Initial Options Appraisal – V2

CAP1616 Stage 2 Develop and Assess

MAG Manchester Airport

Document Details

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Amendments	Section	Amendment Description
	2.3	Amendment of wording relating to information to be collected at Final Options Appraisal (FOA)
	2.4	Amendment of High-level Objectives & Assessment Criteria in table 1 table 1
	2.4.1	Amendment of wording in Appraisal Methodology to define approach and for alignment with amended section 7
	2.4.2	Amendment of wording in Appraisal Methodology to define approach and for alignment with amended section 7
	2.5.1	Amendment to wording and inclusion of planned property developments and noise impact on health and quality of life up to 4,000ft
	3.2.1	Updated wording onto reflect the latest position regarding DVOR de-commissioning and the use of CAP1781 RNAV substitution to ensure routes provide a suitable baseline.
	3.3	Amendment of wording to describe 'do nothing' baseline and the use of CAP1781.
	5.1	Amendment of wording to describe use of overflight as a proxy to algin with amendments to section 5.3
	5.3	Amendment of wording and inclusion of planned property developments and households.
	6	Amendment of wording to describe IOA results

	7	Amendment of wording for updated Shortlisting of Design Options. This section now encompasses the IOA Results (previously section 4)
	8	Additional detail of the actions to be taken in Step 3A.
	8.3	Additional text and table detailing the information that will be collected in Stage 3 in support of the FOA. This includes details of air traffic forecasting data.
	9	Glossary - Included additional definitions and text (to a previous definition).
	Appendix A2	Additional text to clarify population estimate.

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1 Introduction

1.1 Document Purpose & Scope

The Manchester Airport (MAN) 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, and the IOA is then conducted. 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 are:

- Stage 2 Summary Document, which draws together the key points from the Stage 2 submission.
- Design Options Evolution (DOE), Appendix A to the Stage 2 Summary Document, shows the evolution of the design options through Steps 2A and 2B of the CAP1616 process. The resulting shortlist of design options will be considered in the Full Options Appraisal (FOA) at Stage 3.
- Design Options Report (DOR), which presents the design options that were progressed to the Design Principle Evaluation, as reported in the Design Principles Evaluation Report (DPE).
- Design Principle Evaluation (DPE), which assesses how aligned the design options are to the design principles and identifies those that warrant further analysis at the next step: the IOA at Step 2B.
- Initial Options Appraisal Report (IOA), this document, which 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. The purpose of the IOA is to provide, at a minimum, a qualitative assessment of each option providing stakeholders and the CAA with the relative differences between impacts, both positive and negative.
- The Stakeholder Engagement Report, which explains how engagement has been used in the processes described in the other Stage 2 documents and records its outputs.

The Stage 2 Summary Document provides details of the Government's national programme of airspace change, the process under CAP1616 and the progress to date of this ACP. This information is not repeated in this report.

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 Full Analysis Table (an example is shown in Appendix in 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

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/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 airspace change proposal 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 WebTAG[2] (although this is not of relevance to the Options Appraisal process until the Full Options Appraisal (FOA) at Stage 3), which constitutes 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 options (including the 'do nothing/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 Section 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 MAN 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 is expanded on within the FOA, which is 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.

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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 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).

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 section 8.3 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 MAN 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 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 WebTAG[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. 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.
	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.

[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]
	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	CAP 1616 requires a safety assessment of the proposal to be undertaken in accordance with CAP 760 (Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases: For Aerodrome Operators and Air Traffic Service Providers).
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 Design Options Evolution (DOE) in the 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 Section 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, position of the Initial Approach Fix (IAF) and by the altitude of the Final Approach Fix (FAF). 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 A1.

2.4.2 Arrivals Combined Assessment

The change sponsor has been in consultation with NERL and understands that the proposed systemised changes for arrivals (as part of the MAN Future Airspace project) will require a common IAF for both the north and the south as the starting point for the design options, which will be used for both runway ends. This is a safety constraint to ensure both ATC and aircrew have the correct information on the intended routing, especially in the event of a communications failure and/or following a change to the runway in use.

Due to this network connectivity constraint, the change sponsor has taken the view that arrival options should deliver benefits for, and be compatible with, both runway approach ends (Runways 05L/05R and Runways 23L/23R). As a result, rather than conducting standalone assessments of individual arrival options for each runway, the change sponsor considered all runways in combination when assessing arrival options.

In carrying out this assessment, the change sponsor has assessed arrival options in terms of how they were described in the Stakeholder Engagement Report (SER), and therefore, the 'envelopes' that have been applied are:

(North/south) applicable to all runways.

Separate assessment for 2,000ft FAF, 2,500ft FAF, 3,000ft FAF and 3,500ft FAF.

This methodology differs from how departures were assessed as it considered all runways in combination, rather than just one runway in isolation.

2.5 IOA Assessment Criteria Considerations

As part of the IOA assessment criteria, certain contextual factors are 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]

[5] Population figures based on CACI database using 2021 census

[6] Residential figures based on OS AddressBase data

- 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. It should be noted that any overflight of these areas above 1,000ft is unlikely to have an impact on local air quality because of mixing and dispersion as specified in CAP1616, Appendix B, paragraph B74. In addition, due to airspace design constraints, any overflight of these areas in the immediate vicinity of MAN (and therefore below 1,000ft) is unavoidable for all design options due to the flight profiles that will be flown by pilots during the two crucial phases of flight (take-off and landing). 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) 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

2.5.2 Climb Gradient

With reference to departures, the current SIDs at MAN (as published within the UK Aeronautical Information Publication[8]) have varying climb gradients, some of which are specifically designed to assist in reducing the impact of aircraft noise on neighbouring towns and villages.

Analysis of the Noise Track Keeping data has shown that, due to advances in aircraft performance, all aircraft that depart MAN 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 MAN 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 was 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 Policy, the arrivals options

[7] Data was collated by CBRE on five-year housing plans. See "Future Housing Sites" in the Glossary for more information.

[8] UK Aeronautical Information Publication (NATS)

have been designed with the intention of providing CDAs to both runway directions, and also sought to apply latest CAA policy on low noise arrivals metrics as detailed in CAP2302. Further details on the CDA descent gradients can be found in the DOR Section 20.

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 Section 2.6.1, has allowed the track mileage associated with each option to be derived. 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 MAN, as published within the UK AIP are currently only designed to reach an altitude of 5,000ft prior to being transferred to another controlling authority.

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 for the comparison of the arrival / transition design option track lengths.

No specific 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 is utilised for 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 MAN (shown in the red oval).

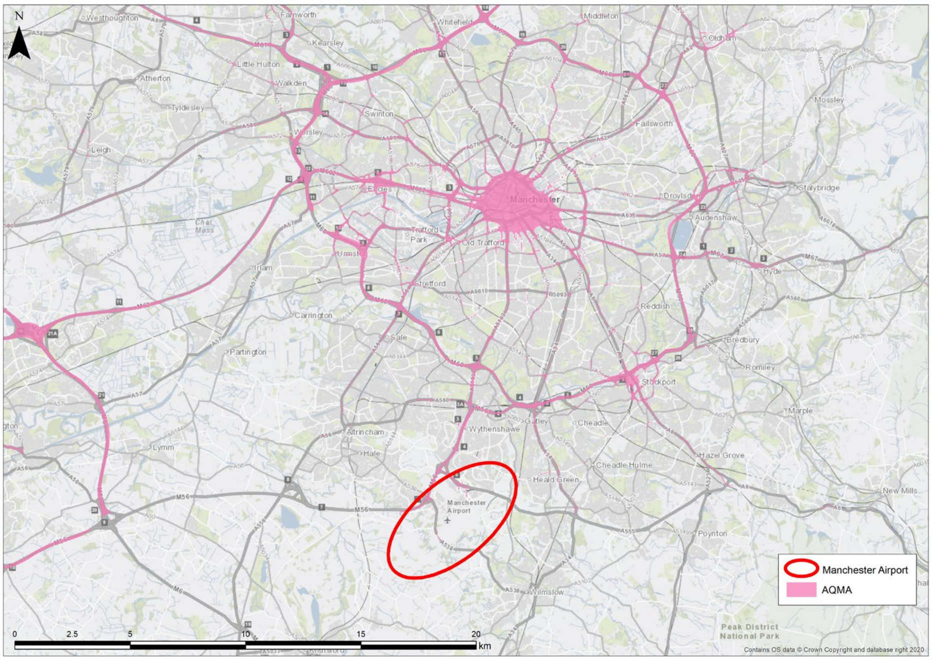


Figure 1 MAN AQMA Map (Source: UK Government)

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 limited change to overflight below 1,000ft. Any overflight of AQMAs below 1,000ft is deemed to be unavoidable due to strict airspace design constraints enabling safe and stable aircraft operations during the two crucial stages of flight (take-off and landing).

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 below shows the registered AONBs (shown in green) closest to MAN (shown in the red oval). These are:

- Forest of Bowland AONB (to the north); and
- Nidderdale AONB (to the north-east).

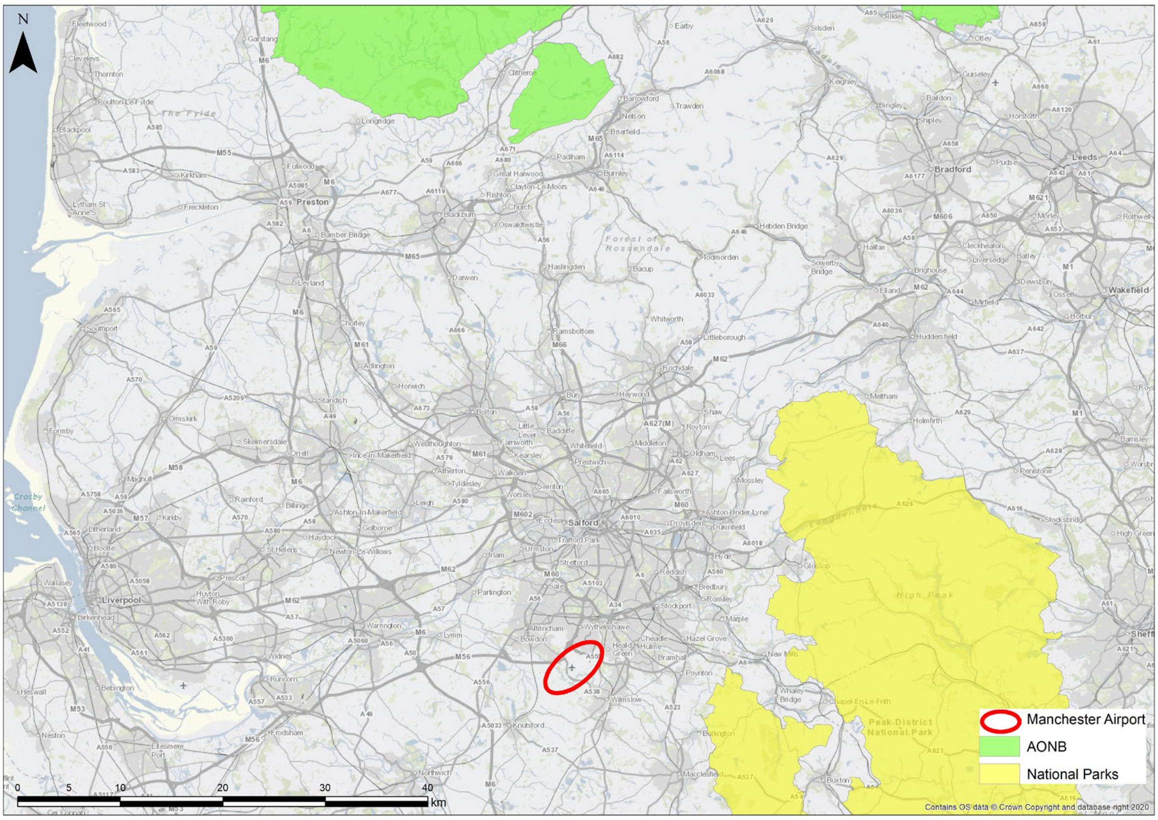


Figure 2 MAN AONB and National Park Map

With regards to AONBs, both the Forest of Bowland and Nidderdale AONBs are assessed as being outside the scope of this ACP as they are a significant distance away from MAN. Any aircraft overflying these areas 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 directly to the east of MAN (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, MAN 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[9]. The UK Government interactive map indicates that there are a number of sites within the vicinity of MAN 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 unlikely to have a significant impact on biodiversity; however, this will be fully assessed at Stage 3 of the CAP1616 process.

[9] 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 [Ref 1] 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)" [Ref 1]

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

MAN 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

In today's operation, aircraft operating to/from MAN rely on ground-based navigational aids known as Doppler VHF [Very High Frequency] Omni-directional Range (DVOR) beacons. For departures, aircraft will usually depart an airfield using a Standard Instrument Departure (SID) which is based upon ground-based navigational aids including DVORs, prior to joining the wider en route airspace structure.

In terms of arriving aircraft, aircraft file flight plans to follow the Standard Terminal Arrival Routes (STARs) that may see them join a hold at DAYNE, ROSUN or MIRSI. However, if there are no anticipated delays, Air Traffic Control (ATC) based at Manchester will provide radar vectors from the point that the aircraft is released from the en route ATC network, until it is established on the final approach. This allows the appropriate sequencing and spacing to be established before the aircraft is guided on to the Instrument Landing System (ILS).

The main beacons applicable to operations at MAN are:

- MANCHESTER (MCT) DVOR
- WALLASEY (WAL) DVOR
- HONILEY (HON) DVOR
- POLE HILL (POL) 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 and allow more efficient navigation-based aircraft systems linked to satellite-based navigation, known as Global Navigation Satellite System (GNSS) to be utilised.

The UK's network of ground-based navigation aids (DVOR's) was programmed for switch-off in December 2022. The switch-off was part of a planned transition to satellite guided operations (performance-based navigation, or PBN). Solutions were explored to mitigate the risk associated with this programmed switch-off 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.

Of the beacons listed above, only the Manchester (MCT) DVOR will be withdrawn. However, this does not remove the change sponsor's obligations to modernise all departure and arrival routes to align with the requirements of the AMS.

The change sponsor is aware of the options available to mitigate for the planned withdrawal of this DVOR. Any mitigations applied are 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. At present, it is assumed that RNAV substitutions shall be established through the process defined in CAP1781. For the purposes of the 'do nothing' baseline that will inform the change sponsor's assessments it is 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. Furthermore, it is also assumed that the implementation of RNAV substitutions under CAP1781 will result in no changes in aircraft behaviour. This is based upon the rationale provided in section 4.4.1 of the DOR which, in summary, states that:

- The CAP1781 process 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.
- The process requires sponsors to undertake pre and post monitoring of track keeping in order to assure this track keeping requirement is met.

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.

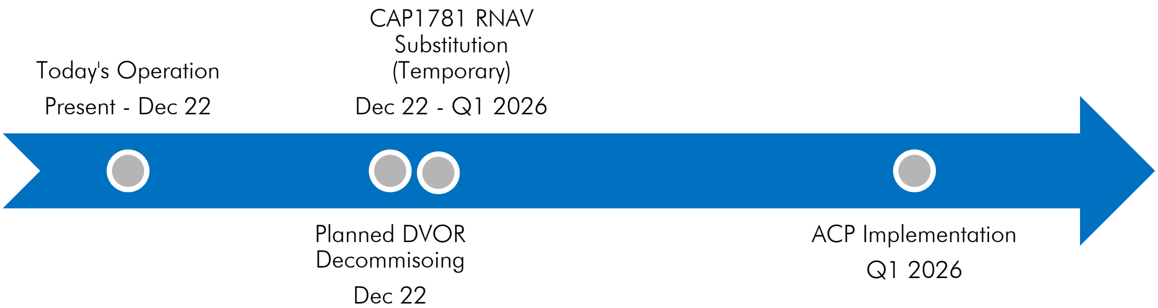


Figure 1 Illustrative Progression of Planned DVOR Decommissioning

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 MCT 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 Policy.

For arrivals, the 'do nothing' scenario assumes the continued use of the existing holds at DAYNE, MIRSI and ROSUN, 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 Policy.

Therefore, neither the 'do nothing' departures or arrivals scenarios represent feasible options to implement, but they 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. Furthermore, as this ACP captures all four runways available at MAN (Runways 05L, 05R, 23L and 23R), appropriate 'do nothing' scenarios have been selected for each runway orientation.

3.3.1 Departures

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

- POL
- SONEX (Runways 23R/23L only)
- DESIG (Runways 05L/05R only)
- MONTY (Runways 23R/23L only)
- LISTO
- SANBA (Runways 23R/23L only)
- ASMIM (Runways 05L/05R only)
- EKLAD (Runways 23R/23L only)
- KUXEM (Runways 23R/23L only)

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 could 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, and other factors such as ATC instructions for either safety or expedition.

In many cases, aircraft are routed off the SID (once they have climbed above the PNR altitude) and may be tactically vectored by ATC to provide a more expeditious routing. For these reasons, 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.

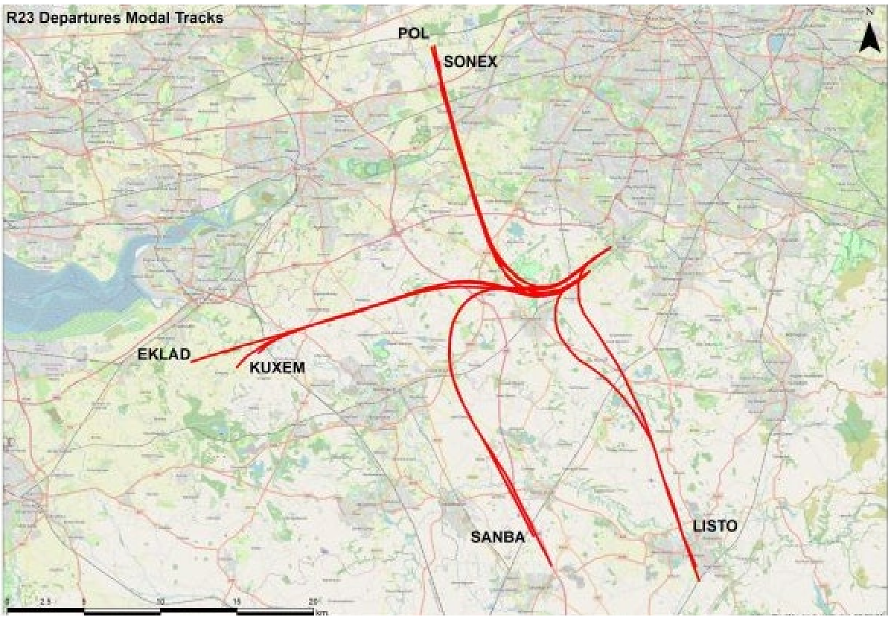


Figure 5 Runways 23R/23L Departures Modal tracks

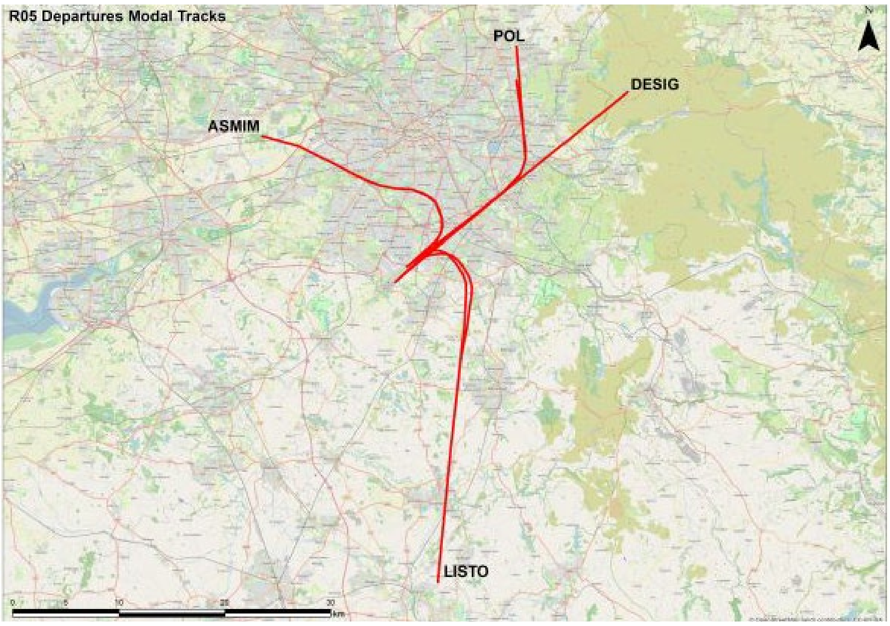


Figure 6 Runways 05L/05R Departures Modal tracks

Furthermore, the modelling of the baseline modal tracks has considered a variety of climb gradients, calculated 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 actually 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.

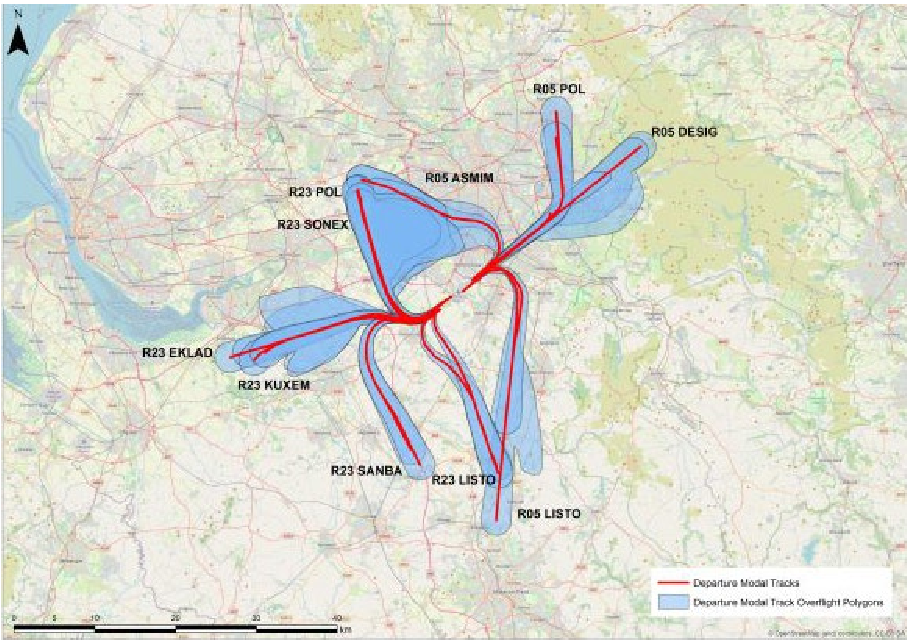


Figure 7 MAN Runways 05L/05R and Runways 23R/23L Departure Baseline Modal Tracks with Radar Vectoring Areas

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

In today's operation, aircraft can be transferred to the control of MAN for an arrival from any direction. This means that arrival routes to MAN are usually dispersed over a wide area. Most MAN arrivals are presented from both north and south to the Runways 23R/23L/05L/05R during busy periods, to ensure that runway capacity is managed safely. Aircraft may be required to join the northerly ATC holds at MIRSI, ROSUN or the southerly hold at DAYNE. Once an aircraft is established in the hold, racetrack like patterns at 1,000ft intervals are adopted and flown until ATC are in a position to clear the aircraft to continue with its final approach.

To enable the final approach at MAN, ATC at MAN, in coordination with en route network colleagues, provide aircraft with radar vectors to establish the aircraft on the ILS for its final approach. Radar vectoring is a technique 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 over the ground caused by sequencing, turning ability of aircraft and approach speeds; however, in general, the direction of the tracks remains the same. Due to the use of radar vectoring, aircraft currently making an approach to MAN cumulatively fly over a greater area (more widely dispersed); however, the frequency of overflight within a specific location is likely to be lower as a result 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 23) and Figure 9 (Runway 05) below. This allows for consistent assessment within the IOA, when comparing the proposed arrival/transition design options to the 'do nothing' scenario.

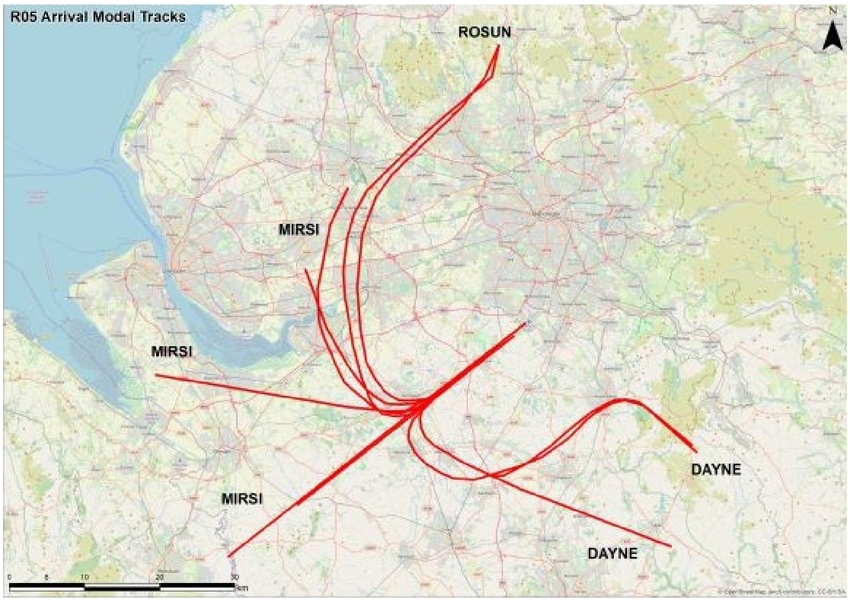


Figure 8 Modal Radar Vectoring Tracks for Runways 05L/05R Arrivals

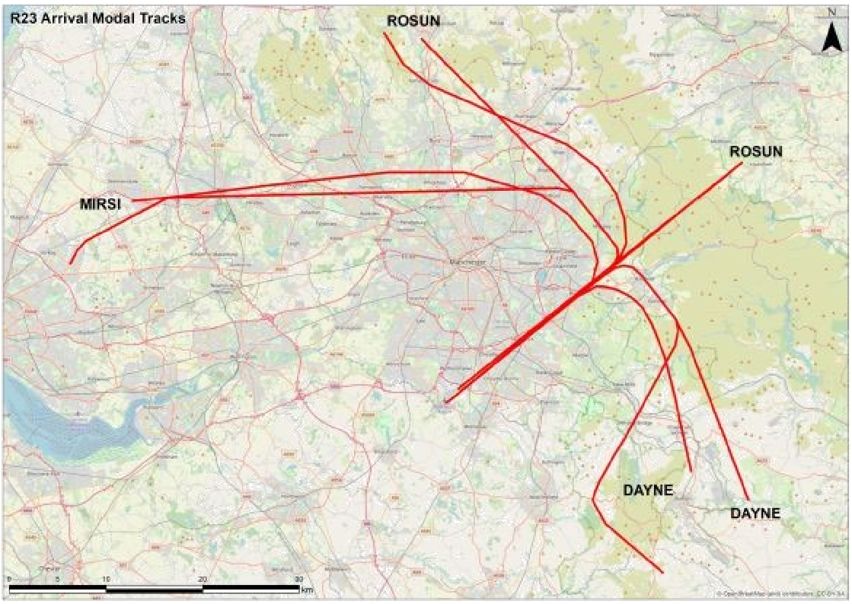


Figure 9 Modal Radar Vectoring Tracks for Runways 23R/23L Arrivals

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 (Runway 23) and Figure 11 (Runway 05) below. In doing so, the change sponsor aims to show complete transparency in using the data relating to tracks actually flown by aircraft today as a comparator.

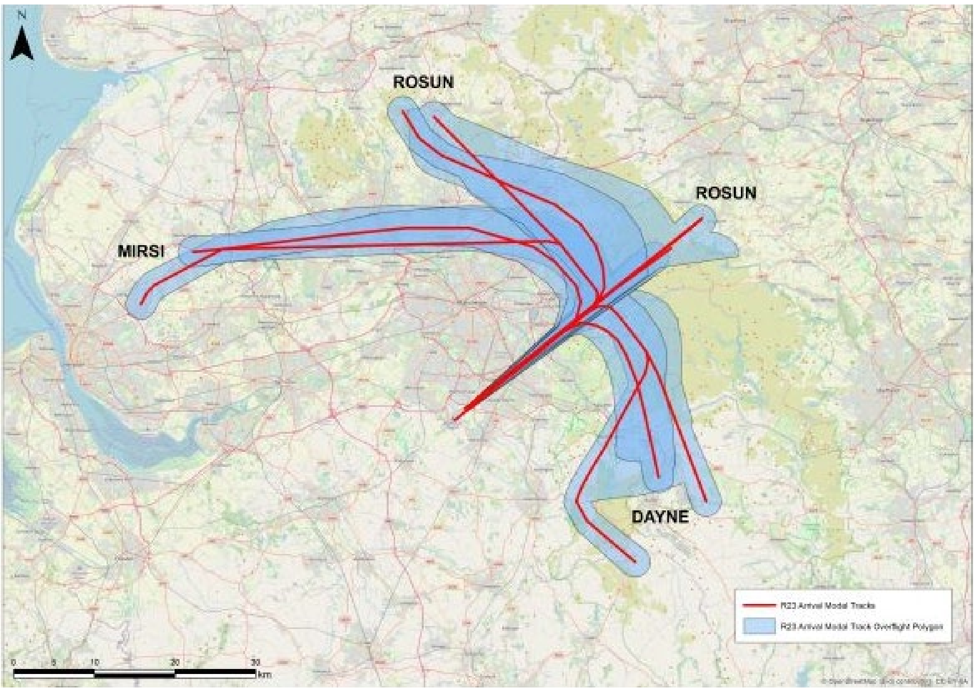


Figure 10 MAN Runways 23R/23L Arrivals/Transitions Baseline Modal Tracks with Radar Vectoring Areas.

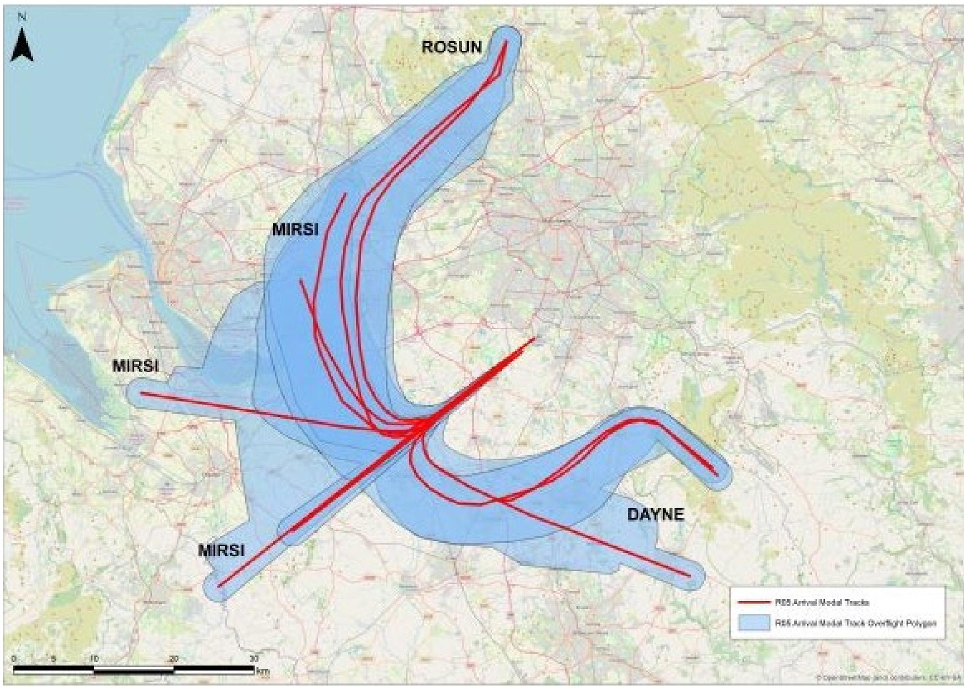


Figure 11 MAN Runways 05L/05R Arrivals/Transitions Baseline Modal Tracks with Radar Vectoring Areas

3.4 The Do Minimum Option

The full description and rationale for the 'do minimum' options is 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 MAN Fleet Equipage Survey.

However, if the 'do minimum' option for departures were to be limited to a replication of the current routes, there would be a number of limitations specifically in respect to the 'must have' Design Principle Capacity. This would mean the 'do minimum' option would not represent an 'informed view of the future' or describe the minimum changes required to address both the issues with the 'do nothing' scenario or the issues identified in the SoN. To address these issues and to meet the requirements of CAP1616, the 'do minimum' option for departures also incorporates the removal or relaxation of the restriction that is currently applied to the use of LISTO.

The 'do minimum' for arrivals would incorporate the use of the existing RNAV holds at DAYNE, MIRSI and ROSUN, ATC vectoring aircraft onto final approach and a final approach based upon final approach procedures designed to both PBN (RNP APCH) standards and ILS. By providing PBN Approach procedures, this addresses the issues associated with the 'do nothing' arrivals scenario and aligns with the 'must have' Design Principle Policy.

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 Section 2.6.3.

The selection of 6% is based upon the MAN Fleet Equipage Survey and engagement with aircraft operators. These tracks are contained within each of the Runways 05L/05R and Runways 23R/23L design envelopes. Figure 12 below shows an example of the replication that has been designed for the POL SID for Runways 05L/05R.

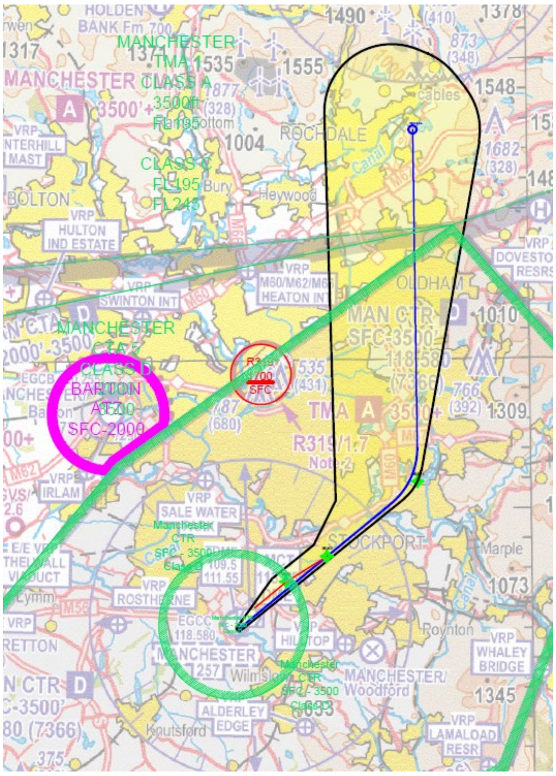


Figure 12 RNAV Replication of Existing POL SID

The route shown above is an RNAV1 replication and 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 Runways 05L/05R and Runways 23R/23L at MAN.

3.4.2 Arrivals/Transitions

For the arrivals 'do minimum', there are currently no conventional transitions designed for MAN that take aircraft from the airborne hold to the final approach. There are therefore no procedures that can be created as a PBN replication as a 'do minimum' option. In addition, since aircraft arriving at MAN 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 current holds of DAYNE, MIRSI and ROSUN, combined with ATC vectoring of aircraft onto final approach from these holds, and a PBN compliant final approach design.

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 CAP 1616, 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; 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 stages 3 and 4 of this ACP.

3.5.2 Arrivals/Transitions

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

- Use of the existing RNAV holds at DAYNE, MIRSI and ROSUN. These holds would remain in their existing location.
- ATC vectoring aircraft onto final approach from these holds.
- Final approach would be 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:

- Use of the existing RNAV holds at DAYNE, MIRSI and ROSUN. Because these are the responsibility of NERL, it is assumed that these holds will remain in their existing location.
- ATC vectoring aircraft onto final approach from these holds.
- Final approach available via both RNP APCH and ILS, which aligns with requirements of the AMS.

3.6 IOA Baseline Scenario Summary

To aid clarity, Table 3 (that follows) presents the baseline scenarios used for comparison within the IOA.

Baseline	Scenario	Variations
'Do nothing' – departures	The existing SIDs utilising MONTY, ASMIM, EKLAD, KUXEM, SONEX, DESIG, LISTO, POL and SANBA.	Modal track of existing Runway 05L ASMIM SID at a calculated climb gradient
		Modal track of existing Runway 05L DESIG SID at a calculated climb gradient
		Modal track of existing Runway 05L POL SID at a calculated climb gradient
		Modal track of existing Runway 05L LISTO SID at a calculated climb gradient
		Modal track of existing Runway 05R ASMIM SID at a calculated climb gradient
		Modal track of existing Runway 05R DESIG SID at a calculated climb gradient
		Modal track of existing Runway 05R POL SID at a calculated climb gradient
		Modal track of existing Runway 05R LISTO SID at a calculated climb gradient
		Modal track of existing Runway 23L MONTY SID at a calculated climb gradient
		Modal track of existing Runway 23L EKLAD SID at a calculated climb gradient
		Modal track of existing Runway 23L KUXEM SID at a calculated climb gradient
		Modal track of existing Runway 23L LISTO SID at a calculated climb gradient
		Modal track of existing Runway 23L POL SID at a calculated climb gradient
		Modal track of existing Runway 23L SONEX SID at a calculated climb gradient
		Modal track of existing Runway 23L SANBA SID at a calculated climb gradient
		Modal track of existing Runway 23R MONTY SID at a calculated climb gradient
		Modal track of existing Runway 23R EKLAD SID at a calculated climb gradient
		Modal track of existing Runway 23R KUXEM SID at a calculated climb gradient
		Modal track of existing Runway 23R LISTO SID at a calculated climb gradient
		Modal track of existing Runway 23R POL SID at a calculated climb gradient
		Modal track of existing Runway 23R SONEX SID at a calculated climb gradient
		Modal track of existing Runway 23R SANBA SID at a calculated climb gradient
		Modal track of existing Runway 23R MONTY SID at a calculated climb gradient
'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 05L/05R
		Modal radar vectoring pattern from a southerly direction to Runway 05L/05R
		Modal radar vectoring pattern from a northerly direction to Runway 23L/23R
		Modal radar vectoring pattern from a southerly direction to Runway 23L/23R

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. MAN 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 6th October 2021, during which the hazards, causes and consequences relating to MAN ACP design envelopes/areas were discussed. The meeting was attended by ATC Subject Matter Experts (SMEs) from both MAN, Liverpool John Lennon Airport (LPL) and NATS alongside airline representatives, Airspace Project Managers/Consultants and an Aviation Safety Practitioner, who facilitated the workshop.

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

Following the HAZID workshop held in October 2021, an additional departure envelope (Runway 05 South-west) was created and as such, this departure envelope was not assessed during the October 2021 workshop. To address this, the change sponsor completed an additional HAZID review which covered the new design envelope. It was not deemed proportionate to conduct a full workshop, for one envelope, so the review was conducted by SMEs who concluded that the hazards present to the new envelope, were similar to that present in another (existing envelope). This enabled the Safety Case Part 1 to be updated. The non-technical summary is set out at Section 5.3, 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
Runways 05L/05R North	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a Missed Approach Procedure (MAP) may conflict with aircraft on the SID. This is an extant hazard. In addition, it was identified that the options within this envelope may conflict with Leeds Bradford Airport (LBA) IFPs and potentially with aircraft operating on the L975 Lower ATS route, both of which can be mitigated through the design process. Furthermore, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Again, this can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 05L/05R East	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, it was identified that the options within this envelope may conflict with on the L975 Lower ATS route and there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Both hazards can be mitigated through the design process or procedurally if required. Furthermore, there is the potential for aircraft to 'drop out' of CAS due to the base level limits of CAS. However, this can be mitigated by designing the procedure to remain within CAS. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 05L/05R South (Left Turn)	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, options within this envelope may conflict with MAN arrivals/transitions and aircraft inbound to Liverpool John Lennon Airport (LPL). In some cases, ATC intervention is required to mitigate this, but it is expected that the introduction of PBN IFPs and the application of the design process (reducing the need for ATC intervention in the future) or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Runways 05L/05R South (Right Turn)	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with MAN arrivals/transitions. Both of which can be mitigated through the design process. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 05L/05R West	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, options within this envelope may conflict with MAN arrivals/transitions and aircraft inbound to LPL. In some cases, ATC intervention is required to mitigate this, but it is expected that the introduction of PBN IFPs and the application of the design process will reduce the need for ATC intervention in the future. Additionally, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation, which can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 05L/05R South-west	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, options within this envelope may conflict with MAN arrivals/transitions and aircraft inbound to LPL. In some cases, ATC intervention is required to mitigate this, but it is expected that the introduction of PBN IFPs and the application of the design process will reduce the need for ATC intervention in the future. Additionally, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation, which can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
SID Runways 23L/23R North	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, options within this envelope may conflict with the L975 Lower ATS route, MAN arrivals/transitions, aircraft inbound to LPL and

	some General Aviation (GA) aircraft operating at low level. Furthermore, there is the potential for 'drop out' of CAS due to the base level limits of CAS. These hazards can be mitigated through the design process. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 23L/23R East (Right Turn)	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with the L975 Lower ATS route, aircraft inbound to LPL, MAN arrivals/transitions and some GA aircraft operating at low level. These hazards can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 23L/23R East (Left Turn)	Possible hazards have been identified, some of which are extant. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with the L975 Lower ATS route, aircraft inbound to Liverpool, MAN arrivals/transitions and some GA aircraft operating at low level. These hazards can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stage 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 23L/23R South	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with LPL traffic and some GA aircraft operating at low level. These hazards can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 23L/23R South-west	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In

	addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with LPL traffic and some GA aircraft operating at low level. These hazards can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 23L/23R West	Possible hazards have been identified, some of which are extant and are currently mitigated through ATC procedures, which have been approved via a CAA endorsed safety case. Firstly, aircraft executing a MAP may conflict with aircraft on the SID. This is an extant hazard. In addition, there is the potential for faster aircraft to catch up with slower aircraft due to dispersion in the turn, which may lead to a loss of separation. Furthermore, options within this envelope may conflict with LPL traffic, MAN arrivals/transitions and some GA aircraft operating at low level. These hazards can be mitigated through the design process or procedurally if required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Table 3 MAN Departures High-level Safety Assessment

4.3.3 Arrivals/Transitions

Design Area	High-level Safety Assessment
Runways 23L/23R Transition	The only hazard identified was the potential conflict with MAN proposed SIDs causing a possible loss of horizontal/vertical separation, causing an increase in ATCO workload. This hazard can be mitigated through the design process. Work has already commenced to understand and resolve the interactions with LPL where required. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.
Runways 05L/05R Transition	The only hazard identified was the potential conflict with MAN proposed SIDs causing a possible loss of horizontal/vertical separation, causing an increase in ATCO workload. This hazard can be mitigated through the design process. Further assessment will be conducted at Stages 3 and 4 of the CAP1616 process to confirm the exact nature of all hazards and mitigations.

Table 4 MAN 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 2.

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°.

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.

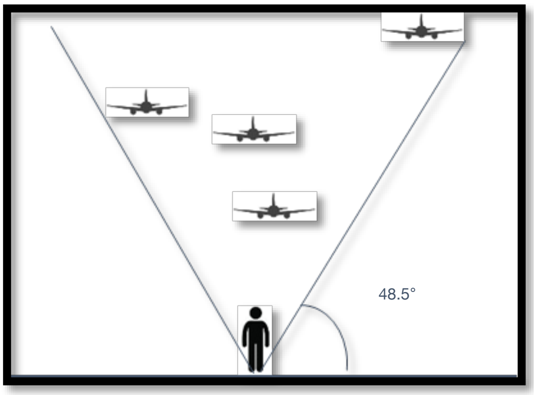


Figure 13 48.5° Overflight Cone

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.

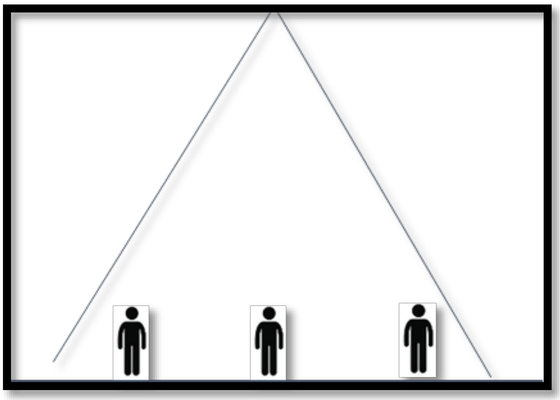


Figure 14 Overflight Cone

6 Initial Option Appraisal Table Results

6.1 Introduction

This section provides some 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) and by the altitude of the Final Approach Fix (FAF). 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 A1.

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 or Rejected option. Design options awarded a classification of Preferred, Favourable, or Acceptable will be further considered and assessed during Stage 3. The option classifications are defined in para 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 4,000ft. 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 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, focusing 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 or transitions FAF altitude group 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 FAF altitude group.
Favourable	This option is considered favourable as it is second-best performing within the departures design envelope or transitions FAF altitude group.
Acceptable	This option is considered acceptable as it is third-best performing within the departures design envelope or transitions FAF altitude group.
Rejected	This option is rejected as it is not preferred, not considered favourable nor considered acceptable within the departures design envelope or transitions FAF altitude group.
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.
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 ANG 2017 para 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 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 and transition, an option classification was entered onto the IOA Assessment table.

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-N programme, 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 the Manchester Terminal Manoeuvring Area (MTMA) cluster. 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 where possible to take through three options (Preferred, Favourable and Acceptable, as defined in Section 7.2 above) from each design envelope or transitions FAF altitude group, even if they were assessed to perform worse than the baseline. All options 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 design options and the option classification for each design option. Those classed as Preferred, Favourable and Acceptable will become the final shortlist of options forward to be taken forward to Stage 3.

RUNWAY 05 DEPARTURES SHORTLIST RESULTS

Key:

Preferred	
Favourable	
Acceptable	
Rejected	
Not Assessed	

Design Envelope	Runway 05L	Runway 05R
NORTH	R05_D_N_O1_L	R05_D_N_O1_R
NORTH	R05_D_N_O4_L	R05_D_N_O4_R
EAST	R05_D_E_O1_L	R05_D_E_O1_R
EAST	R05_D_E_O4_L	R05_D_E_O4_R
EAST	R05_D_E_O5_L	R05_D_E_O5_R
EAST	R05_D_E_O6_L	R05_D_E_O6_R
EAST	R05_D_E_O7_L	R05_D_E_O7_R
EAST	R05_D_E_O8_L	R05_D_E_O8_R
SOUTH (RIGHT)	R05_D_S_O1_L	R05_D_S_O1_R
SOUTH (RIGHT)	R05_D_S_O3_L	R05_D_S_O3_R
SOUTH (RIGHT)	R05_D_S_O6A_L	R05_D_S_O6A_R
SOUTH (RIGHT)	Nil	R05_D_S_O6B_R
SOUTH (LEFT)	R05_D_S_O8_L	R05_D_S_O8_R
SOUTH (LEFT)	R05_D_S_O9_L	R05_D_S_O9_R
SOUTH (LEFT)	R05_D_S_O10_L	R05_D_S_O10_R
WEST	R05_D_W_O1_L	R05_D_W_O1_R
WEST	R05_D_W_O4B_L	R05_D_W_O4B_R
WEST	R05_D_W_O6A_L	R05_D_W_O6A_R
WEST	R05_D_W_O7_L	R05_D_W_O7_R
SOUTHWEST	Nil	R05_D_SW_O1_R
SOUTHWEST	Nil	R05_D_SW_O2A_R
SOUTHWEST	Nil	R05_D_SW_O2B_R
SOUTHWEST	Nil	R05_D_SW_O3A_R
SOUTHWEST	Nil	R05_D_SW_O3B_R
SOUTHWEST	R05_D_SW_O4B_L	R05_D_SW_O4B_R
SOUTHWEST	R05_D_SW_O5_L	R05_D_SW_O5_R

MAG Manchester Airport

RUNWAY 23 DEPARTURES SHORTLIST RESULTS

Key:

Preferred	
Favourable	
Acceptable	
Rejected	
Not Assessed	

23 Baseline	Runway 23L	Runway 23R
NORTH (POL)	R23_D_N_O1A_L	R23_D_N_O1A_R
NORTH (POL)	Nil	R23_D_N_O1B_R
NORTH (POL)	R23_D_N_O2B_L	R23_D_N_O2B_R
NORTH (POL)	R23_D_N_O3_L	R23_D_N_O3_R
NORTH (POL)	R23_D_N_O4A_L	R23_D_N_O4A_R
NORTH (POL)	R23_D_N_O4B_L	R23_D_N_O4B_R
NORTH (POL)	R23_D_N_O6A_L	R23_D_N_O6A_R
NORTH (POL)	R23_D_N_O6B_L	R23_D_N_O6B_R
NORTH (POL)	R23_D_N_O7_L	R23_D_N_O7_R
EAST (RIGHT)(SONEX)	R23_D_E_O1A_L	R23_D_E_O1A_R
EAST (RIGHT)(SONEX)	R23_D_E_O1C_L	R23_D_E_O1C_R
EAST (RIGHT)(SONEX)	Nil	R23_D_E_O4A_R
EAST (RIGHT)(SONEX)	R23_D_E_O4B_L	R23_D_E_O4B_R
EAST (RIGHT)(SONEX)	Nil	R23_D_E_O5_R
EAST (LEFT)(SONEX)	R23_D_E_O6A_L	R23_D_E_O6A_R
EAST (LEFT)(SONEX)	R23_D_E_O6B_L	R23_D_E_O6B_R
EAST (LEFT)(SONEX)	R23_D_E_O6C_L	R23_D_E_O6C_R
EAST (LEFT)(SONEX)	R23_D_E_O8A_L	R23_D_E_O8A_R
EAST (LEFT)(SONEX)	R23_D_E_O8B_L	R23_D_E_O8B_R
EAST (LEFT)(SONEX)	R23_D_E_O8C_L	R23_D_E_O8C_R
SOUTH (SANBA)	R23_D_S_O1_L	R23_D_S_O1_R
SOUTH (SANBA)	R23_D_S_O4A_L	R23_D_S_O4A_R
SOUTH (SANBA)	R23_D_S_O4C_L	R23_D_S_O4C_R
SOUTH (SANBA)	R23_D_S_O5C_L	R23_D_S_O5C_R
SOUTH (SANBA)	R23_D_S_O6_L	R23_D_S_O6_R
SOUTH (SANBA)	R23_D_S_O7B_L	R23_D_S_O7B_R
SOUTH (LISTO)	R23_D_S_O2A_L	R23_D_S_O2A_R
SOUTH (LISTO)	R23_D_S_O2B_L	R23_D_S_O2B_R
SOUTH (LISTO)	R23_D_S_O5A_L	R23_D_S_O5A_R
SOUTH (LISTO)	R23_D_S_O5B_L	R23_D_S_O5B_R
WEST (EKLAD)	R23_D_W_O7_L	R23_D_W_O7_R
WEST (EKLAD)	R23_D_W_O8_L	R23_D_W_O8_R
WEST (EKLAD)	R23_D_W_O9_L	R23_D_W_O9_R
WEST (EKLAD)	R23_D_W_O10_L	R23_D_W_O10_R
WEST (EKLAD)	R23_D_W_O11_L	R23_D_W_O11_R
WEST (EKLAD)	R23_D_W_O12_L	R23_D_W_O12_R
SOUTHWEST (EKLAD)	R23_D_SW_O1D_L	R23_D_SW_O1D_R
SOUTHWEST (MONTY)	R23_D_SW_O1A_L	R23_D_SW_O1A_R
SOUTHWEST (KUXEM)	Nil	R23_D_SW_O1B_R
SOUTHWEST (KUXEM)	R23_D_SW_O1C_L	R23_D_SW_O1C_R
SOUTHWEST (KUXEM)	Nil	R23_D_SW_O3B_R
SOUTHWEST (KUXEM)	Nil	R23_D_SW_O3C_R
SOUTHWEST (KUXEM)	R23_D_SW_O6_L	R23_D_SW_O6_R
SOUTHWEST (KUXEM)	R23_D_SW_O7A_L	R23_D_SW_O7A_R
SOUTHWEST (KUXEM)	R23_D_SW_O7B_L	R23_D_SW_O7B_R
SOUTHWEST (KUXEM)	R23_D_SW_O8_L	R23_D_SW_O8_R
SOUTHWEST (KUXEM)	Nil	R23_D_SW_O10_R

RUNWAY 05 ARRIVALS SHORTLIST RESULTS

Key:

Preferred	
Favourable	
Acceptable	
Rejected	

		05 Baseline	Runway 05L	Runway 05R
NORTH				
2000	IAF 12	ROSUN	R05_A_N_O13_2000_L	R05_A_N_O13_2000_R
2500	STEAK	ROSUN	R05_A_N_O1B_2500_L	R05_A_N_O1B_2500_R
	IAF 3	ROSUN	R05_A_N_O8B_2500_L	R05_A_N_O8B_2500_R
	IAF 4	ROSUN	R05_A_N_O9B_2500_L	R05_A_N_O9B_2500_R
	IAF 5	MIRSI	R05_A_N_O10B_2500_L	R05_A_N_O10B_2500_R
	STEAK	ROSUN	R05_A_N_O2B_2500_L	R05_A_N_O2B_2500_R
3000	STEAK	ROSUN	R05_A_N_O1A_3000_L	R05_A_N_O1A_3000_R
	IAF 3	ROSUN	R05_A_N_O8A_3000_L	R05_A_N_O8A_3000_R
	IAF 4	ROSUN	R05_A_N_O9A_3000_L	R05_A_N_O9A_3000_R
	STEAK	ROSUN	R05_A_N_O2A_3000_L	R05_A_N_O2A_3000_R
SOUTH				
2500	TURKY	DAYNE	R05_A_S_O1B_2500_L	R05_A_S_O1B_2500_R
	IAF 7	DAYNE	R05_A_S_O6B_2500_L	R05_A_S_O6B_2500_R
	IAF 8	DAYNE	R05_A_S_O7B_2500_L	R05_A_S_O7B_2500_R
	IAF 9	DAYNE	R05_A_S_O8B_2500_L	R05_A_S_O8B_2500_R
	IAF 10	DAYNE	R05_A_S_O9B_2500_L	R05_A_S_O9B_2500_R
SOUTH				
3000	TURKY	DAYNE	R05_A_S_O1A_3000_L	R05_A_S_O1A_3000_R
	IAF 7	DAYNE	R05_A_S_O6A_3000_L	R05_A_S_O6A_3000_R
	IAF 8	DAYNE	R05_A_S_O7A_3000_L	R05_A_S_O7A_3000_R
	IAF 9	DAYNE	R05_A_S_O8A_3000_L	R05_A_S_O8A_3000_R
	IAF 10	DAYNE	R05_A_S_O9A_3000_L	R05_A_S_O9A_3000_R

RUNWAY 23 ARRIVALS SHORTLIST RESULTS

Key:

Preferred	
Favourable	
Acceptable	
Rejected	

		23 Baseline	Runway 23L	Runway 23R
NORTH				
3000	IAF 4	ROSUN	R23_A_N_O7B_3000_L	R23_A_N_O7B_3000_R
	IAF 12	MIRSI	R23_A_N_O11B_3000_L	R23_A_N_O11B_3000_R
	IAF 5	ROSUN	R23_A_N_O3B_3000_L	R23_A_N_O3B_3000_R
3500	STEAK	MIRSI	R23_A_N_O1A_3500_L	R23_A_N_O1A_3500_R
	IAF 4	ROSUN	R23_A_N_O7A_3500_L	R23_A_N_O7A_3500_R
	IAF 3	MIRSI	R23_A_N_O8A_3500_L	R23_A_N_O8A_3500_R
	IAF 12	MIRSI	R23_A_N_O11A_3500_L	R23_A_N_O11A_3500_R
	IAF 5	ROSUN	R23_A_N_O3A_3500_L	R23_A_N_O3A_3500_R
SOUTH				
3000	TURKY	DAYNE	R23_A_S_O1B_3000_L	R23_A_S_O1B_3000_R
	TURKY	DAYNE	R23_A_S_O2B_3000_L	R23_A_S_O2B_3000_R
	IAF 8	DAYNE	R23_A_S_O6B_3000_L	R23_A_S_O6B_3000_R
	IAF 9	DAYNE	R23_A_S_O7B_3000_L	R23_A_S_O7B_3000_R
	IAF 10	DAYNE	R23_A_S_O8B_3000_L	R23_A_S_O8B_3000_R
	IAF 7	DAYNE	R23_A_S_O9B_3000_L	R23_A_S_O9B_3000_R
3500	TURKY	DAYNE	R23_A_S_O1A_3500_L	R23_A_S_O1A_3500_R
	TURKY	DAYNE	R23_A_S_O2A_3500_L	R23_A_S_O2A_3500_R
	IAF 8	DAYNE	R23_A_S_O6A_3500_L	R23_A_S_O6A_3500_R
	IAF 9	DAYNE	R23_A_S_O7A_3500_L	R23_A_S_O7A_3500_R
	IAF 10	DAYNE	R23_A_S_O8A_3500_L	R23_A_S_O8A_3500_R
	IAF 7	DAYNE	R23_A_S_O9A_3500_L	R23_A_S_O9A_3500_R

Table 6 Shortlist Results

8 Next Steps

8.1 Developing and assessing operating networks

8.1.1

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

8.1.2

Design options carried forward to Step 2B have been subject to this Initial Options Appraisal. The findings are set out here and in the accompanying assessment tables. This IOA has enabled us to identify a shortlist of design options.

8.1.3

The shortlist of design options has benefited from extensive engagement with stakeholders, including the general public. Amongst the stakeholders were other sponsors of airspace change, including NATS as the enroute airspace provider. Therefore, we are confident that our proposals are flexible enough to provide compatibility with proposals emerging from other change sponsors, in so far as they are known at this time. However, it is still likely that some of our design options will be difficult to integrate with the proposals from other sponsors.

Therefore, we will continue to work with other sponsors, including NATS, to ensure that collectively we optimise operations with the MTMA. This will include providing information to NATS to inform their visualisation and development simulations, which will test the emerging concepts. It is likely that to optimise the MTMA trade-off decisions will need to be made between incompatible airport design options and where this is the case, we will undertake the necessary cumulative assessment of options in accordance with emerging guidance from ACOG. This process may mean that our consideration of some options shortlisted in Stage 2B are discontinued, or some options previously classified as rejected may be reconsidered or require modification in order to continue in the process. Where this is the case, we will set out our rationale and supporting evidence so that stakeholders have the opportunity to comment during the consultation exercise at Stage 3.

This work will allow us to combine our design options into operating networks. Defining networks of routes that support operations to and from MAN will allow us to undertake the more detailed assessment required at Stage 3 and it will also 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 4,000 feet.

8.1.4

This IOA is the first of three appraisals required under the CAP1616 process. The operating networks that result from the steps we set out at 8.1.4 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 also 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 this 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 that estimate aircraft activity at the year of implementation and the ten years after implementation. To allow the networks that we are considering to be compared to today's operations, we will also prepare air traffic forecasts for a 'do nothing' scenario, that reflects the way we operate today and a 'do minimum' scenario, that reflects an informed view of the future and the minimum changes required to address the issues that mean "doing nothing" is not a feasible option in reality, as well as the issues identified in our statement of need.

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 enroute network and adjacent airports. These include noise, emissions, capacity and safety. In defining the full range of criteria that we will assess in the FOA we will be guided by CAP1616 and will take account of the information in Appendices B and E.

Our proposed 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 8.3.

8.1.5

Our Design Principle Airspace states that the amount of Controlled Airspace (CAS) required should be minimised, to ensure the needs of other airspace users are considered. This requirement is also reflected in our Design Principle Policy, which considers the ends of the AMS, including the Integration end, which calls for a transition towards greater integration of air traffic including GA and the military. However, due to the potential for routes to be refined or amended, as referred to in 8.1.3, it would be premature to define future CAS requirements at this stage. As such, CAS requirements for groups of design options will be identified during Stage 3. All stakeholders will be provided with an indication of the CAS requirements within the Step 3C consultation material, and the comments received will be considered as part of the consultation analysis activities in Step 3D. More details of this approach are provided in the DOR section 4.5.

8.1.6

The CAA published its refreshed Airspace Modernisation Strategy (AMS) in January 2023. The refreshed AMS pulls together the ICAO Global Air Navigation Plan, the 2018 AMS and new requirements that the CAA has identified through stakeholder engagement.

This MAN Stage 2 Gateway submissions, including the Viability Filter within the DOR, the Design Principles Evaluation (DPE) and the Initial Options Appraisal (IOA) that assessed alignment to Design

Principle Policy (P), were based on assessments carried out against the requirements of the previous iteration of the AMS, which was in force at the time those assessments were carried out.

MAG have reviewed the refreshed 2023 AMS. This review concluded that no material change would result had the refreshed AMS been applied to this MAN Stage 2 submission. It has therefore been agreed with the CAA that it would not be practical or proportionate to revise the MAN Stage 2 submissions to refer to the 2023 AMS for the purpose of this resubmission. However, our assessment work within Stage 3A and beyond will align to the refreshed 2023 AMS.

8.1.7

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. MAN 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 routeings (SIDs). To support this, we will work with airlines to ensure they implement the appropriate 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.

8.2 Updating stakeholders

The completion of the work required at Stage 2 'Develop and Assess' has developed and refined the design options available at MAN, as well as expanding the understanding of stakeholders' views on those options. While it is not a requirement of the CAP1616 process, all stakeholders that have participated in engagement activities to date, will be provided with the information submitted to the CAA at the conclusion of Stage 2, to ensure that they remain informed of the development of the Airspace Change Proposal at Manchester Airport ahead of the full public consultation at Stage 3.

8.3 Information to collect as part of Full Options Appraisal (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 MAN, 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 MAN 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'. Our approach to defining each of these air traffic forecast scenarios has previously been set out in correspondence with the CAA (Manchester Airspace Modernisation – CAP1616 Assessment Scenarios dated 6 June 2022). In headline, 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, incorporating the amendment or removal of the existing restrictions on LISTO 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 MAN 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)	At Stage 3 we will fully quantify the secondary metrics up to 7000ft. To do this, we will use the movement forecast (see above) alongside the forecast future fleet mix

that take into account the frequency of overflight Secondary noise metric data: Quantitative overflight contours, population counts and size (km2) that take into account the frequency of overflight	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 0-7000ft.
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 7000ft, and will take into account 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 MAN. 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. MAN will also continue to work with ACOG to develop the Safety Assurance Strategy as part of the Airspace Masterplan. At Stage 3A, 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 Stage 2B.
Tranquillity and Biodiversity	Impacts on tranquillity and Bio-diversity 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 ANOBs. 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 work with NATS as the contracted ANSP at MAN 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 7 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 MAN traffic.
Agl	Above ground level.
AIP	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. Unless otherwise stated, all references to the AMS are to the December 2018 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.

ASMIM[10]	A navigation fix to the north-west of Manchester used by departing aircraft.
ATC	Air Traffic Control - service from an air navigation service provider providing guidance to aircraft through Controlled Airspace.
ATM	Air Transport Movement - an aircraft operation for commercial purposes, as opposed to a flight for recreational or personal reasons.
ATS	Air Traffic Services.
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 - the report defines overflight as it relates to airspace regulation; and 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).
CAP1781	The CAA's DVOR/DME/NDB Rationalisation - guidance for the use of RNAV Substitution (www.caa.co.uk/cap1781).
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).
CAP1926	General Requirements and Guidance Material for the use of RNAV Substitution (www.caa.co.uk/cap1926).
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).

[10] The language to communicate between a pilot and an Air Traffic Controller needs to be clear and avoid misunderstanding. Names need to sound different and be incapable of confusion with others, particularly others close by.

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.
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.

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
DAYNE	One of three existing hold stacks used at Manchester 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.
DESIG	A navigation fix to the north-east of Manchester used by departing aircraft.
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 and in Manchester's case - members of the public. The design principles at Manchester 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.
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.
EGCC	The four-letter ICAO code for Manchester Airport.
EU	The European Union - an economic and political union of 27 countries.
EKLAD[10]	A navigation fix to the west of Manchester used by departing aircraft.
ERCD	The Environmental Research and Consultancy Department of the Civil Aviation Authority.
FAF	Final Approach Fix - The point at which an 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 Manchester, that is implementing the Governments Airspace Modernisation Strategy.
FIR	Flight Information Region - airspace delegated to a country by ICAO. In the UK there are two FIRs, London and Scottish.
FL85	FL means 'Flight Level' and uses the standard international pressure (1013.2 hPa) to express altitude in hundreds of feet. FL85 equates to 8,500ft calculated according to the 'constant' pressure altitude rather than local pressure (QNH). So FL90 would mean 9,000ft.
Flat segment	A defined period of level flight as required by a PANS-OPS PBN Approach procedure.
Flightpath	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, reducing the workload on the flight crew.
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.
Future housing sites	Future housing sites 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 MAN on 17th March 2022 with updates included to the Cheshire East Borough Council and Staffordshire Moorlands District Council areas in July and August 2022.

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.
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 aircrafts' 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 radionavigation system owned by the United States government and operated by the United States Space Force.
HAZID Workshop	Hazard Identification workshop - held with air traffic control experts from the Future Airspace team, NATS Manchester, NATS En Route and Liverpool John Lennon Airport as well as airline representatives operating from Manchester Airport.
HON	Abbreviation for the HONILEY DVOR navigation beacon that is to the south of Manchester and is used by departing aircraft as a navigation point.
IAF	Initial Approach Fix - the start of the approach phase of flight. For the Manchester arrival design options, the IAF is at 7,000ft unless stated otherwise.
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.
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.
KUXEM[10]	A navigation fix to the south-west of Manchester used by departing aircraft.
LAeq	Equivalent continuous sound level, or Leq/LAeq, is the average sound level for a specific location, over a given period.
LISTO[10]	A navigation fix to the south of Manchester used by departing aircraft.
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.
LLR	Low-Level Route - the Manchester LLR is Class D airspace within which the CAA have exempted aircraft from requiring an ATC clearance to fly within the route (http://publicapps.caa.co.uk/docs/33/ORS4%20No.1545%20Correction.pdf).
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.
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 occasions, 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 on to the arrivals path for another approach.
MAN	The three letter IATA code for Manchester Airport.
MANTIS	Manchester Airport Noise and Track Information System - a system that monitors and records the path and noise of aircraft arriving and departing from 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.
MCT	Abbreviation for the Manchester DVOR navigation beacon and routes that use that as a navigation point.
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.
MIRSI	One of three existing hold stacks used at Manchester Airport.
Modal average path	The path over the ground most commonly flown, derived from radar data samples.
MONTY[10]	A navigation fix to the south-west of Manchester used by departing aircraft.
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 for Manchester Airport.
NANTI	A navigation fix to the south-west of Manchester used by Liverpool aircraft.
NATS	The air navigation service provider for the UK, formerly National Air Traffic Services. NATS 'En Route' manage the traffic in the upper airspace and climbing and descending to land in the Manchester area.
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.
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 outlines the rules and criteria for designing aircraft flying procedures - commonly shorted 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.
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, Baptistery, Cathedral, Church, Chapel, Citadel, Gurdwara, Kingdom Hall, Methodist, Mosque, Minster, Stupa, Succah, Synagogue, Tabernacle or Temple.

PNR	Preferred Noise Route - lines of tolerances widen from the runway ends out to 1.5km each side of the Standard Instrument Departure route. The area encompassed by these 1.5km tolerances is commonly recognised as the PNR.
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.
POL	Abbreviation for the Pole Hill DVOR navigation beacon and routes that is to the north of Manchester and is used by departing aircraft as a navigation point
Q&A	Question and Answer - a list of questions (and their answers) that help the reader understand the subject material.
Radius to fix	Radius to Fix (RF) is defined as a constant radius circular path around a defined turn centre that terminates at a fix.
RAG	Red, Amber, Green - a means of assessing a project's status using the traffic light colours.
RF	Radius to Fix is defined as a constant radius path around a defined turn centre. It is a type of waypoint used in PBN procedures and provides highly accurate track keeping in a turn.
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.
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.
ROSUN	One of three existing hold stacks used at Manchester Airport.
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.
SANBA[10]	A navigation fix to the south of Manchester used by departing aircraft.
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 flightpath 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. Manchester Airport's SoN can be found online (airspacechange.caa.co.uk/documents/download/602).
SONEX[10]	A navigation fix to the east of Manchester used by departing aircraft.
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 flightpath set by Air Traffic Control that aircraft follow when arriving at an airport.
Step 1B Design Principles Report	A document that formed part of Manchester Airport's Stage 1 submission to the CAA (https://airspacechange.caa.co.uk/documents/download/1382).
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.
TABLY	A navigation fix to the south-west of Manchester used by departing aircraft.
Technical Coordination Group	Created by ACOG the Group regularly meet to discuss and resolve policy and technical issues affecting airspace design across all airports.
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.
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, Policy, and Capacity).
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, Policy and Capacity.
VNAV	Vertical Navigation - a term for vertical (up/down) navigation used within Performance Based Navigation.
VRP	Visual reference point.
WAL	Abbreviation for the Wallasey DVOR navigation beacon that is to the west of Manchester and is used by departing aircraft as a navigation point.
XORBO[10]	A navigation fix to the north-east of Manchester used by departing aircraft.
XUMAT[10]	A navigation fix to the north of Manchester used by departing aircraft.

10 Appendices

10.1 Appendix A1 - Initial Options Appraisal Full Analysis Tables

Figure 15 below shows an example extract of an IOA Full Analysis Table completed for Runway 05L/05R North departures.

MAN ACP - INITIAL OPTIONS APPRAISAL - FULL ANALYSIS TABLE

Departure Envelope: SID Runway 05 North

			'DO NOTHING' BASELINE		OPTION 1		OPTION 4	
			For the north design envelope, the 'do nothing' scenario for departures in terms of today's operation is based around the existing conventional POL SID. The 'do nothing' scenario for departures consists of a modal track that has been derived to provide an accurate representation of what occurs today. In addition to the modal track, a polygon has also been created that represents an area where current operations are dispersed due to radar vectoring and potentially may affect people on the ground. The overflight analysis conducted on this SID was based on the modal track created using Noise and Track Keeping data at altitudes of 4,000ft and 7,000ft with the addition of a radar vectoring area where appropriate. All data is based on current aircraft performance data and is calculated based on the distance between the Departure End of Runway and the end of the modal track.		Option 1 is an RNAV1 replication of the current departure to POL and uses fly-by waypoints to create a replication of the existing conventional POL 4S/1Z departure. As a replicated route it follows a similar track over the ground as the current published departure. The routes combine shortly after departure and fly straight ahead overflying Stockport where they commence a left turn to the north. This takes the routes west of Ashton-under-Lyne and close to Oldham and they terminate at 7,000ft to the east of Rochdale. The design speed will permit a large number of aircraft to fly this route in a clean configuration (without the use of flaps) which has potential benefits in terms of noise. There would be no speed restrictions applied to the procedure; therefore, the maximum speed of 250 KIAS below FL100 would apply. Due to the track-to-fix coding and simplicity of the route, dispersion is likely to be low even with maximum speeds.		This is an RNAV1 option that has a turn mid-way between options 1 and 3. It has been created in line with the Design Principle Noise N1 by following the course of the M60 motorway which already generates a level of ambient noise. This option has a direct routing to the north following the initial turn, which due to the track-to-fix coding and a fly-by waypoint, would result in repeatable ground tracks and a low level of dispersal. The design speed will permit a large number of aircraft to fly this route in a clean configuration (without the use of flaps) which has potential benefits in terms of noise. The route has been designed using fly-by waypoints. •05L: After departure this route combines with the option for 05R and flies straight ahead and commences a left turn just to the east of Stockport. It continues north, broadly following the route of the M60 motorway which takes it over Audenshaw reservoir and west of Ashton-under-Lyne. It passes overhead Oldham and terminates at 7,000ft just to the east of Rochdale. •05R: After departure this route combines with the option for 05L and flies straight ahead overflying Heald Green and commences a left turn just to the east of Stockport. It continues north, broadly following the route of the M60 motorway which takes it over Audenshaw reservoir and west of Ashton-under-Lyne. It passes overhead Oldham and terminates at 7,000ft just to the east of Rochdale There would be no speed restrictions applied to the procedure; therefore, the maximum speed of 250 KIAS below FL100 would apply. Due to the track-to-fix coding however, and simplicity of the route, dispersion is likely to be low even with maximum speeds.	
Group	**Impact**	**Level of Analysis**	**Runway 05L**	**Runway 05R**	**Runway 05L**	**Runway 05R**	**Runway 05L**	**Runway 05R**
Communities	Noise impact on health and quality of life	Initial Options Appraisal: Qualitative	For comparison purposes within the IOA, the 'do nothing' scenario was based upon the existing POL SID. In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this 'do nothing' scenario overflies approximately 46,700 people and approximately 22,850 residential buildings. - Up to 7,000ft, this 'do nothing' scenario overflies approximately 192,900 people and approximately 87,550 residential buildings.	For comparison purposes within the IOA, the 'do nothing' scenario was based upon the existing POL SID. In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this 'do nothing' scenario overflies approximately 51,700 people and approximately 25,350 residential buildings. - Up to 7,000ft, this 'do nothing' scenario overflies approximately 219,800 people and approximately 99,350 residential buildings.	In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this option overflies approximately 79,900 people and approximately 40,300 residential buildings. - Up to 7,000ft, this option overflies approximately 206,600 people and approximately 94,600 residential buildings. Assessed up to 7,000ft, this option overflies more people and residential buildings than the 'do nothing' scenario and is therefore considered to be of dis-benefit.	In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this option overflies approximately 80,700 people and approximately 40,900 residential buildings. - Up to 7,000ft, this option overflies approximately 216,300 people and approximately 99,250 residential buildings. Assessed up to 7,000ft, this option overflies fewer people and residential buildings than the 'do nothing' scenario and is therefore considered to be beneficial.	In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this option overflies approximately 55,200 people and approximately 26,650 residential buildings. - Up to 7,000ft, this option overflies approximately 208,100 people and approximately 91,750 residential buildings. Assessed up to 7,000ft, this option overflies more people and residential buildings than the 'do nothing' scenario and is therefore considered to be of dis-benefit.	In terms of potential noise impact, initial quantitative analysis has identified that: - Up to 4,000ft, this option overflies approximately 61,200 people and approximately 29,850 residential buildings. - Up to 7,000ft, this option overflies approximately 218,000 people and approximately 96,500 residential buildings. Assessed up to 7,000ft, this option overflies fewer people and residential buildings than the 'do nothing' scenario and is therefore considered to be beneficial.
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 of the Departure End of Runway. In terms of AQMAs, the existing Runway 05L POL SID overflies four AQMAs. Overflight of these AQMAs occurs when the aircraft is above 1,000ft.	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 of the Departure End of Runway. In terms of AQMAs, the existing Runway 05R POL SID overflies four AQMAs. Overflight of these AQMAs occurs when the aircraft is above 1,000ft.	Option 1 L overflies five AQMAs; however, as per CAP1616, para B74, due to mixing and dispersion, the impact on air quality above 1,000ft is not likely to be significant. There are areas within the immediate vicinity of the airport that may be overflown below 1,000ft; however, for safety reasons, this is unavoidable. Therefore, overall, when compared to the 'do nothing' scenario, this option is deemed to be of dis-benefit as it overflies more AQMAs.	Option 1 R overflies five AQMAs; however, as per CAP1616 para B74, due to mixing and dispersion, the impact on air quality above 1,000ft is not likely to be significant. There are areas within the immediate vicinity of the airport that may be overflown below 1,000ft; however, for safety reasons, this is unavoidable. Therefore, overall, when compared to the 'do nothing' scenario, this option is deemed to be of dis-benefit as it overflies more AQMAs.	Option 4 L overflies five AQMAs; however, as per CAP1616 para B74, due to mixing and dispersion, the impact on air quality above 1,000ft is not likely to be significant. There are areas within the immediate vicinity of the airport that may be overflown below 1,000ft; however, for safety reasons, this is unavoidable. Therefore, overall, when compared to the 'do nothing' scenario, this option is deemed to be of dis-benefit as it overflies more AQMAs.	Option 4 R overflies five AQMAs; however, as per CAP1616 para B74, due to mixing and dispersion, the impact on air quality above 1,000ft is not likely to be significant. There are areas within the immediate vicinity of the airport that may be overflown below 1,000ft; however, for safety reasons, this is unavoidable. Therefore, overall, when compared to the 'do nothing' scenario, this option is deemed to be of dis-benefit as it overflies more AQMAs.
Wider Society	Greenhouse Gas impact	Initial Options Appraisal: Qualitative	Current routes do not enable continuous climb operations. 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 predicted to have a greater environmental impact compared to 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 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 existing 'do nothing' scenario, the track length is 22.90km (12.37nm).	Current routes do not enable continuous climb operations. 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 predicted to have a greater environmental impact compared to 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 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 existing 'do nothing' scenario, the track length is 27.85km (15.04nm).	Option 1 L has been designed to support continuous climb operations. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of Option 1 L is 40.10km (21.65nm). When compared to the 'do nothing' scenario, Option 1 L is longer and is therefore expected to emit more greenhouse gases this option is deemed to be of dis-benefit. More in-depth analysis will take place at Stage 3, to confirm the exact volumes of greenhouse gases released.	Option 1 R has been designed to support continuous climb operations. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of Option 1 R is 41.81km (22.57nm). When compared to the 'do nothing' scenario, Option 1 R is longer and is therefore expected to emit more greenhouse gases this option is deemed to be of dis-benefit. More in-depth analysis will take place at Stage 3, to confirm the exact volumes of greenhouse gases released.	Option 4 L has been designed to support continuous climb operations. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of Option 4L is 39.31km (21.22nm). When compared to the 'do nothing' scenario, Option 4 L is longer and is therefore expected to emit more greenhouse gases this option is deemed to be of dis-benefit. More in-depth analysis will take place at Stage 3, to confirm the exact volumes of greenhouse gases released.	Option 4 R has been designed to support continuous climb operations. An element of radar vectoring may still be required to manage aircraft separation distances. The track mileage of Option 4 R is 35.92km (19.39nm). When compared to the 'do nothing' scenario, Option 4 R is longer and is therefore expected to emit more greenhouse gases this option is deemed to be of dis-benefit. More in-depth analysis will take place at Stage 3, to confirm the exact volumes of greenhouse gases released.

Figure 15 IOA Full Analysis Table Example (Runway 05L/05R North Departures)

10.2 Appendix A2 - CAP2091

CAP2091[11] 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 MAN 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 MAN 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[12].*

Table 1: Thresholds for noise modelling Categories, average summer day, population exposed to 51 dB $L_{Aeq,\ 16h}$ 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 day, population exposed to 45 dB L_{Aeq}, 8h 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

Aircraft arrivals and departures during 2020 and 2021 were distorted by the COVID-19 pandemic, with a greatly reduced number of flights, no dual runway operations and a distorted mix of short/long haul operations/destinations. The change sponsor has therefore considered the calendar year and summer of 2019 as the last experience of 'normal' operations.

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

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

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

$L_{Aeq,\ 16hr}$ dB	Area (sq. km)	Population	Households
>51	104.0	140,900	62,100
>54	57.7	67,600	30,100
>57	32.9	34,700	15,000
>60	19.2	12,100	4,900
>63	11.1	3,400	1,300
>66	6.5	1,300	500
>69	3.9	100	<100
>72	2.5	<100	<100

Table 3: 2019 average summer night LAeq, $_{8hr}$ contours – estimated areas, populations and households

$L_{Aeq,\ 16hr}$ dB	Area (sq. km)	Population	Households
>45	133.1	200,800	88,000
>48	77.7	134,600	59,500
>51	43.1	63,700	27,900
>54	23.3	30,200	13,000
>57	13.4	10,500	4,100
>60	7.6	3,000	1,200
>63	4.5	1,300	500
>66	2.6	100	<100

From the above results, it can be concluded that Category C is the appropriate level for modelling daytime noise and Category B appropriate for modelling noise levels at night. Overall, therefore, Category B noise modelling is (currently) considered appropriate for MAN.

However, 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 (2026 – 2036) the number of flights operating at MAN is forecast to increase by approximately one third, from the number that operated in 2019.

Since the number of night flights at MAN are strictly limited, it is anticipated that almost all of this growth will be seen during the 16-hour day. It is therefore unlikely that the population within the 45 LAeq,8hr contour will increase greatly beyond 2019 levels (during the 10-year period) and certainly not to the recommended minimum threshold required to trigger a move to Category A (400,000). Category B therefore remains the appropriate noise modelling category, for the night.

Using 2019 noise contour output as a baseline, we have estimated that a doubling of the number of daytime flights at MAN, would result in a population count within the 51 LAeq, 16hr contour, of 213,000* and this would be sufficient to mandate a move to Category B for the purposes of CAP2091, during the 16-hour daytime modelling period. However, given the forecast (lesser) increase in the number of flights this is likely to be an overestimation and a conservative assumption. The actual figure will likely sit between the recommended minimum threshold for Category B (160,000) and the mandatory minimum threshold (200,000). Category B therefore becomes the appropriate noise modelling category, for the 16hr daytime contour and this assumption provides assurance that noise modelling undertaken as part of the full options appraisal will be to the required standard.

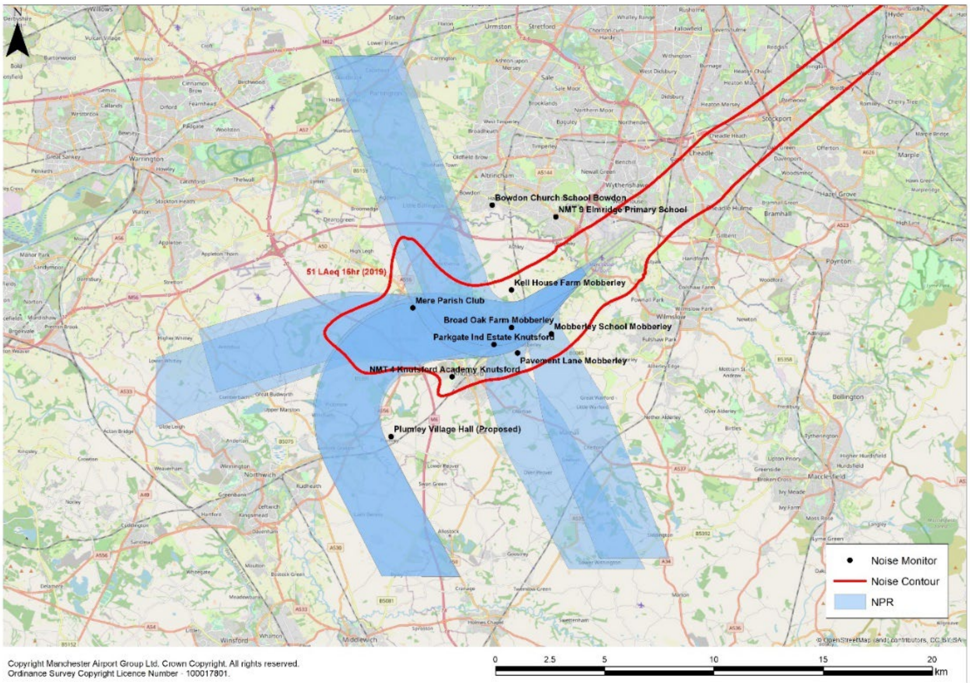
*Based upon the premise that, where all else remains unchanged, (traffic mix, flight profiles, dispersion etc), a doubling in the number of flights modelled would result in a 3dB increase in contour noise levels. This would mean that, if 2019 traffic volumes were to double, the 51 LAeq, 16hr contour, would increase in size and shape to become identical to the current 48 LAeq, 16hr contour. The size and shape of this 2019 48 LAeq, 16hr contour has been modelled and the population count within the contour is estimated to be 213,000.

Based upon the above, it can be concluded that Category B noise modelling is applicable for MAN and the requirements of this standard will be adopted throughout this ACP.

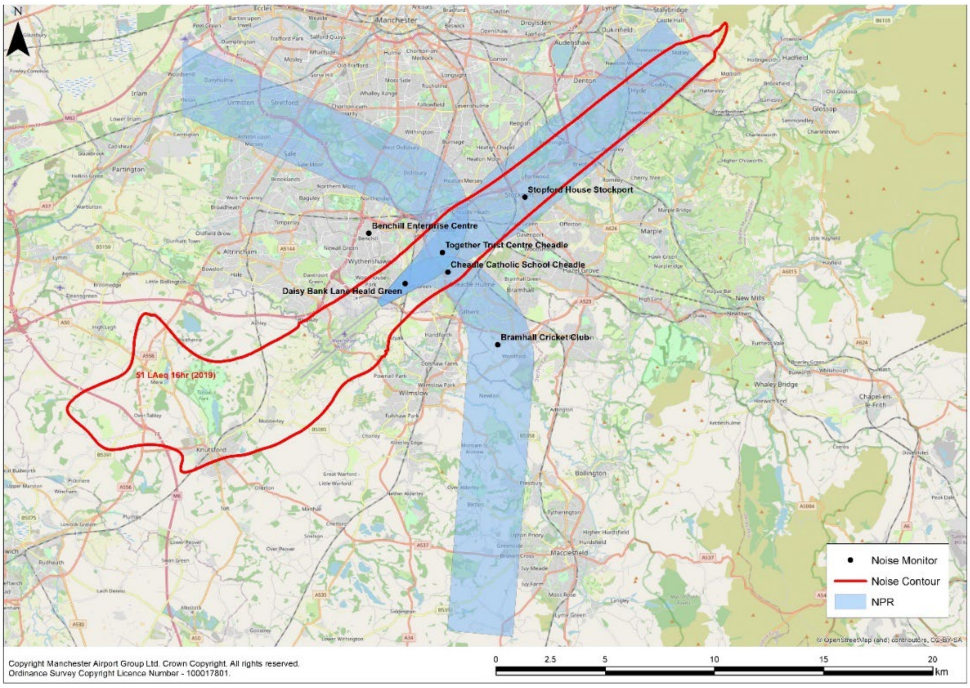
CAP2091 requires that in order for noise modelling to be carried out to the standards of Category B, it is "validated by local noise monitor data for major aircraft types". That is to say, "the main noise dominant aircraft types, which must cover more than 75% of the total noise energy produced by aircraft 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 51 dB $L_{Aeq,\ 16h}$ 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 MAN, would fulfil this requirement.

The image below shows fixed noise monitoring locations to the west of MAN.



The image below shows fixed noise monitoring locations to the east of MAN.



Nb. Runway 05R departure corridors are not depicted, due to extreme infrequency of use.

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