approximate population of 137,000. Taking account of 4,950 planned property developments, this option is estimated to overfly and impact a total population of 146,700. The potential noise impact on health and quality of life from 7,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario. From 4,000ft, this option is estimated to overfly approximately 28,900 households with an approximate population of 60,000. Taking account of 2,900 planned property developments, this option is estimated to overfly and impact a total population of 66,000. The potential noise impact on health and quality of life from 4,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario.	From 7,000ft, this option is estimated to overfly approximately 50,650 households with an approximate population of 93,000. Taking account of 7,050 planned property developments, this option is estimated to overfly and impact a total population of 105,900. The potential noise impact on health and quality of life from 7,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario. From 4,000ft, this option is estimated to overfly approximately 12,850 households with an approximate population of 23,200. Taking account of 3,150 planned property developments, this option is estimated to overfly and impact a total population of 28,900. The potential noise impact on health and quality of life from 4,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario.	From 7,000ft, this option is estimated to overfly approximately 52,200 households with an approximate population of 95,700. Taking account of 7,500 planned property developments, this option is estimated to overfly and impact a total population of 109,500. The potential noise impact on health and quality of life from 7,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario. From 4,000ft, this option is estimated to overfly approximately 10,100 households with an approximate population of 18,600. Taking account of 3,500 planned property developments, this option is estimated to overfly and impact a total population of 25,100. The potential noise impact on health and quality of life from 4,000ft is assessed as likely to affect fewer people than the 'do nothing' scenario.
Communities	Air Quality	Initial Options Appraisal: Qualitative	No change to air quality is predicted in maintaining baseline conditions. The majority of the extant procedure involves overflight above 1,000ft, other than the areas in the immediate vicinity or final approach to EMA. In terms of AQMAs, the ROKUP 'do nothing' scenario overflies 3 AQMAs. Overflight of these AQMAs occurs when the aircraft is above 1,000ft.	There is not likely to be a change in aviation emissions by location below 1,000 feet. As per CAP1616, para B72 a full Air Quality Assessment is deemed not required. This option overflies two AQMAs. When compared to the 'do nothing' scenario, this option is deemed to be beneficial as it overflies fewer AQMAs.	There is not likely to be a change in aviation emissions by location below 1,000 feet. As per CAP1616, para B72 a full Air Quality Assessment is deemed not required. This option overflies two AQMAs. When compared to the 'do nothing' scenario, this option is deemed to be beneficial as it overflies fewer AQMAs.	There is not likely to be a change in aviation emissions by location below 1,000 feet. As per CAP1616, para B72 a full Air Quality Assessment is deemed not required. This option overflies one AQMA. When compared to the 'do nothing' scenario, this option is deemed to be beneficial as it overflies fewer AQMAs.	There is not likely to be a change in aviation emissions by location below 1,000 feet. As per CAP1616, para B72 a full Air Quality Assessment is deemed not required. This option overflies one AQMA. When compared to the 'do nothing' scenario, this option is deemed to be beneficial as it overflies fewer AQMAs.
Wider Society	Greenhouse Gas impact	Initial Options Appraisal: Qualitative	Current arrival options do not facilitate continuous descent approaches to EMA from 7,000ft. It must be noted that the exact track length flown by aircraft may vary slightly due to the nature of radar vectoring. Existing procedures do not support optimal aircraft performance and therefore are predicated to have greater environmental impact compared to the proposed options. Within Stage 2 of the CAP1616 process, there is no requirement for a change sponsor to conduct quantitative fuel burn or emissions analysis; this will be conducted in Stage 3. In order to make a comparison, track mileage is used as a proxy using the theory that the shorter the track mileage, the less greenhouse gases are emitted. The track length of the 'do nothing' scenario for Runway 27 from the North is 55.06km (29.73nm).	This option has been designed to support continuous descent approaches to EMA. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of this option is 52.44 km (28.32 nm). When compared to the 'do nothing' scenario, this option is shorter and is therefore expected to result in a reduction in greenhouse gas emissions compared to the 'do nothing' scenario and is deemed to be of environmental benefit. More in-depth analysis will take place at Stage 3 to confirm the exact volumes of greenhouse gases released.	This option has been designed to support continuous descent approaches to EMA. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of this option is 46.55 km (25.13 nm). When compared to the 'do nothing' scenario, this option is shorter and is therefore expected to result in a reduction in greenhouse gas emissions compared to the 'do nothing' scenario and is deemed to be of environmental benefit. More in-depth analysis will take place at Stage 3 to confirm the exact volumes of greenhouse gases released.	This option has been designed to support continuous descent approaches to EMA. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of this option is 62.07 km (33.52 nm). When compared to the 'do nothing' scenario, this option is longer and is therefore expected to result in an increase in greenhouse gas emissions compared to the 'do nothing' scenario and is deemed to be of environmental dis-benefit. More in-depth analysis will take place at Stage 3 to confirm the exact volumes of greenhouse gases released.	This option has been designed to support continuous descent approaches to EMA. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of this option is 66.47 km (35.89 nm). When compared to the 'do nothing' scenario, this option is longer and is therefore expected to result in an increase in greenhouse gas emissions compared to the 'do nothing' scenario and is deemed to be of environmental dis-benefit. More in-depth analysis will take place at Stage 3 to confirm the exact volumes of greenhouse gases released.
Wider Society	Capacity and resilience	Initial Options Appraisal: Qualitative	Retaining extant procedures would maintain current capacity; however, due to the reliance upon ground-based navigational aids, resilience could be adversely affected, following the removal of the TNT DVOR and the requirement to adopt PBN procedures.	The introduction of PBN routes is expected to deliver benefits by increasing airspace capacity which subsequently leads to more predictable flight paths and fewer delays (both in the air and on the ground). The reduction of the reliance on outdated ground based navigational aids will significantly increase operational resilience through the introduction of PBN.	The introduction of PBN routes is expected to deliver benefits by increasing airspace capacity which subsequently leads to more predictable flight paths and fewer delays (both in the air and on the ground). The reduction of the reliance on outdated ground based navigational aids will significantly increase operational resilience through the introduction of PBN.	The introduction of PBN routes is expected to deliver benefits by increasing airspace capacity which subsequently leads to more predictable flight paths and fewer delays (both in the air and on the ground). The reduction of the reliance on outdated ground based navigational aids will significantly increase operational resilience through the introduction of PBN.	The introduction of PBN routes is expected to deliver benefits by increasing airspace capacity which subsequently leads to more predictable flight paths and fewer delays (both in the air and on the ground). The reduction of the reliance on outdated ground based navigational aids will significantly increase operational resilience through the introduction of PBN.
Wider Society	Tranquillity	Initial Options Appraisal: Qualitative	As per CAP 1616, Appendix B, para B76, change sponsors are required to consider Tranquillity with specific reference to AONBs and National Parks only, unless other areas have been identified through community engagement. No additional specific areas were identified by community engagement. The 'do nothing' scenario does not overfly any AONBs or National Parks.	This option overflies no statutorily identified tranquillity receptors (AONBs or National Parks), nor any identified through community engagement and is therefore comparable to the 'do nothing' scenario and assessed as neutral.	This option overflies no statutorily identified tranquillity receptors (AONBs or National Parks), nor any identified through community engagement and is therefore comparable to the 'do nothing' scenario and assessed as neutral.	This option overflies no statutorily identified tranquillity receptors (AONBs or National Parks), nor any identified through community engagement and is therefore comparable to the 'do nothing' scenario and assessed as neutral.	This option overflies no statutorily identified tranquillity receptors (AONBs or National Parks), nor any identified through community engagement and is therefore comparable to the 'do nothing' scenario and assessed as neutral.
Wider Society	Biodiversity	Initial Options Appraisal: Qualitative	The change sponsor has mapped the designated Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites, as identified on the DEFRA MAGiC Map. CAP 1616, Appendix B, para B74, states that because of dispersion and mixing, there is unlikely to be an impact on local air quality from aircraft above 1,000ft. Furthermore, CAP 1616, Appendix B, para B80, states that in general, airspace change proposal will not have an impact on biodiversity as they do not involve ground-based infrastructure. However, the change sponsor acknowledges that any potential impact to the designated sites around EMA will be assessed in Stage 3 of the ACP process by Subject Matter Experts.	CAP1616, Appendix B, para B74, states that because of dispersion and mixing, there is unlikely to be an impact on local air quality from aircraft above 1,000ft. Furthermore, CAP1616, Appendix B, para B80, states that in general, airspace change proposals will not have an impact on biodiversity as they do not involve ground-based infrastructure. The change sponsor has mapped the designated Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites, as identified on the DEFRA MAGiC Map and acknowledges that any potential impact to the designated sites around EMA will be assessed in Stage 3 of the ACP process by Subject Matter Experts.	CAP1616, Appendix B, para B74, states that because of dispersion and mixing, there is unlikely to be an impact on local air quality from aircraft above 1,000ft. Furthermore, CAP1616, Appendix B, para B80, states that in general, airspace change proposals will not have an impact on biodiversity as they do not involve ground-based infrastructure. The change sponsor has mapped the designated Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites, as identified on the DEFRA MAGiC Map and acknowledges that any potential impact to the designated sites around EMA will be assessed in Stage 3 of the ACP process by Subject Matter Experts.	CAP1616, Appendix B, para B74, states that because of dispersion and mixing, there is unlikely to be an impact on local air quality from aircraft above 1,000ft. Furthermore, CAP1616, Appendix B, para B80, states that in general, airspace change proposals will not have an impact on biodiversity as they do not involve ground-based infrastructure. The change sponsor has mapped the designated Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites, as identified on the DEFRA MAGiC Map and acknowledges that any potential impact to the designated sites around EMA will be assessed in Stage 3 of the ACP process by Subject Matter Experts.	CAP1616, Appendix B, para B74, states that because of dispersion and mixing, there is unlikely to be an impact on local air quality from aircraft above 1,000ft. Furthermore, CAP1616, Appendix B, para B80, states that in general, airspace change proposals will not have an impact on biodiversity as they do not involve ground-based infrastructure. The change sponsor has mapped the designated Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and RAMSAR sites, as identified on the DEFRA MAGiC Map and acknowledges that any potential impact to the designated sites around EMA will be assessed in Stage 3 of the ACP process by Subject Matter Experts.
General Aviation	Access	Initial Options Appraisal: Qualitative	No change to existing airspace arrangements. Any General Aviation users of airspace in the vicinity of EMA will maintain their current level of access under extant operational arrangements.	Impact to General Aviation access is anticipated to be minimal as a consequence of this ACP. All Visual Reference Points and existing Letters of Agreement pertaining to General Aviation access will be reviewed and updated (where applicable) prior to implementation to ensure their continued validity. Airspace classification requirements and any additional airspace requirements will be reviewed as part of Stage 3 activities.	Impact to General Aviation access is anticipated to be minimal as a consequence of this ACP. All Visual Reference Points and existing Letters of Agreement pertaining to General Aviation access will be reviewed and updated (where applicable) prior to implementation to ensure their continued validity. Airspace classification requirements and any additional airspace requirements will be reviewed as part of Stage 3 activities.	Impact to General Aviation access is anticipated to be minimal as a consequence of this ACP. All Visual Reference Points and existing Letters of Agreement pertaining to General Aviation access will be reviewed and updated (where applicable) prior to implementation to ensure their continued validity. Airspace classification requirements and any additional airspace requirements will be reviewed as part of Stage 3 activities.	Impact to General Aviation access is anticipated to be minimal as a consequence of this ACP. All Visual Reference Points and existing Letters of Agreement pertaining to General Aviation access will be reviewed and updated (where applicable) prior to implementation to ensure their continued validity. Airspace classification requirements and any additional airspace requirements will be reviewed as part of Stage 3 activities.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Initial Options Appraisal: Qualitative	No increase to effective capacity anticipated for continued use of extant procedures, therefore no economic benefit for GA/airlines.	The introduction of PBN is expected to deliver benefits by increasing airspace capacity which in turn will lead to more predictable flight paths and fewer delays (both in the air or on the ground). This is expected to facilitate economic benefit by potentially increasing the frequency of air transport movements, increasing passenger numbers and increasing cargo tonnage carried.	The introduction of PBN is expected to deliver benefits by increasing airspace capacity which in turn will lead to more predictable flight paths and fewer delays (both in the air or on the ground). This is expected to facilitate economic benefit by potentially increasing the frequency of air transport movements, increasing passenger numbers and increasing cargo tonnage carried.	The introduction of PBN is expected to deliver benefits by increasing airspace capacity which in turn will lead to more predictable flight paths and fewer delays (both in the air or on the ground). This is expected to facilitate economic benefit by potentially increasing the frequency of air transport movements, increasing passenger numbers and increasing cargo tonnage carried.	The introduction of PBN is expected to deliver benefits by increasing airspace capacity which in turn will lead to more predictable flight paths and fewer delays (both in the air or on the ground). This is expected to facilitate economic benefit by potentially increasing the frequency of air transport movements, increasing passenger numbers and increasing cargo tonnage carried.
General Aviation / commercial airlines	Fuel burn	Initial Options Appraisal: Qualitative	The existing EMA procedures for arrivals do not facilitate continuous descent operations from 7,000ft. Within Stage 2 of the CAP 1616 process, there is no requirement for a change sponsor to conduct quantitative fuel burn analysis. This will be covered in Stage 3. In order to make a comparison in Stage 2, track mileage is used, based on the theory that the shorter the track mileage, the less greenhouse gases are emitted. In the case of the 'do nothing' baseline scenario, the track length is 55.06km (29.73nm).	This option supports continuous descent operations, reducing the overall amount of fuel burnt. There is no requirement within Stage 2 of the CAP1616 process to quantify fuel burn, this will be conducted in Stage 3. Therefore, to enable a comparison, the logic applied is that the shorter the track length, the less fuel is burnt. With regards to this option, it is 52.44 km (28.32 nm) long. When compared to the 'do nothing' scenario, this option is shorter and at this stage, it is assumed that it will be of economic benefit as less fuel will be burnt. More in-depth analysis will be carried out in Stage 3 to confirm.	This option supports continuous descent operations, reducing the overall amount of fuel burnt. There is no requirement within Stage 2 of the CAP1616 process to quantify fuel burn, this will be conducted in Stage 3. Therefore, to enable a comparison, the logic applied is that the shorter the track length, the less fuel is burnt. With regards to this option, it is 46.55 km (25.13 nm) long. When compared to the 'do nothing' scenario, this option is shorter and at this stage, it is assumed that it will be of economic benefit as less fuel will be burnt. More in-depth analysis will be carried out in Stage 3 to confirm.	This option supports continuous descent operations, reducing the overall amount of fuel burnt. There is no requirement within Stage 2 of the CAP1616 process to quantify fuel burn, this will be conducted in Stage 3. Therefore, to enable a comparison, the logic applied is that the shorter the track length, the less fuel is burnt. With regards to this option, it is 62.07 km (33.52 nm) long. When compared to the 'do nothing' scenario, this option is longer and at this stage, it is assumed that it will be of economic dis-benefit as more fuel will be burnt. More in-depth analysis will be carried out in Stage 3 to confirm.	This option supports continuous descent operations, reducing the overall amount of fuel burnt. There is no requirement within Stage 2 of the CAP1616 process to quantify fuel burn, this will be conducted in Stage 3. Therefore, to enable a comparison, the logic applied is that the shorter the track length, the less fuel is burnt. With regards to this option, it is 66.47 km (35.89 nm) long. When compared to the 'do nothing' scenario, this option is longer and at this stage, it is assumed that it will be of economic dis-benefit as more fuel will be burnt. More in-depth analysis will be carried out in Stage 3 to confirm.
Commercial airlines	Training costs	Initial Options Appraisal: Qualitative	Standard training would be applicable for existing procedures which would be practised by crews through existing simulator exercises.	It is anticipated that no extra pilot/crew training will be required to enable pilots to fly the new PBN procedures as PBN has become a common navigation standard across the world.	It is anticipated that no extra pilot/crew training will be required to enable pilots to fly the new PBN procedures as PBN has become a common navigation standard across the world.	It is anticipated that no extra pilot/crew training will be required to enable pilots to fly the new PBN procedures as PBN has become a common navigation standard across the world.	It is anticipated that no extra pilot/crew training will be required to enable pilots to fly the new PBN procedures as PBN has become a common navigation standard across the world.
Commercial airlines	Other costs	Initial Options Appraisal: Qualitative	It is not proportionate at this stage for EMA to assess potential other costs for commercial airlines - there may be costs associated with maintaining legacy systems to continue flying conventional navigation but there are too many variables (e.g. aircraft types, on-board system capability etc.) to consider these effectively.	Other costs to commercial airlines may include updates to Flight Management Systems (FMS), navigation databases and operating procedures, increased pilot hire costs versus training etc. It is not proportionate at this stage of the ACP for EMA to assess the 'other costs' to commercial airlines of flying PBN procedures.	Other costs to commercial airlines may include updates to Flight Management Systems (FMS), navigation databases and operating procedures, increased pilot hire costs versus training etc. It is not proportionate at this stage of the ACP for EMA to assess the 'other costs' to commercial airlines of flying PBN procedures.	Other costs to commercial airlines may include updates to Flight Management Systems (FMS), navigation databases and operating procedures, increased pilot hire costs versus training etc. It is not proportionate at this stage of the ACP for EMA to assess the 'other costs' to commercial airlines of flying PBN procedures.	Other costs to commercial airlines may include updates to Flight Management Systems (FMS), navigation databases and operating procedures, increased pilot hire costs versus training etc. It is not proportionate at this stage of the ACP for EMA to assess the 'other costs' to commercial airlines of flying PBN procedures.
Airport / Air navigation service provider	Infrastructure costs	Initial Options Appraisal: Qualitative	No additional infrastructure is required at EMA to maintain extant conventional procedures; however, maintaining accessibility to current ground-based equipment (operated by NERL) may become prohibitively expensive should a CAP 1781 RNAV substitution not be implemented prior to the proposed removal date.	There are no expected additional infrastructure costs. All options relate to the implementation of PBN and no additional infrastructure is required as the introduction of PBN reduces the reliance on ground infrastructure, in particular ground-based navigation aids are no longer needed.	There are no expected additional infrastructure costs. All options relate to the implementation of PBN and no additional infrastructure is required as the introduction of PBN reduces the reliance on ground infrastructure, in particular ground-based navigation aids are no longer needed.	There are no expected additional infrastructure costs. All options relate to the implementation of PBN and no additional infrastructure is required as the introduction of PBN reduces the reliance on ground infrastructure, in particular ground-based navigation aids are no longer needed.	There are no expected additional infrastructure costs. All options relate to the implementation of PBN and no additional infrastructure is required as the introduction of PBN reduces the reliance on ground infrastructure, in particular ground-based navigation aids are no longer needed.
Airport / Air navigation service provider	Operational costs	Initial Options Appraisal: Qualitative	No change to operational costs is attributable to maintaining the extant procedures.	Some operational costs are anticipated with respect to the implementation of new procedures and training of air traffic controlling staff at EMA; however, these cannot be identified at this stage of the ACP process.	Some operational costs are anticipated with respect to the implementation of new procedures and training of air traffic controlling staff at EMA; however, these cannot be identified at this stage of the ACP process.	Some operational costs are anticipated with respect to the implementation of new procedures and training of air traffic controlling staff at EMA; however, these cannot be identified at this stage of the ACP process.	Some operational costs are anticipated with respect to the implementation of new procedures and training of air traffic controlling staff at EMA; however, these cannot be identified at this stage of the ACP process.
Airport / Air navigation service provider	Deployment costs	Initial Options Appraisal: Qualitative	No deployment costs applicable to extant procedures.	Some deployment costs are anticipated with respect to the implementation of the new departure procedures and training of air traffic controllers; however, these cannot be identified at this stage of the ACP process.	Some deployment costs are anticipated with respect to the implementation of the new departure procedures and training of air traffic controllers; however, these cannot be identified at this stage of the ACP process.	Some deployment costs are anticipated with respect to the implementation of the new departure procedures and training of air traffic controllers; however, these cannot be identified at this stage of the ACP process.	Some deployment costs are anticipated with respect to the implementation of the new departure procedures and training of air traffic controllers; however, these cannot be identified at this stage of the ACP process.
Safety Assessment	Safety Assessment	Initial Options Appraisal: Qualitative	The 'do nothing' scenario assumes that current operations at EMA are safe including use of the extant conventional procedures. Following the removal of ground-based navigational aids, aircraft arriving at EMA would continuously require radar vectoring (should CAP 1781 or a commercial agreement to maintain the existing navigational aid not be implemented), resulting in a possible increase in ATCO workload.	A hazard relating to arrivals from the north was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a northerly or easterly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.	A hazard relating to arrivals from the north was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a northerly or easterly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.	A hazard relating to arrivals from the north was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a northerly or easterly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.	A hazard relating to arrivals from the north was identified where there is the potential for loss of horizontal and/or vertical separation between arriving aircraft conflicting with aircraft departing from EMA in a northerly or easterly direction. This would require ATC tactical intervention and could result in an increase in ATCO workload. This hazard could be further mitigated through the design process or procedurally if required. Further assessment will be conducted during Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
		Summary of Analysis	The 'do nothing' scenario in relation to this ACP is not a viable option as it does not provide a sustainable solution in terms of airspace modernisation. The existing arrival arrangements do not enable continuous descent operations from 7,000ft, which could lead to a greater volume of fuel burn, emissions and noise at lower levels. In terms of Tranquillity, Biodiversity, General Aviation access and Economic impact, the 'do nothing' baseline provides minimal/no change to today's operations. Furthermore, there are very limited costs incurred as a result of this scenario. From a safety perspective, it is assumed that current EMA operations are safe. It is acknowledged that ATCO workload is likely to increase due to the enduring requirement for radar vectoring.	When compared to the 'do nothing' scenario, this option performs: Better in the following areas: - Noise impact from 4,000ft - Noise impact from 7,000ft - Greenhouse gas emissions - Fuel burn - Air Quality Equal/neutral in terms of the remaining criteria because there is no change when compared to today's operation. At this time, it is not possible to fully determine the safety implications of this specific option as this option has been assessed in isolation rather than as a set of design options as part of a wider system. Additional analysis will be required in Stage 3 and 4 of the CAP 1616 process to determine the cumulative impact of this option when compared to all the other options.	When compared to the 'do nothing' scenario, this option performs: Better in the following areas: - Noise impact from 4,000ft - Noise impact from 7,000ft - Greenhouse gas emissions - Fuel burn - Air Quality Equal/neutral in terms of the remaining criteria because there is no change when compared to today's operation. At this time, it is not possible to fully determine the safety implications of this specific option as this option has been assessed in isolation rather than as a set of design options as part of a wider system. Additional analysis will be required in Stage 3 and 4 of the CAP 1616 process to determine the cumulative impact of this option when compared to all the other options.	When compared to the 'do nothing' scenario, this option performs: Worse in the following areas: - Greenhouse gas emissions - Fuel burn Better in the following areas: - Noise impact from 4,000ft - Noise impact from 7,000ft - Air Quality Equal/neutral in terms of the remaining criteria because there is no change when compared to today's operation. At this time, it is not possible to fully determine the safety implications of this specific option as this option has been assessed in isolation rather than as a set of design options as part of a wider system. Additional analysis will be required in Stage 3 and 4 of the CAP 1616 process to determine the cumulative impact of this option when compared to all the other options.	When compared to the 'do nothing' scenario, this option performs: Worse in the following areas: - Greenhouse gas emissions - Fuel burn Better in the following areas: - Noise impact from 4,000ft - Noise impact from 7,000ft - Air Quality Equal/neutral in terms of the remaining criteria because there is no change when compared to today's operation. At this time, it is not possible to fully determine the safety implications of this specific option as this option has been assessed in isolation rather than as a set of design options as part of a wider system. Additional analysis will be required in Stage 3 and 4 of the CAP 1616 process to determine the cumulative impact of this option when compared to all the other options.
			IOA Shortlist Assessment	Based on IOA Shortlist Assessment methodology, Option 17 has been deemed the ACCEPTABLE option within this design envelope.	Based on IOA Shortlist Assessment methodology, Option 18 has been deemed the REJECTED option within this design envelope.	Based on IOA Shortlist Assessment methodology, Option 19 has been deemed the FAVOURABLE option within this design envelope.	Based on IOA Shortlist Assessment methodology, Option 20 has been deemed the PREFERRED option within this design envelope.
			OPTION SHORTLIST CLASSIFICATION FOR STAGE 3	**ACCEPTABLE**	**REJECTED**	**FAVOURABLE**	**PREFERRED**

Figure 15 IOA Full Analysis Table Example (Runway 27 North Arrivals IAF 1)

Appendix A2 – CAP2091

CAP2091[9] describes the 'minimum acceptable level of sophistication of noise modelling' that can be used to provide the CAA with the outputs they require to carry out certain of their statutory duties, including airspace change.

Five noise modelling categories are established which are Category A to Category E. Category A being the most sophisticated and Category E, the least.

As part of the EMA ACP Stage 2 submission, CAP2091 requires the change sponsor to set out and justify the noise modelling category to be adopted in this ACP and to advise which category that EMA currently falls into. This will be a component of the analyses that shall be applied in relation to subsequent stages of the ACP.

The minimum level of sophistication (category) required is dependent upon the size of the current or proposed noise effect of an airport on its local community. *In line with current Government policies for noise, daytime noise annoyance is assumed to start at 51 dB $L_{Aeq, 16h}$ and night time noise at 45 dB $L_{Aeq, 8h}$. These are called the Lowest Observed Adverse Effect Levels (LOAELs). The minimum assessment required by an airspace change sponsor is to see whether the options for change will make a difference to the numbers of residents affected at these levels and the distribution of residents affected by higher levels. The tables below, show the thresholds for each category*[10].

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

Table 1: Thresholds for noise modelling Categories, average summer day, population exposed to 51dB $L_{Aeq, 16h}$ or above

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

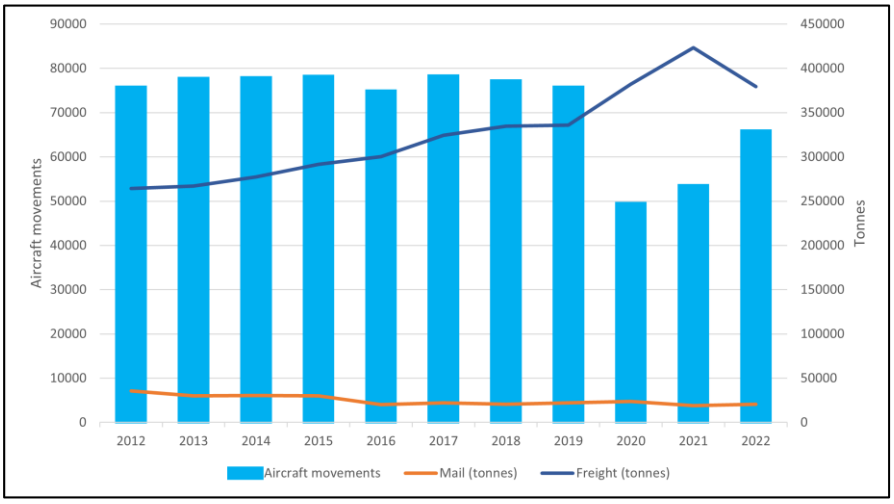
Table 2: Thresholds for noise modelling Categories, average summer night, population exposed to 45dB L_{Aeq}, 8h or above

The number of aircraft arrivals and departures in 2020 and 2021 was significantly affected by the pandemic with a reduced number of passenger aircraft movements and an increased number of cargo movements as shown in Figure 1. Whilst 2022 showed a return towards pre-pandemic trends, instability in the industry continued to impact operations in both passenger and cargo movements.

[9] CAA Policy on Minimum Standards for Noise Modelling www.caa.co.uk/cap2091.
[10] Paragraph 4.4 of CAP2091 (www.caa.co.uk/cap2091).

During 2023, passenger operations have showed a steady recovery towards pre pandemic levels. The number of cargo movements has reduced compared to 2020 and 2021 levels. As EMA operations continue to stabilise, we expect this trend to continue albeit with some cargo growth retained, and for 2023 to be a more representative year. However, in the meantime, the calendar year of 2019 represents the last full year of (pre-pandemic) normal operations and has therefore been used as the baseline for analysis in the DPE and IOA, as it most closely reflects 'normal' operations.

Figure 1:Annual traffic statistics



The results of the 2019 average summer day modelling for EMA are shown below, with the relevant noise contour bands highlighted.

LAeq, 16hr dB	Area (sq. km)	Population	Households
>51	29.0	7,050	2,950
>54	15.2	2,350	1,000
>57	8.3	1,000	450
>60	4.3	550	250
>63	2.2	100	50
>66	1.2	0	0
>69	0.7	0	0
>72	0.4	0	0

Table 3: 2019 average summer day LAeq, $_{16hr}$ contours – estimated areas, populations and households

LAeq, 8hr dB	Area (sq. km)	Population	Households
>45	104.4	32,937	14,070
>48	56.1	19,900	8,500
>55	12.7	1,800	750
>57	8.5	1,000	450
>60	4.5	600	250
>63	2.4	100	50
>66	1.3	0	0

Table 4: 2019 average summer night LAeq, $_{8hr}$ contours – estimated areas, populations and households

From the above results, it could be concluded that Category D is the appropriate level for modelling daytime noise and Category C appropriate for modelling noise levels at night.

However, for a number of years, noise modelling at EMA has voluntarily been carried out to a level of sophistication reflecting a category higher than that mandated by CAP2091- Category B. The 'no decrement' criterion incorporated into CAP2091, requires that '…no airport (or other stakeholder) should do less in terms of its noise modelling than it did on or before January 2020…'. As a result Category B is currently considered to be the appropriate minimum noise modelling level for EMA.

Since there is an obvious need for a consistent standard of noise modelling throughout the airspace change process, CAP2091 requires that air traffic forecasts for a period of 10 years, from the intended year of implementation, are also taken into consideration.

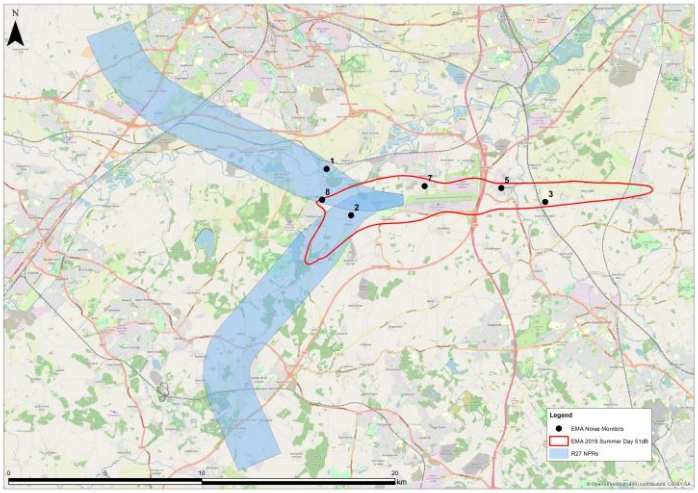
Over this 10-year period (2028 – 2038) the number of flights operating at EMA is forecast to increase by approximately one third, from the number that operated in 2019. Taking this growth into account and given current population estimates, it is considered extremely unlikely that the maximum population threshold for Category B (500,000) will be exceeded.

Based upon the above, it has been concluded that Category B noise modelling will remain applicable for EMA and the requirements of this standard will be adopted throughout this ACP.

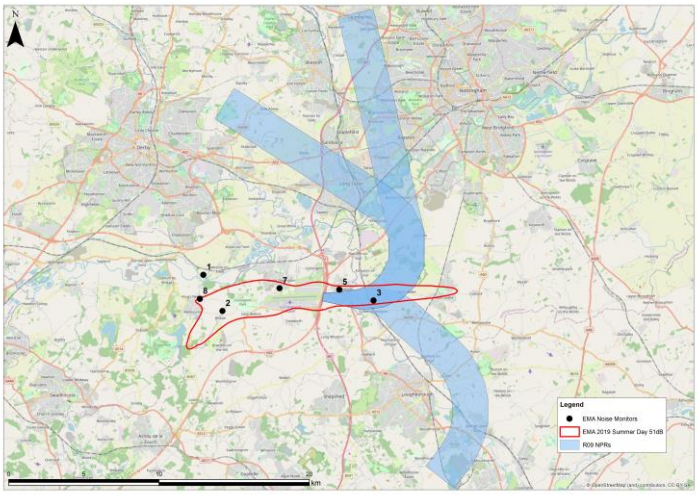
CAP2091 requires that in order for noise modelling to be carried out to the standards of Category B, it is "validated by local noise monitor data for major aircraft types". That is to say, "the main noise dominant aircraft types, which must cover more than 75% of the total noise energy produced by aircraft at that airport".

The requirements, in terms of the number and location of the noise monitoring positions, used to provide this data are specific. CAP2091 states, "We require noise monitoring at a minimum of two different distances from the runway for arrivals and departures respectively. The distances shall be selected to cover the extent of the 51dB $L_{Aeq,\ 16h}$ average summer day noise contour and capture both arrival and departure noise. This will require a minimum of four noise monitor positions. However, in practice, if arrival and departure routes overfly the same point on the ground, a single monitor position will be able to cover both arrival and departure noise, such that the practical minimum number of monitors could be two. Overflight of a position on the ground is defined in CAP1498. This should be applied at the noise monitoring position using a minimum elevation angle of 60°". It is expected that the existing noise monitor array at EMA, would fulfil this requirement.

The image below shows the fixed noise monitoring locations and NPRs to the west of EMA.



The image below shows fixed noise monitoring locations and NPRs to the east of EMA.



MAG
East Midlands
Airport