UK Civil Aviation Authority

Airspace change: masterplan trade-off procedure

CAP 3042

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Civil Aviation Authority
Aviation House
Beehive Ring Road
Crawley
West Sussex
RH6 0YR

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Enquiries regarding the content of this publication should be addressed to:
airspace.modernisation@caa.co.uk

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Executive Summary

1. This procedure has been developed specifically for airspace change proposals (ACPs) forming part of the airspace change masterplan programme (masterplan ACPs). The purpose of this procedure is to assist the sponsor of a masterplan ACP in proposing trade-offs as it develops its proposal through the regulatory process for airspace change (CAP 1616) and submits it to the Civil Aviation Authority (CAA) for approval.

2. The sponsor must propose trade-offs that deliver the objectives of the CAA's Airspace Modernisation Strategy (AMS). The trade-offs must prioritise maintaining a high standard of safety and secure system-wide benefits and overall network optimisation. This means maximising the efficient use of airspace and the resilience of the airspace network, while giving due consideration to local circumstances and environmental impacts. This is a fundamental objective of AMS and therefore a principle of the masterplan programme.

3. This procedure summarises the process a sponsor must follow when proposing trade-offs to ensure it:

   - provides a robust, coherent and transparent design narrative; and
   - presents the evidence necessary for the CAA to make regulatory decisions on airspace change, the AMS and the masterplan.

Chapter 1

Introduction

1.1 The Civil Aviation Authority (**CAA**) and the Department for Transport (**DfT**), as co-sponsors of airspace modernisation in the UK, commissioned NATS (En Route) plc (**NERL**) to create and maintain a single coordinated implementation plan for airspace changes in the UK to cover the period to 2040, known as the airspace change masterplan (**the masterplan**).

1.2 Given the large number of parties involved in the development of the masterplan, including many airports and NERL itself, the co-sponsors required NERL to set up a separate and impartial unit, the Airspace Change Organising Group (**ACOG**), to create and maintain the masterplan. ACOG is also responsible for engaging on the masterplan and coordinating the airspace changes proposals (**ACPs**) necessary to develop the masterplan.

1.3 The purpose of the masterplan is to set out what airspace changes are needed to upgrade the UK's airspace and deliver the objectives of the CAA's Airspace Modernisation Strategy (**AMS**)[1] at a strategic level. The masterplan will be required to, *inter alia*, describe how individual ACPs relate to each other (**interdependencies**) and where there are potential conflicts in their proposed designs, as well as explain how trade-offs decisions to resolve those conflicts have been made.

1.4 A trade-off is the choice or decision to resolve a conflict. In the context of airspace design, such conflicts can arise between:

- two or more sponsors of interdependent airspace changes (for example, where they want to make use of the same volume of airspace); or
- two or more objectives for airspace design (for example, achieving noise reduction and securing the most efficient use of airspace).

1.5 Trade-offs are needed whenever there is a choice between airspace designs that each create a different mix of positive and negative impacts. The phrase 'trade-off' is typically used to refer to the positive impacts generated by a particular option which are lost when another option is preferred instead.

1.6 In the context of the masterplan, trade-offs will be driven by the choices made about airspace design by sponsors of interdependent ACPs that interact. For

[1] CAA, CAP 1711, *Airspace Modernisation Strategy 2023–2040 Part 1: Strategic objectives and enablers*. www.caa.co.uk/cap1711

example, an emissions benefit for Airport A may be traded-off against a noise benefit for Airport B.

1.7 ACOG is responsible for engaging on the masterplan and coordinating the airspace changes necessary to develop the masterplan. This includes supporting the sponsor of an ACP forming part of the masterplan programme (**masterplan ACP**) in proposing trade-offs and helping to coordinate the resolution of those trade-offs.

1.8 This procedure has been developed specifically for masterplan ACPs. The purpose of this procedure is to assist the sponsor of a masterplan ACP in proposing trade-offs as it develops its proposals through the regulatory process for airspace change (**CAP 1616**)[2] and submits it to the CAA for approval. The procedure summarises:

- when and how trade-offs will be represented in the masterplan
- the criteria that a sponsor must apply and the evidence that a sponsor must collect when proposing trade-offs, and
- the government policies applicable to such choices.

1.9 The procedure does not tell the sponsor what the outcome of different trade-offs should be. Instead, it guides the sponsor through the process it must follow in proposing trade-offs to ensure it gathers the necessary evidence for a robust, coherent and transparent design narrative.

1.10 When the CAA assesses and decides on an ACP (including at gateways) or an iteration of the masterplan, we will always consider the supporting justification provided by the sponsor in proposing trade-offs and selecting designs to ensure that the outcomes deliver the AMS and government policy. This includes making sure that any trade-offs proposed by the sponsor is consistent with the masterplan.

1.11 The document assumes the reader has a good understanding of the CAP 1616 process.

1.12 This procedure is published under Direction 4(1) of the Civil Aviation Authority (Air Navigation) Directions 2023.

[2] CAA, CAP 1616, *Airspace Change Process.* www.caa.co.uk/cap1616

Chapter 2

Masterplan and trade-offs

2.1 The masterplan is being developed in iterations that will each be assessed by the co-sponsors and accepted by the CAA separately. The iterations broadly align with certain gateways of the CAP 1616 process that each masterplan ACP will follow. As the masterplan is developed through the iterations, it will show more detail about the trade-offs between interdependent masterplan ACPs.

Iteration 1

2.2 Iteration 1 of the masterplan provided a high-level programme plan identifying airspace changes in the south of England (known as the Future Airspace Strategy Implementation (**FASI**)-South programme). Iteration 1 was assessed by the CAA in February 2020.[3]

2.3 As a high-level plan only, it did not consider trade-offs in detail, but the co-sponsors recognised that trade-offs would need to be considered as part of the masterplan process, coordinated by ACOG.

Iteration 2

2.4 Iteration 2 of the masterplan provided a system-wide view of the scope of the masterplan ACPs and identified the potential interdependencies between the proposals.[4] The content of Iteration 2 derived from the work conducted by each of the sponsors during Stages 1 and 2 of the CAP 1616 process. Iteration 2 was assessed by the co-sponsors and accepted by the CAA in January 2022.[5]

2.5 Given that the masterplan ACPs were at the early stages of their development, Iteration 2 described potential design conflicts, possible solutions and the associated trade-offs qualitatively, and at a system level, with case study examples included to offer additional context.

Iteration 3

2.6 ACOG prepares Iteration 3 by working with the sponsors of masterplan ACPs to incorporate the outputs that are available in Part 1 of the Cumulative Analysis

3 CAA and DfT, CAP 1884: Airspace Masterplan Iteration One (Southern UK): Co-Sponsor Assessment (February 2021). www.caa.co.uk/cap1884

4 CAA, CAP 2312B, UK Airspace Change Masterplan Iteration 2. www.caa.co.uk/cap2312B

5 CAA, CAP 2312A, Airspace Change Masterplan Iteration 2: Co-sponsor Assessment and CAA Acceptance Decision (January 2022). www.caa.co.uk/cap2312A

Framework (**CAF**),[6] which draws from the 'initial' options appraisals undertaken by sponsors during Stage 2 of the CAP 1616 process.

2.7 Iteration 3 will describe airspace design trade-offs between interdependent ACPs in greater detail than Iteration 2, with more information about the cumulative impacts of different design choices and the methods used to calculate them.

2.8 Iteration 3 will also describe how interdependent ACPs sponsors will consult on their proposals in a coordinated manner so that stakeholders are presented with a holistic view of the overall airspace design, the cumulative impacts of the ACPs and the potential trade-offs to be made.

2.9 Iteration 3 will be delivered in clusters or deployments, corresponding to different geographical regions covered by the masterplan.

Iteration 4

2.10 Iteration 4 will present a detailed description of the proposed airspace structure, route network and anticipated cumulative impacts of the masterplan. This will build on previous iterations of the masterplan and incorporate the output of Parts II and III of the CAF, which respectively draw information on collective performance from the sponsors' 'full' options appraisal (Stage 3) and 'final' options appraisal (Stage 4). Iteration 4 will also be developed from responses to the ACP coordinated consultations.

2.11 In Iteration 4, ACOG will provide detail of the final proposed trade-offs between interdependent masterplan ACPs so that the sponsors can assess that information and ensure that their proposals are in accordance with the AMS and deliver government policy.

2.12 Where trade-offs are unable to be resolved by sponsors in coordination with ACOG, the problem may be brought before the CAA and the DfT, as co-sponsors, to propose a resolution. The co-sponsors will select a trade-off solution to form part of the overall proposal based upon their views of the individual situation, in accordance with the principles in this document. Utilisation of the co-sponsors for resolving trade-off proposals does not mean the overall ACP will be approved. That decision will not be made until Stage 5 of the CAP 1616 process.

2.13 Part 1 of the Air Traffic Management and Unmanned Aircraft Act 2021 provides powers for the Secretary of State (delegable to the CAA) to direct airports, air navigation service providers and other persons with functions relating to air navigation to progress ACPs which are linked to the AMS. Where trade-offs are

[6] ACOG has developed guidance on the treatment of cumulative impacts for masterplan ACPs: the Cumulative Analysis Framework (CAF).

unable to be resolved between sponsors or by the co-sponsors, the Secretary of State may consider the use of these powers to progress an ACP and the masterplan programme as a whole. As a matter of policy, the powers in the Act are to be used as a last resort, and only for masterplan ACPs.

2.14 Iteration 4 will be delivered in clusters or deployments, corresponding to different geographical regions covered by the masterplan.

Chapter 3

When are trade-offs proposed by the sponsor?

3.1 In practice, trade-offs take place throughout the CAP 1616 process as part of the sponsor's design work and options development. In this section, we look at key stages or 'touch-points' of the CAP 1616 process where trade-offs are likely to be proposed by the sponsor.

Stage 1

3.2 In Stage 1 of the CAP 1616 process, the sponsor is required to develop design principles as a framework or reference point when drawing up, and later considering and comparing all the options open to it to address the airspace issue or opportunity that it has identified.

3.3 The design principles must be developed in a local context, in accordance with national policy. They must address any local trade-offs that need to be made, for example by addressing whether aircraft should, as a priority, avoid flying over specific local areas or populations. Some of the principles may contradict one another and some may be prioritised over others. Together with the options appraisal and impact analysis that follow, those design principles form part of the basis against which the sponsor proposes future trade-offs.

Stage 2

3.4 In Stage 2, the sponsor undertakes an initial options appraisal whereby a list of potential options is compared, largely on a qualitative basis. It is focussed on the local performance of its ACP rather than the cluster as a whole. The initial options appraisal enables the sponsor to illustrate any trade-offs that are being proposed between impacts within its own suite of designs. For example, if an option results in an increase in the number of people overflown but also results in a decrease in significant adverse impacts from aircraft noise.

Stage 3

3.5 In Stage 3, the sponsors of interdependent masterplan ACPs are required to combine their individual designs into a cluster-wide[7] design that maintains a high standard of safety. This requires sponsors to consider the cumulative and collective impacts of their proposals together in order to reflect the impacts at a system level. The CAF provides guidance on how to capture cumulative and

[7] A cluster may be split into a number of deployments, in which case sponsors are required to combine options to built designs that are safe for each deployment.

collective impacts. The CAF is broken down into three parts (**CAF1**, **CAF2** and **CAF3**), which are explained in the following paragraphs.

3.6 CAF1 is undertaken after a safe cluster-wide design(s) has been identified, but before the full options appraisal. CAF1 is used to:

- provide an assessment of design conflicts and trade-offs between the route options in the interdependent ACPs that contribute to the cluster-wide design, and
- provide a basis for sponsors to resolve the design conflicts/trade-offs considering cumulative and collective performance, and
- help identify incompatible combinations of designs for discontinuation or for modification to improve overall performance.

3.7 Trade-offs may result in individual ACP performance being traded-off for a collective benefit. This is where a proposal has been affected by the need to accommodate benefits or minimise impacts in another sponsor's ACP. For example, a sponsor may have to discontinue or modify its preferred option(s) in order to produce a design that prioritises maintaining a high standard of safety and secures system-wide benefits and overall network optimisation.

3.8 After that, **CAF2** describes the second stage of analysis called the 'full cumulative analysis'. The purpose of that analysis is to provide detailed information on the collective impacts and trade-offs between each sponsor's preferred designs for consultation, based on aggregating the analysis of each sponsor's full options appraisal.

3.9 Each sponsor then formally consults on its preferred set of designs, referencing the CAF2 information so that stakeholders are provided with a picture of the collective impact of the cluster. The overriding aim is to ensure that anyone who may be affected by a change can see and understand what is proposed, both at a local and cluster-wide level, and respond meaningfully. The consultation must include specific details of the trade-offs that have been proposed by the sponsor in drawing up their preferred set of designs, so that stakeholders can provide input on trade-offs that may affect them.

Stage 4

3.10 **CAF3** describes the third and final stage of analysis as the 'final cumulative analysis'. The final cumulative analysis brings together the details of each sponsor's final options appraisal to present updated information on the cumulative and collective impacts of each sponsor's final proposed designs. This will also describe where any further trade-offs have been proposed in the final designs.

3.11 In Stage 4, the sponsor is required to publish a consultation response document containing evidence demonstrating how they have proposed trade-offs and taken stakeholders' views into account.

Stage 5

3.12 In Stage 5, the CAA reviews and assesses the ACP and decides whether to approve it. As part of that assessment, the CAA will look for evidence from the sponsor that trade-offs:

- have been described clearly in the sponsor's materials, including in their final submission
- have been consulted on appropriately
- have been made transparently, with the coordination of ACOG
- have been made in accordance with the AMS and deliver government policy, and
- prioritise maintaining a high standard of safety and secure system-wide benefits and overall network optimisation.

Chapter 4

How must the sponsor propose trade-offs?

4.1 During Stages 2 to 4 of the airspace change process, the sponsor is required to undertake a series of options appraisals which collect evidence on expected impacts and provide a basis for the sponsor to shortlist options to a final proposed design. This involves trade-offs between different impacts both within an ACP, and in the case of the masterplan ACPs, between interdependent ACPs in a cluster or deployment. Guidance on the requirements for conducting the options appraisals are contained in the *Guidance on Airspace Change Process for Permanent Airspace Change Proposals* (**CAP 1616f**).[8] This guidance also provides a framework for the presentation of data on impacts on individual submissions (see pages 36 to 41). This format is also followed in the CAF for addressing trade-offs.

4.2 This section outlines the process the sponsor must follow to ensure that it gathers the necessary data to propose trade-offs in a holistic and evidence-based way, and which enables the CAA to fulfil its statutory duties. **Failure to do so may mean that the CAA is unable to approve its proposal.**[9]

4.3 That process involves responding to two legal tests, sequentially:

- first, trade-offs must be in accordance with the AMS, including any accepted iterations of the masterplan (explained in section **7** below); and
- second, in proposing trade-offs, the sponsor must consider the material factors in section 70 of the Transport Act 2000 (**Transport Act**), noting that safety is to have priority over the CAA's other duties in this area of work (explained in section **8** below).[10]

4.4 Note that where trade-offs can be easily resolved, the sponsor may be able to scale, expedite or compress certain steps described in this document, with the aim of ensuring that the process for proposing trade-offs remains as proportionate as possible.

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8 CAA, *Guidance on Airspace Change Process for Permanent Airspace Change Proposals (CAP 1616f)* (November 2023). https://publicapps.caa.co.uk/CAP1616f

9 Having assessed the ACP and all the documentation and evidence accompanying it, in Stage 5 the CAA makes its decision. The CAA's decision is made in the context of a number of legal duties and where applicable government policy (as outlined in the following sections of this procedure). The CAA's duties highlight the factors it must consider before making its decision.

10 Material factors are used to refer to each of the considerations listed in sections 70(1) and 70(2) of the Transport Act 2000.

4.5 The impacts of airspace changes will be experienced by stakeholders in different ways, and what is the best achievable outcome overall in a particular instance will depend on the circumstances of each case.

4.6 For these reasons, there is no single formula or ideal solution that applies to every airspace change. Where there are competing factors, section 70(3) of the Transport Act requires the CAA to apply them in the manner it thinks is reasonable having regard to them as a whole. It is therefore imperative that the sponsor adopts an evidence-based approach to airspace design, using their professional judgment and expertise to evaluate and propose trade-offs in accordance with the AMS and which deliver government policy.

Chapter 5

Airspace Modernisation Strategy (AMS)

5.1 The AMS lays out the overall vision for airspace modernisation by setting out the **ends** (strategic objectives), **ways** (delivery elements) and **means** (delivery plans) of modernising airspace. That vision is to deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. It is underpinned by four strategic objectives (or 'ends') to be achieved from airspace modernisation:

- **Safety:** maintaining and, where possible, improving the UK's high levels of aviation safety has priority over all other 'ends' to be achieved by airspace modernisation
- **Integration of diverse airspace users:** airspace modernisation should wherever possible satisfy the requirements of operators and owners of all classes of aircraft, including the accommodation of existing users (e.g. commercial air transport, all General Aviation operations, military, taking into account interests of national security) and new users (e.g. remotely piloted aircraft systems, advanced air mobility (aerial taxis), spacecraft, high-altitude platform systems)
- **Simplification of the airspace system:** consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of airspace and the expeditious flow of traffic,[11] accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumers
- **Environmental sustainability:** environmental sustainability will be an overarching principle applied through all airspace modernisation activities. Airspace modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace.

5.2 The CAA is under a duty in direction 5(1) of the Air Navigation Directions 2023[12] to decide ACPs in accordance with its published strategy, including the AMS, procedures, and policy on the design and classification of UK airspace. This means that any sponsor must take account of the AMS and accepted iterations

[11] See footnotes 14 and 15.

[12] Civil Aviation Authority (Air Navigation) Directions 2023:
https://www.caa.co.uk/media/lzrl3drs/caa-air-navigation-directions-2023.pdf

of the masterplan, where applicable, in the development of its ACP such that it is not inconsistent with the delivery of that strategy and plan.

5.3 In proposing trade-offs, the sponsor will therefore need to ensure that those choices align with the vision and strategic objectives of the AMS, as well as accepted iterations of the masterplan. The final iteration of the masterplan will act as a framework for the masterplan ACPs, which must be consistent with it.

5.4 Not every ACP will further all the strategic objectives of the AMS. Some proposals may contribute positively to one or more objectives and negatively to others. Where such conflicts arise, in deciding whether the ACP is in accordance with the AMS, we will look at how the proposal performs against the strategic objectives of the AMS having regard to that strategy as a whole.

5.5 The CAA's assessment will include considering whether the proposal prioritises maintaining a high standard of safety and secures system-wide benefits and overall network optimisation, rather than solely considering the proposal as an individual change. This means maximising the efficient use of airspace and the resilience of the airspace network, while giving due consideration to local circumstances and environmental impacts.

5.6 **Appendix A** sets out examples of beneficial and detrimental characteristics of a trade-off which could be used to demonstrate how that trade-off performs against the strategic objectives of the AMS. The examples are not an exhaustive list, and each proposal will need to be looked at in its own context. When proposing trade-offs, the sponsor should apply these characteristics in a consistent and systematic way, documenting its key findings through the CAP 1616 options appraisal process. **Appendix A** therefore also lists how the strategic objectives of the AMS map across to the impact categories in CAP 1616.

5.7 Some trade-offs may only require brief consideration, whereas others, especially those with greater impacts, may require closer scrutiny. Not all strategic objectives, or characteristics relating to those objectives, may be relevant to the trade-off in question.

5.8 Not all trade-offs will engage all four of the strategic objectives of the AMS. **Appendix B** provides a case study showcasing the practical application of some of the strategic objectives of the AMS within the context of two hypothetical trade-off scenarios following the CAP 1616 and CAF format for impact assessment. The sponsor should seek to adopt a similar structure in evaluating different trade-offs and document the results of its analysis accordingly. The CAA will want to see evidence that the sponsor's trade-offs are in accordance with the AMS.

Chapter 6

Transport Act 2000

6.1 Section 70(1) of the Transport Act places the CAA under a general duty in relation to its air navigation functions (such as deciding whether to approve airspace changes) to exercise those functions in a way which maintains a high standard of safety in the provision of air traffic services. That duty is to have priority over the CAA's other duties in this area.

6.2 Noting that priority, section 70(2) requires the CAA to exercise its functions in the manner it thinks best calculated:

(a) to secure[13] the most efficient use of airspace[14] consistent with the safe operation of aircraft and the expeditious flow of air traffic;[15]

(b) to satisfy the requirements of operators and owners of all classes of aircraft;

(c) to take account[16] of the interests of any person (other than an operator or owner)[17] in relation to the use of any particular airspace or airspace generally;

(ca) to take account of any guidance relating to spaceflight activities given to the CAA by the Secretary of State;[18]

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13 As its starting point, when considering a trade-off, the CAA will give its duty to 'secure' something higher weight than its duty to 'satisfy' or 'facilitate'. (These are all terms used in the CAA's statutory duties in section 70(2) of the Transport Act.) For example, the CAA would give the obligation to secure the most efficient use of airspace higher weight than the obligation to satisfy owners and operators of aircraft.

14 The CAA uses the following overall definition of 'the most efficient use of airspace': the most aircraft movements through a given volume of airspace over a period of time in order to make the best use of the limited resource of UK airspace from a whole system perspective.

15 The CAA uses the following definition of 'expeditious flow': the shortest amount of time that an aircraft spends from gate to gate, from the perspective of an individual aircraft, rather than the wider air traffic system.

16 The CAA regards the term 'to take account of' as meaning that the material factors in question may or may not be applicable in a particular case (for example, national security) and also that the range of ways they could affect its decision could be wide. This means that sometimes, a factor we must 'take account of' is prioritised over one we need to 'secure'.

17 The CAA considers the words 'any person (other than an operator or owner of an aircraft)' to include: airport operators, air navigation service providers, members of the public on the ground, owners of cargo being transported by air, and anyone else potentially affected by an ACP.

18 This factor will not be relevant to the masterplan ACPs.

(d) to take account of any guidance on environmental objectives given to the CAA by the Secretary of State;[19]

(e) to facilitate the integrated operation of air traffic services provided by or on behalf of the armed forces and other air traffic services;

(f) to take account of the interests of national security; and

(g) to take account of any international obligations of the UK notified to the CAA by the Secretary of State.[20]

6.3 Where a particular ACP would contribute positively to some of the material factors, but negatively in respect of others, the relevant statutory provision (section 70(3) of the Transport Act) refers to this situation as a 'conflict'. Section 70(3) then requires the CAA to apply those material factors in the manner it thinks is reasonable having regard to them as a whole.

6.4 Trade-offs will need to be proposed where conflicts between airspace designs occur that each create a different mix of positive and negative impacts. As outlined in Section 5. above, this may occur when the sponsor is selecting which designs to progress to full cumulative analysis (after conducting the short-list comparison exercise in the CAF), consultation or even final submission to the CAA.

6.5 To resolve such conflicts, the CAA expects the sponsor to apply the material factors in section 70(2) of the Transport Act in a holistic way. There is no concrete formula for how different material factors must be considered. The sponsor should apply professional judgment to determine the weight that each of the material factors should be given based on an objective analysis of the anticipated impacts against those factors. Not all of the material factors will be relevant in all trade-offs.

6.6 Chapter 6 of CAP 1616f sets out in more detail the CAA's policy approach in carrying out these duties – including what it understands the duties to mean, how it evaluates competing priorities, whether these be strategic policy, environmental impacts such as noise, the needs of airspace users, and/or the interests (economic or otherwise) of airports or air navigation service providers, and what evidence from stakeholders it will take into account when reaching a decision.

6.7 **Appendix A** sets out examples of beneficial characteristics of an ACP which could be used to demonstrate how the proposal impacts each material factor. It also sets out examples of detrimental characteristics which, if they arise from the

[19] Department for Transport, *Air Navigation Guidance 2017* (October 2017). www.gov.uk/airnavigationguidance2017

[20] No such international obligations have been notified to the CAA by the Secretary of State.

proposal, would likely indicate that the proposal has not contributed positively towards one of the material factors or has had a detrimental effect. The examples are not an exhaustive list, nor should they be taken as examples that will demonstrate a factor under every circumstance. However, it is expected that for most trade-offs that reflect these examples, they will be evidence that the sponsor has considered the factor in question.

6.8 Not all trade-offs will involve all of the material factors. The case study in **Appendix B** showcases the practical application of some of the material factors in section 70 of the Transport Act within the context of two hypothetical trade-off scenarios. It does so by linking each impact category with the relevant legal/policy factors and the beneficial/ detrimental characteristics which can be used to help show how the proposal performs against those factors – in terms of both its impacts and design principles.

6.9 The sponsor should seek to adopt a similar structure to evaluating different trade-offs and document the results of its analysis accordingly. The CAA will want to see evidence that the sponsor has considered the material factors.

Chapter 7

Air Navigation Guidance

7.1 Strategic Objective 4 (Environmental Sustainability) of the AMS and section 70(2)(d) of the Transport Act highlight the need to consider government guidance on environmental objectives, namely the Air Navigation Guidance 2017.

7.2 The Air Navigation Guidance sets out the government's environmental objectives with respect to air navigation. These environmental objectives are designed to minimise the environmental impact of aviation within the context of supporting a strong and sustainable aviation sector. These objectives are, in support of sustainable development, to:

(a) limit and, where possible, reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise;[21]

(b) ensure that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions; and

(c) minimise local air quality emissions and in particular ensure that the UK complies with its international obligations on air quality.

Environmental trade-offs

7.3 Where there is a conflict between two or more of these environmental objectives, and a trade-off needs to be made, the Air Navigation Guidance (section 3.3) provides a series of altitude-based priorities.

"Noise from aircraft flying at or above 4,000 feet is less likely to affect the key noise metrics used for determining adverse effects and as aircraft continue to climb above this altitude their noise impact reduces. Set against this, there is also a need to secure an efficient use of airspace and to ensure that aircraft operations emissions are minimised. So when considering requests to change the airspace design, the CAA should apply the following altitude-based priorities of the government:

[21] In assessing the number of people 'significantly affected by aircraft noise', the total adverse effects must be considered. This builds in an assessment of health impacts so that, for example, the creation of a respite route could reduce the total adverse health effects while increasing the absolute number of people affected. As a result, the sponsor is required to consider options when designing airspace to find ways to manage the distribution of noise that best reflects this policy objective, including taking into account local circumstances and preferences.

- *in the airspace from the ground to below 4,000 feet, the government's environmental priority is to limit and, where possible, reduce the total adverse effects on people*
- *where options for route design from the ground to below 4,000 feet are similar in terms of the number of people affected by total adverse noise effects, preference should be given to that option which is most consistent with existing published airspace arrangements*
- *in the airspace at or above 4,000 feet to below 7,000 feet, the environmental priority should continue to be minimising the impact of aviation noise in a manner consistent with the government's overall policy on aviation noise, unless the CAA is satisfied that the evidence presented by the sponsor demonstrates this would disproportionately increase carbon dioxide (**CO_2**) emissions*[22]
- *in the airspace at or above 7,000 feet, the CAA should prioritise the reduction of aircraft CO_2 emissions and the minimising of noise is no longer the priority*
- *where practicable, it is desirable that airspace routes below 7,000 feet should seek to avoid flying over Areas of Outstanding Natural Beauty (**AONB**) and National Parks*
- *all changes below 7,000 feet should take into account local circumstances in the development of the airspace design, including the actual height of the ground level being overflown, and should not be agreed to by the CAA before appropriate community engagement has been conducted by the sponsor."*

7.4 The altitude-based priorities are intended to be applied 'bottom-up'. For example, for an aircraft arriving at 7,000 feet in a sub-optimal position for the reduction of CO_2 emissions, the altitude-based priority from 7,000 feet (to reduce CO_2 emissions) does not permit the sponsor to prioritise reducing CO_2 emissions at lower altitude, even if there was a consequential effect.

7.5 To provide another example, if there is a conflict between a design that minimises the total adverse effects of noise below 7,000 feet but has a detrimental impact on CO_2 emissions above 7,000 feet, against a design that minimises CO_2 emissions above 7,000 feet at the cost of more total adverse noise effects below 7,000 feet, the 'bottom up' approach would, in general, favour the former as the low altitude objective should be addressed first. However, in all cases there are a number of other factors that must be taken into

[22] There is no fixed definition of what disproportionate means in this context. It is a matter for sponsors to demonstrate whether or not the increase in CO_2 emissions is disproportionate. In doing so, sponsors may want to consider an appropriate metric such as at least 50% more emissions from aircraft operating between 4,000 feet and 7,000 feet resulting from the airspace change proposal than would otherwise be the case if noise was the priority.

account (based on the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and design principles), meaning that the sponsor must build a case to demonstrate why each proposed trade-off is proportionate and justified.

Environmental and economic trade-offs

7.6 Where there is a conflict between environmental and economic objectives, such as the improvement of noise and the need to enhance the overall efficiency of the UK airspace network, the Air Navigation Guidance does not provide a priority of impacts.

7.7 The Air Navigation Guidance recognises that each of these objectives needs to be considered alongside each of the others and within the context of sustainable development. Sustainable development has environmental, social and economic considerations, and includes the need to enable aviation to grow sustainably if the UK economy is to remain competitive and achieve its objective for growth and employment.[23]

7.8 Trade-offs between environmental, social and economic objectives therefore need to be made in a way which consider the impacts as a whole, based on high-quality and objective evidence (such as a monetised cost-benefit approach described in CAP 1616). In all trade-offs, maintaining a high standard of safety remains the CAA's primary duty.

[23] Air Navigation Guidance 2017, footnote 1.

Chapter 8

CAP 1616 design principles

8.1 Design principles, in the CAP 1616 process, encompass the safety, environmental and operational criteria and strategic policy objectives that the sponsor aims for in developing its ACP. There are mandatory, discretionary and bespoke design principles in CAP 1616. Design principles are tested through engagement with stakeholders and form a qualitative structure against which designs can be evaluated.

8.2 The mandatory and discretionary design principles are based around fundamentals such as safety, environmental impact and throughput of traffic. But design principles must also be developed in a local context, in accordance with national policy. Some of the principles may contradict one another and some may be prioritised over others. For example, communities already overflown may express that distributing noise over a wider area should be a design principle, whereas those not currently overflown may express that minimising overflight of new communities should be a design principle. These principles will nearly always be contradictory in terms of the designs they lead to.

8.3 Design principles are not the only criteria that will determine whether a trade-off proposed by the sponsor is acceptable or not. They form part of the overall framework or reference point that the sponsor uses when drawing up, and later considering and comparing, trade-offs and design choices to address the airspace issue or opportunity it has identified in its ACP. As part of that framework, the sponsor also needs to consider and compare the impacts of its proposed trade-offs, both quantitative and qualitative. The information on those impacts is generated through the sponsor's options appraisal (for local impacts) and CAF analysis (for system-wide impacts).

8.4 In other words, the sponsor should not only propose trade-offs which present the lowest impact in terms of monetised value. Equally, the sponsor should not only propose trade-offs which meet its design principles regardless of the impacts (whether monetised or not). The sponsors need to propose trade-offs in a way which properly understands and accounts for impacts and stakeholder concerns specifically related to its designs. In doing so, it needs to look at the full picture – both in terms of local and system-wide impacts, and its design principles.

8.5 When the CAA reviews an ACP submission at Stage 5, we will need to ensure that any trade-offs are properly justified and supported by evidence as to how and why the sponsor arrived at its final proposed design. If the sponsor has placed too much weight on design principles in justifying its trade-offs, therefore disregarding the economic, environmental or other impacts of its designs, this

may result in a negative ACP decision, the need to revise its designs or commence a fresh ACP.

8.6 The case study in **Appendix B** showcases the practical application of design principles within the context of a hypothetical trade-off scenario.

Chapter 9

Habitats Regulations Assessment

9.1 Under CAF 1616f and the *Environmental Assessment Requirements and Guidance for Airspace Change Proposals* (**CAP 1616i**),[24] there are requirements relating to Habitats Regulations Assessment. It is in the interests of all parties to have regard to the need to avoid or minimise adverse effects on European sites through all stages of the CAP 1616 process.

9.2 In considering proposed trade-offs when assessing and deciding on individual airspace change decisions, the CAA will ascertain whether an ACP is likely to have a significant effect on a European site and therefore whether an appropriate assessment of the potential adverse effects of the proposal on that site is needed.

[24] CAA, *Environmental Assessment Requirements and Guidance for Airspace Change Proposals (CAP 1616i)* (November 2023). https://publicapps.caa.co.uk/CAP1616i

Chapter 10

Trade-off conclusions

10.1 As explained earlier in this document, there is no one-size-fits-all solution when it comes to proposing trade-offs. In many cases, the sponsor will be faced with finely balanced design choices which create a different mix of positive and negative impacts, and which deliver on their design principles in different ways.

10.2 By stepping through each of the legal tests and assessing how a trade-off performs against the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and its design principles, the sponsor will be able to gather the necessary data to propose trade-offs in a holistic and evidence-based way.

10.3 In doing so, the sponsor must propose trade-offs that deliver the objectives of the AMS. The trade-offs must prioritise maintaining a high standard of safety and secure system-wide benefits and overall network optimisation. This means maximising the efficient use of airspace and the resilience of the airspace network, while giving due consideration to local circumstances and environmental impacts. This is a fundamental objective of AMS and therefore a principle of the masterplan programme.

10.4 The CAA requires the following approach:

(a) The sponsor approaches trade-offs by looking first at the impacts of different trade-off choices, using the data that is developed by them through their options appraisals and CAF analysis. This can be done by evaluating impacts in categories (see pages 36 to 41 of CAP 1616f).

(b) The sponsor then examines how a proposed trade-off performs against the strategic objectives of the AMS and the material factors in section 70 of the Transport Act, based on an objective analysis of the anticipated impacts against each of the statutory factors. This can be done by linking each impact category with the relevant legal/policy factors and the beneficial/detrimental characteristics (**Annex A**) which can be used to help show how the proposal performs against those factors.

(c) Next, the sponsor determines how a proposed trade-off responds to its design principles, noting that some design principles may be conflicting or prioritised over others.

(d) Based on all the information, the sponsor proposes trade-offs which prioritise maintaining a high standard of safety and secure system-wide benefits and overall network optimisation.

10.5 Throughout each of these steps, it is essential that the sponsor explains and documents (including the evidence relied on) how the different factors have contributed to its ultimate decision on what trade-offs to propose to the CAA. The CAA will review this evidence when it assesses and decides on ACPs. Ultimately, the CAA will look to ensure that the sponsor has provided a robust, coherent and transparent design narrative and that any trade-offs proposed by the sponsor prioritise maintaining a high standard of safety and secure system-wide benefits and overall network optimisation.

10.6 Where trade-offs are unable to be resolved by sponsors in coordination with ACOG, the problem may be brought before the CAA and the DfT, as co-sponsors, to propose a resolution. The co-sponsors will select a trade-off solution to form part of the overall proposal based upon their views of the individual situation, in accordance with the principles in this document.

10.7 The case study in **Appendix B** takes you through each of these steps in a hypothetical trade-off scenario.

10.8 The flow chart in **Appendix C** provides a high-level outline of the trade-off process for masterplan ACPs.

Chapter 11

Policy framework

11.1 There is a large volume of government policy which applies to aviation and airspace change. This section summarises the government's key policies in this area. It is not intended to be exhaustive.

11.2 The CAA will look for consistency with government policy when assessing and deciding whether to approve ACPs, including any trade-offs that have led to the design being proposed by the sponsor in its submission.

11.3 The CAA has built these policies into the AMS and the CAP 1616 process. By developing its proposals in accordance with the AMS and the airspace change process, the sponsor can expect to have taken account of and applied these policies.

Aviation Policy Framework (March 2013)

The Aviation Policy Framework (**APF**) recognises that the aviation sector is a major contributor to the economy and sets out government support for the growth of the aviation sector within a framework that maintains a balance between the benefits of aviation and its costs.

The APF recognises that maintaining the UK's international connectivity is a complex and contentious one, but that solving it is crucial to securing the UK's long-term economic growth.

General Aviation Strategy (March 2015)

The General Aviation Strategy details the government's vision to make the UK the best place in the world for general aviation as a flourishing, wealth-generating and job-producing sector of the economy.

Upgrading UK Airspace: Strategic Rationale (February 2017)

The Upgrading UK Airspace paper describes the strategic national importance of an industry-led investment programme to upgrade the UK's airspace structure because it is outdated, inefficient and reaching its capacity. The report describes why the UK's airspace is being upgraded and how, and also gives an indication of what might happen if the modernisation does not happen, such as increased passenger delays and flight cancellations.

Air Navigation Guidance (October 2017)

The Air Navigation Guidance sets out the government environmental, airspace and noise management policies in relation to air navigation. It contains environmental objectives

relating to noise, global emissions and air quality which are designed to minimise the environmental impact of aviation within the context of supporting a strong and sustainable aviation sector. The guidance also covers policies for assessing the potential environmental impacts of airspace change options, such as the altitude-based priorities.

Airports National Policy Statement (June 2018)

The Airports National Policy Statement (**ANPS**) provides the primary basis for decision making on development consent order applications for the government's preferred scheme for a Northwest runway at Heathrow Airport to address the capacity gap identified by the Airports Commission.

Chapter 2 of the ANPS sets out the need for additional capacity in the South East of England. It states that aviation demand is likely to increase significantly with all major airports in the South East of England expected to be full by the mid-2030s, and that, even on the low demand forecast, demand is expected to outstrip capacity at these airports by at least 34% by 2050.

Chapter 3 of the ANPS sets out why the Heathrow Northwest Runway project, with a package of supporting measures, is Government's preferred option for meeting the need for new capacity in the South East of England.

Beyond the Horizon: Making Best Use of Existing Runways (June 2018)

The Making Best Use of Existing Runways (**MBU**) policy confirms government support for other UK airports making best use of their existing runways. It recognises that the development of airports can result in negative impacts as well as positive local impacts, and that any development seeking to make best use of their existing runway will therefore need to demonstrate how it will mitigate local environmental issues as part of their planning application.

The MBU policy is clear that airports that wish to increase either their passenger or air traffic movement caps will need to submit applications to the relevant planning authority.

Aviation 2050: The Future of UK Aviation (Dec 2018)

The Aviation 2050 green paper highlights that the UK has the largest aviation network in Europe and the third largest in the world and that aviation directly contributes at least £22 billion to the economy and supports around half a million jobs.

The aim of the proposed Aviation Strategy is to achieve a safe, secure and sustainable aviation sector that meets the needs of consumers and of a global, outward-looking Britain. The objectives of the proposed strategy are to: help the aviation industry work for its customers; ensure a safe and secure way to travel; build a global and connected Britain; encourage competitive markets; support growth while tackling environmental impacts; and development, innovation, technology and skills.

The Aviation 2050 green paper is clear that there is a need to increase capacity in the South-East by 2030, and that the forecasted aviation demand in the period to 2030 can be

met through a northwest runway at Heathrow and by other UK airports making best use of their existing runways, subject to environmental and other impacts being addressed.

Decarbonising Transport: A Better, Greener Britain (July 2021)

Decarbonising Transport is the government's plan to decarbonise the entire transport system in the UK, through a series of commitments and actions. The plan includes: the UK's pathway to net zero transport in the UK; the wider benefits that net zero transport can deliver; and the principles that underpin the UK's approach to delivering net zero transport.

The plan lays out the initiatives for accelerating aviation decarbonisation, such as consultation of a Jet Zero Strategy and sustainable aviation fuels mandate, emissions reduction targets and airspace modernisation.

Net Zero Strategy: Build Back Greener (October 2021)

The Net Zero Strategy (**NZS**) sets out the government's policies and proposals for decarbonising all sectors of the UK economy to meet the net zero target by 2050. The NZS includes: the UK's decarbonisation pathways to net zero by 2050, including illustrative scenarios; policies and proposals to reduce emissions for each sector; and cross-cutting action to support the transition.

Flightpath to the Future (May 2022)

Flightpath to the Future is a strategic framework that builds on the responses received to the Aviation 2050 consultation. It establishes the government's ambitions and commitments for aviation over the next 10 years. There are four key themes: enhancing global impact for a sustainable recovery, embracing innovation for a sustainable future, realising benefits for the UK and delivering for users.

These themes are underpinned by a ten-point plan. The plan highlights key priority areas which will help deliver the Government's commitment to growth, as well as supporting a modern, sustainable, and innovative sector for the future. This includes supporting growth in airport capacity where it is justified, putting the sector on course to achieve Net Zero by 2050 and capturing the potential of new technology and its uses.

Jet Zero Strategy: Delivering Net Zero Aviation by 2050 (July 2022)

The Jet Zero Strategy (**JZS**) is the government's sector-specific strategy for achieving net zero aviation by 2050. The strategy aims to reduce in-sector emissions from aviation by around 50% by 2050.

The guiding principles for the approach to delivery focus on the rapid development of technologies in a way that maintains the benefits of air travel while maximising the opportunities that decarbonisation can bring to the UK.

The strategy focuses its policies across seven measures: system efficiencies in airports, airspace and aircraft; sustainable aviation fuels; zero emission flight; markets and removals; consumer information; and addressing non-CO_2 impacts.

Overarching Aviation Noise Policy (March 2023)

The government's overall policy on aviation noise is to balance the economic and consumer benefits of aviation against their social and health implications in line with the International Civil Aviation Organisation's Balanced Approach to Aircraft Noise Management. This should take into account the local and national context of both passenger and freight operations, and recognise the additional health impacts of night flights.

The impact of aviation noise must be mitigated as much as is practicable and realistic to do so, limiting, and where possible reducing, the total adverse impacts on health and quality of life from aviation noise.

APPENDIX A

Beneficial and Detrimental Characteristics

A1 This appendix sets out examples of beneficial and detrimental characteristics of an ACP which can be used to demonstrate how the proposal impacts each of the strategic objectives of the AMS and material factors in section 70 of the Transport Act. The characteristics are examples only and are not an exhaustive list. The sponsor does not need to meet all of the characteristics and each proposal will be looked at in its own context.

A2 CAP 1616f describes the impact categories that the sponsor must consider in an ACP as part of their options appraisals. This provides a format for the presentation of impacts in individual ACPs, and is the format recommended in CAF for capturing proposed trade-offs. This appendix therefore links the strategic objectives of the AMS and material factors in section 70 of the Transport Act to the CAP 1616f impact categories in **lists A1** and **A2** respectively. These lists also highlights which of the strategic objectives of the AMS and material factors in section 70 of the Transport Act can be monetised and captured using the CAP 1616 cost-benefit methodology (in italics).

A1 - AMS Strategic Objectives Characteristics and Mapping Against CAP 1616 Impact Categories

AMS Strategic Objective 1: Safety

Maintaining and, where possible, improving the UK's high levels of aviation safety has priority over all other 'ends' to be achieved by airspace modernisation.

Beneficial Characteristics for this Objective

Safety remains the primary consideration. The characteristics that contribute positively or negatively to maintaining a high level of safety will vary and depend on individual circumstances.

Detrimental Characteristics for this Objective

As above

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

Safety assessment is performed in accordance with the *Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases* (CAP 760).[25]

AMS Strategic Objective 2: Integration

Airspace modernisation should, wherever possible, satisfy the requirements of operators and owners of all classes of aircraft, including the accommodation of existing users (e.g. commercial, General Aviation, military, taking into account interests of national security) and new users (e.g. remotely piloted aircraft systems, advanced air mobility, spacecraft, high-altitude platform systems).

Beneficial Characteristics for this Objective

- Facilitates access by diverse airspace users with a transition towards greater integration of air traffic.
- No segregation (e.g. aircraft types do not need to be segregated from one another, but can operate alongside one another in the same block of airspace)
- Where segregation is necessary, it is proportionate (e.g. in terms of volume, duration and time of day/year)
- Where segregation is necessary, mitigations are put in place to mitigate impacts (e.g. Danger Area Crossing Service for a proposed Danger Area)
- Facilitates the planning and ongoing demand for airspace (including utilising information available from flight intent/plan

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[25] CAA, *Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases) (CAP 760)* (December 2010):
https://publicapps.caa.co.uk/CAP760

- Enables an electronically interoperable environment (e.g. adoption of electronic conspicuity to enable integration)
- Manages airspace in a flexible, near real-time operation (e.g. maximises the amount of time that access is possible in airspace that at some point requires segregation)
- Allows for operators to achieve their desired business trajectory
- Greater integration of air traffic without adding undue complexity to the design of the airspace (i.e. routing and procedures).

Detrimental Characteristics for this Objective

- Fails to facilitate access by diverse airspace users
- Increases segregation of airspace (e.g. long/excessive periods of time set aside for airspace reservations, denying access to other users)
- Airspace is designed to accommodate a use which is not supported by credible evidence (e.g. larger volumes of controlled airspace than necessary)
- Does not facilitate the effective use of the electronic interoperability of the airspace
- Leads to a lack of interoperability between systems (e.g. lack of interoperability between aircraft/RPAS and ATM systems)
- Reduces the ability to manage airspace in a flexible, real-time operation
- Prevents, or reduces the opportunity for operators to achieve their desired business trajectory.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: General Aviation, Impact: Access**

The sponsor should describe how General Aviation access may be affected by providing commentary (supported by data where available) on the performance of the proposed design against each of these characteristics where relevant. Impacts to the military would also be captured under this category.

Quantifying and monetising effects to General Aviation in particular can be difficult due to it not involving scheduled activities.

AMS Strategic Objective 3: Simplification

Consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of traffic, accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumers.

Beneficial Characteristics for this Objective

- Introduces the least complex airspace design to satisfy the objectives of the airspace change (which may include airspace volume, airspace classification, ATM procedures or a combination of any of these)

- Is designed to optimise aircraft equipment capabilities to maximise their best equipment performance (e.g. performance-based navigation)
- Removes unnecessary airspace structures and/or alters the classification freeing up airspace capacity for other airspace users
- Increases the strength of airspace network resilience (e.g. reduces controller intervention)
- Increases capacity through optimised design
- Reduces delays for airspace users and enables the network to be more effectively managed (e.g. reduced need for STAM)
- Enables a high proportion of predicted movements, which are planned and/or follow pre-planned paths (predictability) (e.g. performance-based navigation)
- Greater integration of air traffic without adding undue complexity to the design of the airspace (i.e. routing and procedures)
- Reduces the need for airborne delays
- Results in a low number of controller interactions / tactical interventions, which may include 3D/4D operations – automatically managed utilisation of 3D
- Allows optimum sectorisation and/or number of air traffic controllers required to service demand
- Results in a consistent application of airspace classification and the use of rules set, applicable to that classification, making it simpler for users to understand available air traffic services
- Interoperability and consistency with international obligations including operational interfaces.

Detrimental Characteristics for this Objective

- Introduces and/or retains unnecessary complexities in airspace design
- Prevents the use of the best aircraft equipment capabilities (e.g. is designed with a lower navigational specification thus leads to larger volumes of airspace forming part of the design
- Results in the creation and/or maintenance of otherwise unnecessary airspace structures
- Reduces the strength of airspace network resilience (e.g. increases need for tactical controller intervention i.e. radar vectoring)
- Decreases capacity through poor design
- Increases the need for air traffic flow management thus the potential for delays for airspace users (e.g. increased need for short-term air traffic flow and capacity management measures)
- Reduces the predictability of air traffic movements
- Increases the need for airborne delays
- Increased number of controller interactions / tactical interventions
- Difficult for operator to navigate as they move from one type of airspace to another (i.e. complex boundaries)
- Unacceptable increase flight deck workload and increase in the risk of air traffic controller overload (e.g. increased pilot RT to request clarification of level, route etc)
- Does not allow for interoperability and consistency with international obligations.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: Wider Society, Impact: Capacity / Resilience**
- **Group: General Aviation / Commercial Airlines, Impact: Economic Impact from Increased Effective Capacity**

These categories are primarily focussed on improving the efficiency of the air traffic management system, reducing the complexity thereby decreasing the reliance of air traffic controllers which is a key determinant of current capacity and resilience.

- **Group: General Aviation / Commercial Airlines, Impact: Fuel Burn**

Expeditious flow will often, but not always, be synonymous with the shortest routes, and therefore the above category may also be used to illustrate benefits or costs against this objective.

Economic impacts can usually be monetised.

AMS Strategic Objective 4: Sustainability

Environmental sustainability will be an overarching principle applied through all airspace modernisation activities. Airspace modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace.

Beneficial Characteristics for this Objective

- Demonstrating that the environmental objectives of the Air Navigation Guidance have been met at a system-level
- Enables improvements to environmental impacts, or at least, no reduction in the level of environmental impact or protection at a system-level

Detrimental Characteristics for this Objective

- Failing to demonstrate that the environmental objectives of the Air Navigation Guidance have been met at a system-level
- Worsening of environmental impacts or the level of environmental protection at a system-level

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: Communities, Impact: Noise**
- **Group: Communities, Impact: Local Air Quality**
- **Group: Wider Society, Impact: Greenhouse Gas Emissions**

The environmental objectives of the Air Navigation Guidance 2017 are captured by the above categories. Note that in considering this strategic objective, the CAA assessment will include looking at how the ACP contributes to the overall aviation network in terms of environmental impacts rather than solely considering the proposal as an individual change

Significant impacts can be monetised using the Government's TAG methodology.

A2 - Transport Act, Section 70 Characteristics and Mapping Against CAP 1616 Impact Categories

Material Factor 1 (MF1) – Maintain a high standard of safety

Beneficial Characteristics for this Objective

Safety remains the primary consideration. The characteristics that contribute positively or negatively to maintaining a high level of safety will vary and depend on individual circumstances.

Detrimental Characteristics for this Objective

As above

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

Safety assessment is performed in accordance with the *Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases* (**CAP 760**).[26]

Material Factor 2 (MF2) – To secure the most efficient use of airspace consistent with the safe operation of aircraft and the expeditious flow of air traffic

Beneficial Characteristics for this Objective

<u>Most efficient use of airspace</u>

- Enabling more aircraft than is currently the case to use the airspace and there is a likelihood that capacity will be utilised
- Volume of regulated airspace (meaning controlled and subject to a classification other than G) is appropriate (including any buffer) for operations intending to use the airspace but no bigger
- Airspace classification is appropriate for operations intending to use the airspace, but classification is no higher than necessary
- High proportion of movements are sequenced

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[26] CAA, *Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases) (CAP 760)* (December 2010):
https://publicapps.caa.co.uk/CAP760

- High proportion of movements take place alongside similar aircraft or aircraft with similar capability (uniformity)
- High proportion of movements are planned and/or follow pre-planned path (predictability)
- Low number of controller interactions
- Least complex airspace design appropriate for the intended utilisation
- Enabling access to airspace in a flexible
- Appropriate surveillance capability for the intended use in accordance with national policy
- Minimising the occurrence of 'choke points'

Expeditious flow of traffic

- Enabling optimum routes (vertical and/or horizontal)
- Enabling 3D/4D operations (e.g. free routeing)
- Short or no delays (airborne holding or on the ground)

Detrimental Characteristics for this Objective

Most efficient use of airspace

- Reduces the total number of aircraft movements.
- Existence of obsolete or unused procedures and/or profiles.
- Inappropriate airspace classification that results in a reduction in the total number of aircraft in an airspace, for example because the airspace is classified as X when all the other factors in fact only require Y.
- A greater need for tactical interventions.
- A high number of controller interactions.

Expeditious flow of traffic

- Increasing gate-to-gate times
- Creating sub-optimal routes, e.g. longer track miles, stepped climbs / descents.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: Wider Society, Impact: Capacity / Resilience**
- **Group: General Aviation / Commercial Airlines, Impact: Economic Impact from Increased Effective Capacity**

These categories are primarily focussed on improving the efficiency of the air traffic management system, reducing the complexity thereby decreasing the reliance of air traffic controllers which is a key determinant of current capacity and resilience.

- **Group: General Aviation / Commercial Airlines, Impact: Fuel Burn**

Expeditious flow will often, but not always, be synonymous with the shortest routes, and therefore the above category may also be used to illustrate benefits or costs against this objective.

Economic impacts can usually be monetised.

Material Factor 3 (MF3) – Satisfy the requirements of operators and owners of all classes of aircraft

Beneficial Characteristics for this Objective

- Satisfy the requirements of all operators
- Minimum financial cost to operators using airspace (i.e. minimum cost of capability / equipment) (equipage)
- Enabling 3D/4D operations (for example, free routeing)
- Enabling trajectory-based operations and free route airspace
- Enable the most fuel efficient routes to be flown thereby reducing the cost of fuel for operators.

Detrimental Characteristics for this Objective

- Increasing costs to aircraft operators for access to airspace

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Economic Impact from Increased Effective Capacity**
- **Group: General Aviation / Commercial Airlines, Impact: Fuel Burn**
- **Group: Commercial Airlines, Impact: Training Costs**
- **Group: Commercial Airlines, Impact: Other Costs**

This factor is represented by the above categories which relate to airspace users.

These impacts can usually be monetised. However, quantifying effects to General Aviation in particular can often be difficult due to it not involving scheduled activities.

Material Factor 4 (MF4) – Take account of the interests of any person (other than an operator or owner of an aircraft) in relation to the use of any particular airspace or the use of airspace generally

Beneficial Characteristics for this Objective

- No increase or a reduction in third-party safety risk
- No reduction or an improvement in third-party impact

- Meets known requirements of interested parties, for example air navigation service providers, airports, government (local and national), non-governmental organisations, residents, general public
- No negative impact on other commercial interests.

Detrimental Characteristics for this Objective

- Increase in third-party safety risk
- A potential reduction in competition in a particular market – for example, between competing airports or operators
- Consequences that run counter to Government policy or instruction
- Increase in public annoyance due to overflights
- Negative impact upon tranquillity or visual intrusion in Areas of Outstanding Natural Beauty or National Park
- Negative impact upon biodiversity.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: Airport / Air Navigation Service Provider, Impact: Infrastructure Costs**
- **Group: Airport / Air Navigation Service Provider, Impact: Operational Costs**
- **Group: Airport / Air Navigation Service Provider, Impact: Deployment Costs**
- **Group: Airport / Air Navigation Service Provider, Impact: Other Costs**
- **Group: Wider Society, Impact: Tranquillity**
- **Group: Wider Society, Impact: Biodiversity**

This factor is represented by the above categories which relate to stakeholders involved in the ATM system, as well as local communities affected by the use of airspace.

The impacts to stakeholders involved in the ATM system can usually be monetised, whereas impacts in the tranquillity and biodiversity categories cannot.

Material Factor 5 (MF5) – Take account of any guidance on environmental objectives

Beneficial Characteristics for this Objective

- Demonstrating that the requirements and priorities of the Department for Transport's Air Navigation Guidance have been met
- Improvements to environmental impacts, or at least no reduction
- Improvement or no impact on any environmental factors required by the CAA.

<u>Noise</u>

Limits and, where possible, reduces the number of people in the UK significantly affected by adverse impacts from aircraft noise, by, for example:

- Using more noise efficient operational practices

- Minimising total population overflown
- Minimising the number of people newly overflown
- Enabling more continuous climbing and descending based on aircraft capability
- Avoiding population centres and noise-sensitive areas
- Enabling aircraft to navigate more accurately around population centres and noise-sensitive areas
- Demonstrating a broad range of options and flexibility in the approach to noise management to accommodate the needs of community stakeholders.

Greenhouse gas emissions

Ensures that the aviation sector makes a significant and cost-effective contribution towards reducing global emissions, by, for example:

- Reducing emissions per flight
- Enabling more direct flightpaths / fuel-efficient routes
- Enabling more frequent continuous climbing and descending
- Reducing the time taken for climbing aircraft to reach their optimum cruising altitude
- Reducing the need for holding.

Air Quality

Minimises local air quality emissions and in particular ensure that the UK complies with its international obligations on air quality, by, for example:

- Minimising the impact on the overall air quality pollution levels in the local area
- Complying with national air quality objectives and air quality standards, including limit and target values in the UK Air Quality Strategy.

Detrimental Characteristics for this Objective

- Failing to demonstrate that the requirements of the Air Navigation Guidance have been met
- Worsening of any environmental impacts
- Negative impact on any environmental factors required by the CAA.

Noise

- Fails to introduce climbing and descending performance based on aircraft capability
- Overflies population centres and noise-sensitive areas
- Introduces an inappropriate mix of options for noise dispersal and concentration.

Greenhouse gas emissions

- Increases emissions per flight
- Creates routes with longer track miles

- Introduces stepped climbs and descents / maintains inefficient climb and/or descent profiles
- Increases the taken for climbing aircraft to reach their optimum cruising altitude
- Increases the need for holding.

Air Quality

- Minimises the impact on the overall air quality pollution levels in the local area
- Breaches national air quality objectives and air quality standards, including limit and target values in the UK Air Quality Strategy.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

- **Group: Communities, Impact: Noise**
- **Group: Communities, Impact: Local Air Quality**
- **Group: Wider Society, Impact: Greenhouse Gas Emissions**

The environmental objectives of the Air Navigation Guidance 2017 are captured by the above categories.

Significant impacts can be monetised using the Government's TAG methodology. However, this methodology does not cover all impacts, in particular around noise distribution.

Material Factor 6 (MF6) – Facilitate the integrated operation of air traffic services provided by or on behalf of the armed forces of the Crown and other air traffic services

Beneficial Characteristics for this Objective

- Facilitates MOD access where required
- Maintenance of tactical freedom
- Use of common Communication, Navigation, Surveillance platforms negating technical non-compatibility
- Technical interoperability.

Detrimental Characteristics for this Objective

- Increase in costs imposed on Ministry of Defence
- Inadequate access for Ministry of Defence
- Increased resource implications for military Lower Airspace Radar Services units.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

While not expressly referenced as an impact category in CAP 1616f, engagement with, and consideration of the implications to, military airspace users should be captured in options appraisals where relevant.

Sponsors may want to include impacts to military airspace users, airports or air navigation service providers alongside the following category:

- **Group: General Aviation, Impact: Access**

Like General Aviation, impacts to the military may be difficult to monetise due to it involving unscheduled activities.

Material Factor 7 (MF7) – Take account of the interests of national security

Beneficial Characteristics for this Objective

- A proposal that maintains or improves national security
- A proposal that improves the ability to react to national security needs.

Detrimental Characteristics for this Objective

- A proposal that weakens national security
- Negative impact on tactical freedom / military training.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

While not expressly referenced as an impact category in CAP 1616f, engagement with, and consideration of the implications to, military airspace users should be captured in options appraisals where relevant.

Sponsors may want to include impacts to military airspace users, airports or air navigation service providers alongside the following category:

- **Group: General Aviation, Impact: Access**

Like General Aviation, impacts to the military may be difficult to monetise due to it involving unscheduled activities.

Material Factor 8 (MF8) – Take account of any international obligations of the United Kingdom notified to the CAA by the Secretary of State

Beneficial Characteristics for this Objective

No such international obligations have been notified to the CAA.

Detrimental Characteristics for this Objective

As above.

Relevant CAP 1616 and CAF Impact Categories (pages 36 to 41 of CAP1616)

N/A

APPENDIX B

Case studies

B1 The case studies in this appendix are purely illustrative. Their purpose is to demonstrate the practical application of the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and certain design principles, within the framework of a hypothetical trade-off scenario.

B2 A table format has been used to link each impact category (as per pages 36 to 41 of CAP 1616f) with the relevant legal/policy factors and the beneficial/detrimental characteristics to help show how the designs in this example perform against those factors. The proposed trade-offs and outcomes are descriptive only, based on the limited parameters of the case study. They are not directly applicable to real-life trade-off scenarios.

B3 Any actual ACP is highly context-specific and the trade-off choices in any given proposal will need to be based on individual circumstances, recognising that each airspace change varies greatly in terms of size, scale of impact and complexity. The trade-off selected in this example may not be those selected in any real-life scenario similar to this one.

B4 Case Study 1 looks at trade-offs based on CAF1 work. Case Study 2 looks at trade-offs based on CAF2 work. CAF1 an exercise to compare the benefits and impacts of route options against one another to help select which of those to progress with for full options appraisal. It is not an exercise to compare options for a complete system design against a baseline to show differences between options and what occurs today. The latter is achieved by CAF2.

Case Study 1: CAF1 Trade-Off Example

This is an example trade-off scenario showing how trade-offs and impact categories may influence which combinations of options are taken forward into full options appraisals by sponsors. The focus of CAF1 is on subsets of an overall cluster or deployment. The CAF2 case study presents system-wide trade-offs.

This case study looks at a theoretical trade-off between noise distribution, carbon and fuel effects. The example does not look at every possible category of impact.

Context:

- Airport X, Airport Y and the ANSP are currently sponsoring their own ACPs as part of the masterplan programme. They are part of the same cluster.
- All sponsors are currently at the beginning of Stage 3. They have collaborated with each other to identify an initial cluster design.
- In undertaking CAF Part I, they have reviewed interdependencies and identified one design conflict.
- Airport X's proposed departure route below 7000 ft has an impact on the design of ANSP 1's route above 7000 ft and on Airport Y's proposed arrival route below 7,000 ft.
- The design conflict needs to be resolved before the sponsors commence Stage 3 full options appraisal. This because each sponsor has a number of other options relating to more sensitive parts of the design to take through to FOA. This means they only have the capacity to take one scenario relating to this design conflict through to Full Options Appraisal.
- All sponsors have completed their design principles, which are the broadly the same - see list to the right.
- ANSP 1 has similar principles except for noise as their remit is above 7000 feet.

Noise

- **Discretionary Design Principle (DDP) Environment (Noise) -** the ACP should limit and, where possible, reduce the total adverse effects from aircraft noise from the ground to below 4,000 ft
- **DDP Environment (Sharing of Noise)** – the ACP should disperse traffic on multiple routes which can potentially provide relief or respite.
- **Bespoke Design Principle (BDP) Environment (Noise - Total Overflight) -** the ACP should minimise the total number of people overflown below 7,000 ft.
- **BDP Environment (Noise - New Overflight) -** the ACP should minimise the number of people newly overflown below 7,000 ft.

Greenhouse gases

- **DDP (Noise and greenhouse gas emissions) -** the ACP should limit and, where possible, reduce the total adverse effects from aircraft noise at or above 4,000 feet to below 7,000 feet, unless there is a disproportionate increase in greenhouse gas emissions.
- **DDP Environment (Greenhouse gas emissions) -** the ACP should minimise greenhouse gas emissions at or above 7,000 feet.

Capacity

- **DDP Operational (Capacity) -** the ACP should provide the greatest capacity benefits.

Other design principles exist but are not included in this example

Airport X's proposed SID routeing East (white dashed) crosses the arrival transition for Airport Y (**Black**).

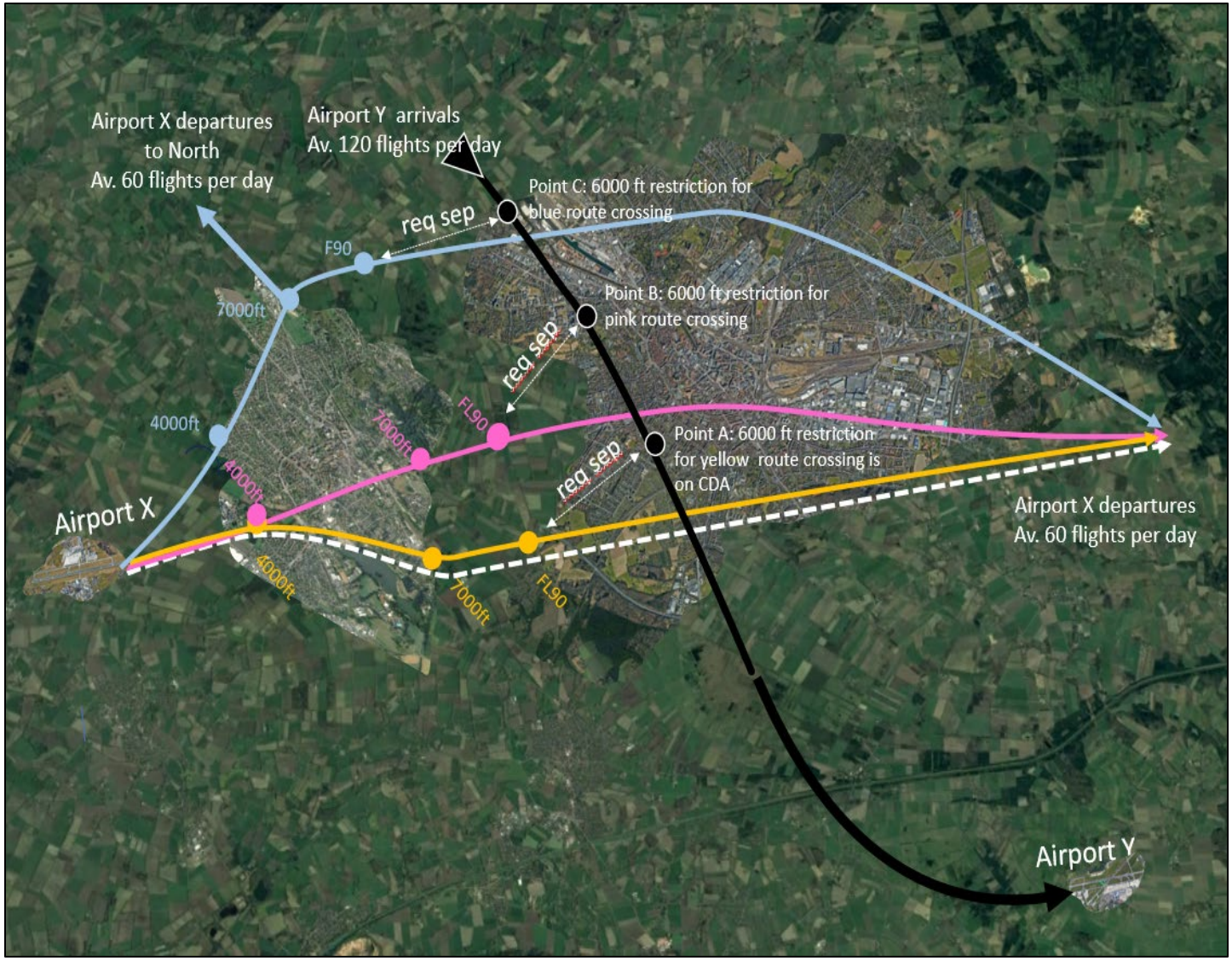
Airport X has four options for its SID which have different impacts on ANSP's route above 7000 ft and Airport Y's arrival transition.

Yellow Scenario: SID to East replicates today's track crossing above the arrival track without affecting the performance of Airport Y's continuous descent approach.

Pink Scenario: SID to East climbs to FL90, requiring the Airport Y arrival track to descend to 6000 ft earlier (Point B) to achieve the required separation before crossing.

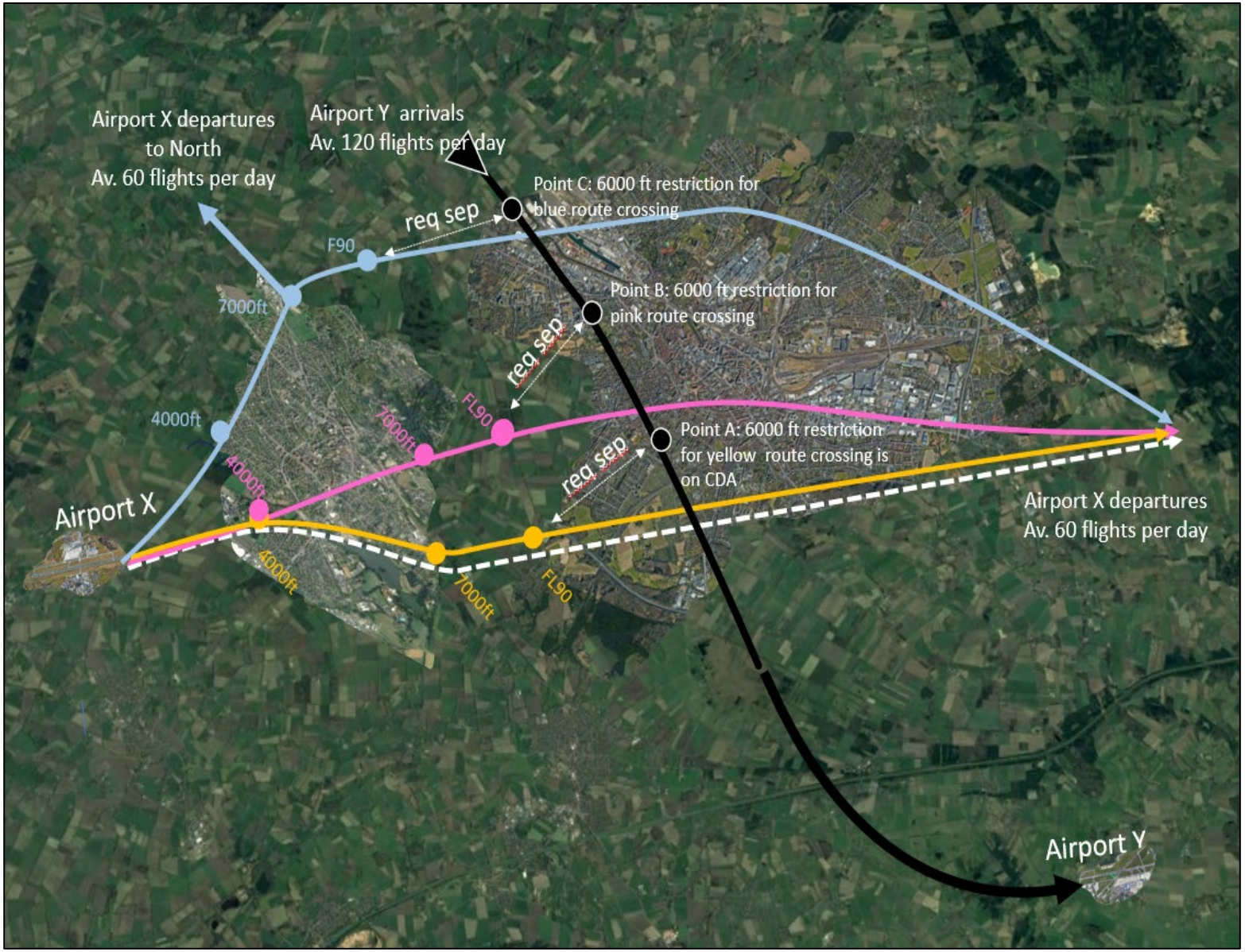
Blue Scenario: SID to East follows the same track as SID to North, requiring the arrival track to descend to 6000 ft earlier (Point C) to achieve the required separation before crossing.

Respite Scenario: both **pink** and **yellow** SIDs are used for dispersal/respite, requiring the Airport Y arrival track to descend to 6000 ft earlier (Point B) to achieve the required separation before crossing.



Overflight Impacts

Numbers show the population overflown by various parts of each route.



Review of Trade-Offs

- CAF Part I review of trade-offs compares the scenarios by considering the collective impact across all the impact categories listed in CAP 1616f.
- The options must be assessed against the strategic objectives of the AMS and the statutory factors in section 70 of the Transport Act 2000. The relationship between these factors and the impact categories listed in CAP 1616f is shown in **Appendix A**. The impact categories in CAP 1616f have been designed to address the relevant statutory factors; no additional categories are deemed necessary for this assessment.
- The options must also be assessed against the design principles. In many cases, the design principles will also be covered by the impact categories listed in CAP 1616f, but in some cases there may be additional impacts that need to be captured. In this example, additional categories are considered under noise for respite and people newly overflown.
- For this case study, there are no cumulative impacts to consider because there are no routes from separate ACPs that fly below 7,000 ft over the same areas (i.e. the overflight cones on the previous slide do not overlap).
- As per CAF Part I, one scenario must be identified as the 'comparison scenario'. The choice of comparison scenario does not affect the trade-off outcome. In this example, the Yellow Scenario is chosen as the comparison scenario.
- The following describes how the various scenarios perform in each impact category against the comparison scenario;
    - Scenario is significantly worse than comparison scenario
    - Scenario is worse than comparison scenario
    - 0 – No Difference
    - Scenario is better than comaprsion scenario
    - Scenario is significantly better than comparison scenario

Table B1: CAF1 Review of Trade-offs for Pink Scenario vs Yellow Scenario (the Comparison Scenario)

CAP1616 Impacts on Communities	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Noise impact on health and quality of life	0 - LAed or NX contours (for overflight see design principles below)	-	-
Air Quality (AMS4, MF5)	0	0	0
CAP1616 Impacts on Wider Society	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Greenhouse gas impact (AMS4, MF5)	0	+200 tonnes of CO2 per annum (due to earlier descent)	+200 tonnes of CO_2 per annum
Capacity / resilience (AMS3, MF2)	0	0	0
Tranquility	0	0	0
Biodiversity	0	0	0
CAP1616 Impacts General Aviation	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Access (AMS2, MF3)	0	0	0
CAP1616 Impacts on General Aviation/Commerical Airlines	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Economic impact from increased effective capacity (AMS3)	0	0	0
Fuel burn (AMS3, MF2)	0	+65 tonnes of fuel per annum (due to earlier descent)	+65 tonnes of fuel per annum
CAP1616 Impacts on Commercial Airlines	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Training Costs (MF3)	0	0	0
Other Costs (MF3)	0	0	0
CAP1616 Impacts on Airports/Airports Navigation Services Provider	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Infrastructure Costs (MF4)	0	0	0
Operational Costs (MF4)	0	0	0
Deployment Costs (MF4)	0	0	0
Design Principles	**Airport X eastbound departure**	**Airport Y Arrival**	**Collective Impact**
Impact	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**
BDP Environment (Noise - Total Overflight) - the ACP should minimise the total number of people overflown below 7,000 ft (AMS 4, MF5)	-2,000 net reduction in people overflown between 4,000 ft and 7,000 ft	+500 people overflown below 7,000ft (due to earlier decent)	-1,500 people overflown below 4,000 ft and 7,000 ft
DDP Environment (Sharing of Noise) - the ACP should disperse traffic on multiple routes which can potentially provide relief or respite (AMS 4, MF5)	0	0	0
BDP Environment (Noise - New Overflight) - the ACP should minimise the number of people newly overflown below 7,000 ft (AMS 4, MF5)	3,000 people newly overflown (below 7,000 ft)	1,500 people newly overflown (below 7,000 ft)	4,500 people newly overflown (below 7,000 ft)

Trade-Off Conclusions for Pink Scenario vs Yellow Scenario

- Airport X individually favours the pink route over the yellow route on the basis that it directly overflies 2,000 fewer people albeit with 3,000 people newly overflown.
- However, choosing the pink route would require a restriction to Airport Ys arrival and so would negatively affect the performance of the Airport Y arrival in terms of:
  - people overflown (500 more) of whom all would be newly overflown below 7,000 ft; and
  - CO_2/fuel burn (an extra 200 tonnes of CO_2 and 65 tonnes of fuel per annum, respectively).
- The sponsors consider the impacts against the beneficial and detrimental characteristics in **Appendix A**, and their design principles.
- In this example, the sponsors may propose to the CAA that the collective benefit of a reduction in people overflown between 4,000 and 7,000 ft (which would be beyond the Lowest-observed-adverse-effect level (LOAEL) noise contour), does not outweigh the detrimental impact expressed by the number of newly overflown people, increase in CO_2 emissions caused by the earlier descent profile, and associated increases in fuel burn. Accordingly, they would propose to discontinue the pink route before full options appraisal.

- Alternatively, the sponsors may propose to the CAA to discontinue the yellow route based on the net reduction of people overflown resulting from the pink route. In terms of environmental priorities, they would need to conclude there is no disproportionate increase in CO_2 emissions from prioritising the reduction of noise between 4,000 and 7,000 ft.
- In all cases, the choice must be evidenced and made considering the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and the design principles.
- For the purposes of this fictitious case study, it is assumed that the sponsors have proposed the former - i.e. to discontinue the pink route.

Table B2: CAF1 Review of Trade-offs for Blue Scenario vs Yellow Scenario (the Comparison Scenario)

CAP1616 Impacts on Communities	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Noise impact on health and quality of life	No difference to LAed or NX contours (for overflight see design principles below)	-	-
Air Quality (AMS4, MF5)	0	0	0
CAP1616 Impacts on Wider Society	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Greenhouse gas impact (AMS4, MF5)	+600 tonnes of CO^2 per annum (due to earlier descent)	+ 400 tonnes of CO^2 per annum (due to earlier descent)	+1,000 tonnes of CO^2 per annum
Capacity / resilience (AMS3, MF2)	Sharing SID will reduce departure split from 2 mins to 1 min, reducing runway capacity	0	Airport X capacity impact
Tranquility	0	0	0
Biodiversity	0	0	0
CAP1616 Impacts General Aviation	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Access (AMS2, MF3)	0	0	0
CAP1616 Impacts on General Aviation/Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Economic impact from increased effective capacity (AMS3)	Economic cost of fewer slots (qualitative only)	0	Economic cost of fewer slots for Airport X
Fuel burn (AMS3, MF2)	+ 190 tonnes of fuel per annum (due to longer SID)	+130 tonnes of fuel per annum (due to earlier descent)	+310 tonnes of fuel per annum
CAP1616 Impacts on Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Training Costs (MF3)	0	0	0
Other Costs (MF3)	0	0	0
CAP1616 Impacts on Airports/Airports Navigation Services Provider	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Infrastructure Costs (MF4)	0	0	0
Operational Costs (MF4)	0	0	0
Deployment Costs (MF4)	0	0	0

Design Principles	Airport X eastbound departure	Airport Y Arrival	Collective Impact
Impact	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
BDP Environment (Noise - Total Overflight) - the ACP should minimise the total number of people overflown below 7,000 ft (AMS 4, MF5)	-2,000 net reduction in people overflown between 4,000 ft and 7,000 ft	+500 people overflown below 7,000ft (due to earlier decent)	-1,500 people overflown below 4,000 ft and 7,000 ft
DDP Environment (Sharing of Noise) - the ACP should disperse traffic on multiple routes which can potentially provide relief or respite (AMS 4, MF5)	0	0	0
BDP Environment (Noise - New Overflight) - the ACP should minimise the number of people newly overflown below 7,000 ft (AMS 4, MF5)	3,000 people newly overflown (below 7,000 ft)	1,500 people newly overflown (below 7,000 ft)	4,500 people newly overflown (below 7,000 ft)

Trade-Off Conclusions for Blue Scenario vs Yellow Scenario

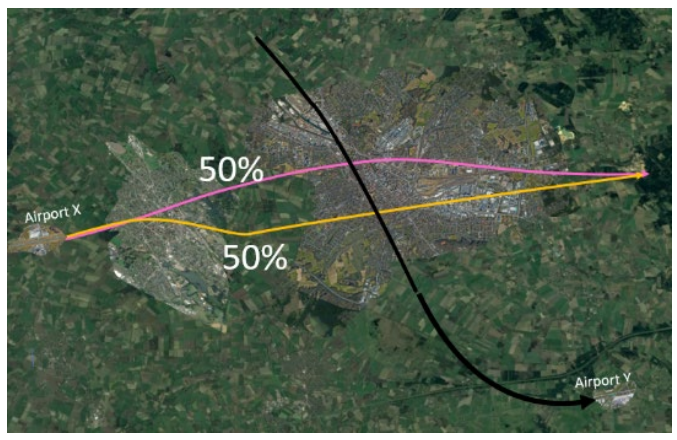
- Airport X has identified an option that reduces the number of people overflown, however, it has a number of disadvantages both locally and collectively.
- The sponsors consider the impacts against the beneficial and detrimental characteristics in **Appendix A**, and their design principles.
- In this example, the sponsors may proposed to the CAA that the collective benefit of a reduction in people overflown between 4,000 and 7,000 ft (which would be beyond the LOAEL noise contour), does not outweigh the detrimental impact expressed by the capacity impacts on Airport X, increase in CO_2 emissions caused by the longer SID and earlier descent profile, and associated increases in fuel burn. Accordingly, they would discontinue the blue route before full options appraisal.
- Alternatively, the sponsors may propose to the CAA to continue with both the blue route because of overflight impacts and yellow route based on capacity, CO_2 emission and fuel burn results.
- In all cases, the choice must be evidenced and made considering the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and the design principles.
- For the purposes of this fictitious case study, it is assumed that the sponsors have proposed the former - i.e. to discontinue the blue route.

Table B3: CAF1 Review of Trade-offs for Respite (Pink and Yellow) vs Yellow Scenario (the Comparison Scenario)

CAP1616 Impacts on Communities	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Noise impact on health and quality of life	No difference to LAed or NX contours (for overflight see design principles below)	-	-
Air Quality (AMS4, MF5)	0	0	0
CAP1616 Impacts on Wider Society	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Greenhouse gas impact (AMS4, MF5)	0	+100 tonnes of CO^2 per annum (due to earlier descent)	+100 tonnes of CO^2 per annum
Capacity / resilience (AMS3, MF2)	0	0	0
Tranquillity	0	0	0
Biodiversity	0	0	0
CAP1616 Impacts General Aviation	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Access (AMS2, MF3)	0	0	0
CAP1616 Impacts on General Aviation/Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Economic impact from increased effective capacity (AMS3)	0	0	0
Fuel burn (AMS3, MF2)	0	+33 tonnes of fuel per annum (due to earlier descent)	+33 tonnes of fuel per annum
CAP1616 Impacts on Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Training Costs (MF3)	0	0	0
Other Costs (MF3)	0	0	0
CAP1616 Impacts on Airports/Airports Navigation Services Provider	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Infrastructure Costs (MF4)	0	0	0
Operational Costs (MF4)	0	0	0
Deployment Costs (MF4)	0	0	0

Design Principles	Airport X eastbound departure	Airport Y Arrival	Collective Impact
Impact	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**
BDP Environment (Noise - Total Overflight) - the ACP should minimise the total number of people overflown below 7,000 ft (AMS 4, MF5)	-3000 people overflown (below 7,000 ft)	+500 people overflown below 7,000ft (due to earlier decent)	+3,500 people overflown below 7,000 ft
DDP Environment (Sharing of Noise) - the ACP should disperse traffic on multiple routes which can potentially provide relief or respite (AMS 4, MF5)	Flights to East spread over two routes from 4,000 ft		Flights to East spread over two routes from 4,000 ft
BDP Environment (Noise - New Overflight) - the ACP should minimise the number of people newly overflown below 7,000 ft (AMS 4, MF5)	3,000 people newly overflown below 7,000 ft	1,500 people newly overflown (below 7,000 ft)	4,500 people newly overflown (below 7,000 ft)

Trade-Off Conclusions for Respite (Pink and Yellow) vs Yellow Scenario



- Airport X has identified an option to spread the departing flights over two routes for dispersal/respite.
- The sponsors consider the impacts against the beneficial and detrimental characteristics in **Appendix A**, and their design principles.
- This option would increase the number of people overflown, and those newly overflown. The use of the pink route would add a restriction to Airport Y's arrival which would add further collective disadvantage in terms of people overflown overall and the number newly overflown below 7,000 ft.
- In this example, the sponsors may propose to the CAA that the collective impact, especially the increased population overflown (all of whom would be newly overflown) and the capacity limitation on Airport Y's arrival, justifies discontinuation of the design where both the pink and yellow routes are used in advance of the full options appraisal.
- Alternatively, the sponsors may propose to the CAA that the spreading of flights across two routes for respite best meets the DDPs for noise and discontinue the yellow route.
- In all cases, the choice must be evidenced and made considering the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and the design principles.
- For the purposes of this fictitious case study, it is assumed that the sponsors have proposed the former - i.e. to discontinue the pink and yellow route options.

Overall Conclusion from Case Study 1

- The three CAF1 comparisons above provide an evidential basis for discontinuing some options in favour of others ahead of the sponsors' full options appraisals.
- In this fictitious example, the yellow route was proposed by sponsors to have a better collective performance than the pink route, the blue route and a combination of pink and yellow (note that this fictious case study example shows how sponsors can collectively make choices - it does not present a precedent for actual decisions).
- This evidence would be presented in the ACP as the basis for resolving the interdependency with the yellow route (with the pink, blue and pink /yellow route options being discontinued before full options appraisal).

Case Study 2: CAF2 Trade-Off Example

This case study is for trade-offs proposed before selecting the final design for submission in Stage 4 of the CAP 1616 process.

Context:

- Airport X, Airport Y and ANSP are currently sponsoring their own ACPs as part of the masterplan programme. They are part of the same cluster.
- All sponsors are at Stage 4 of the CAP 1616 process.
- Each Airport has two consulted on two airport system options, and ANSP has consulted on a single network design option.
- The airport options were developed, before conducting their full options appraisals, to be safe (and therefore operationally compatible) with the NERL network design option. However, there were some dependencies between the options for each airport.

Combination	Airport X Option A	Airport X Option B
Airport Y Option A	Compatible	Compatible
Airport Y Option B	Unsafe - discontinued	Compatible

- This information on compatibility was presented in the consultation.
- As a result, there are three viable combinations of options (A&A, A&B and B&B).
- The collective performance of these options as been assessed in line with CAF2 which compares cluster-wide performance against a cluster-wide baseline. The key differences are presented in the following tables.
- The collective impacts of the options are then presented in graphs.

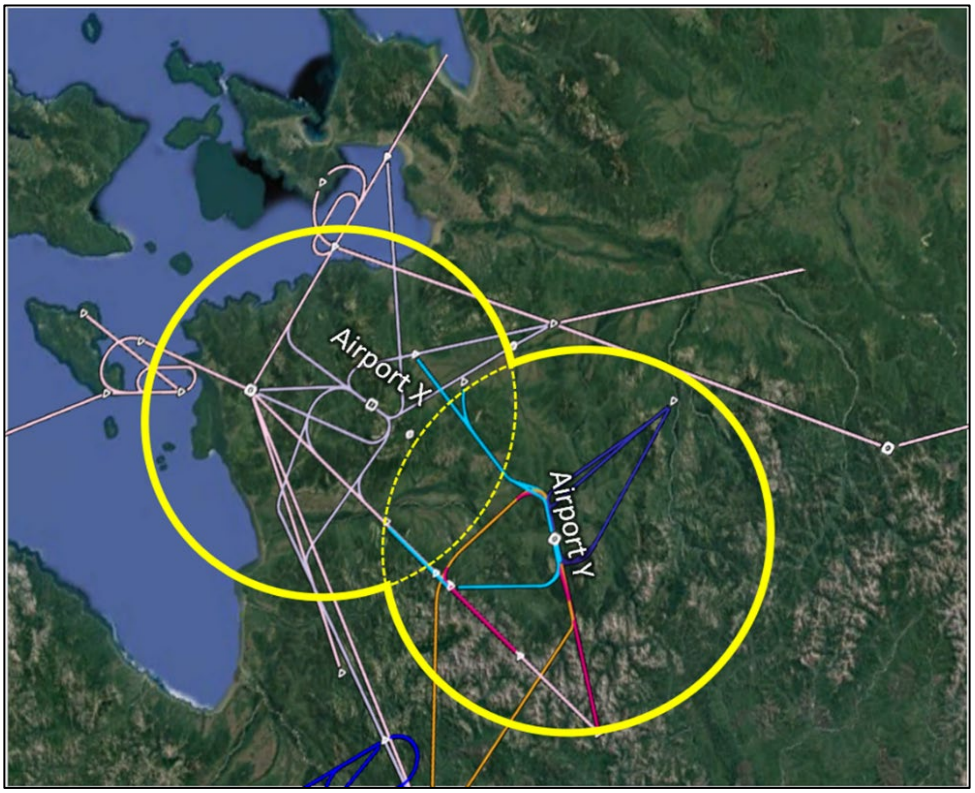
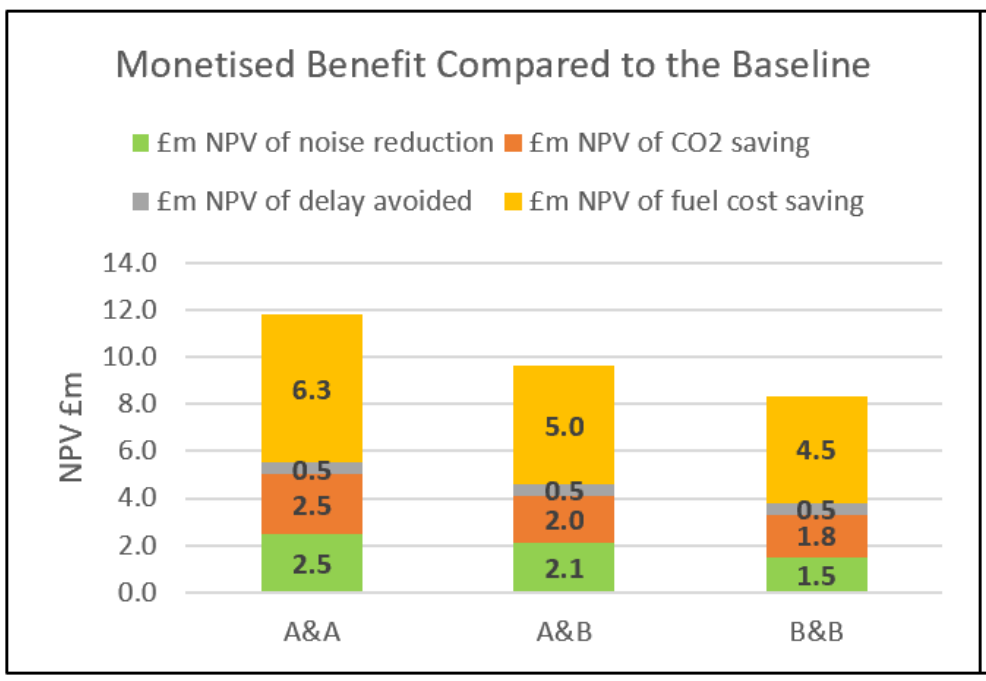

Airport X
Airport Y

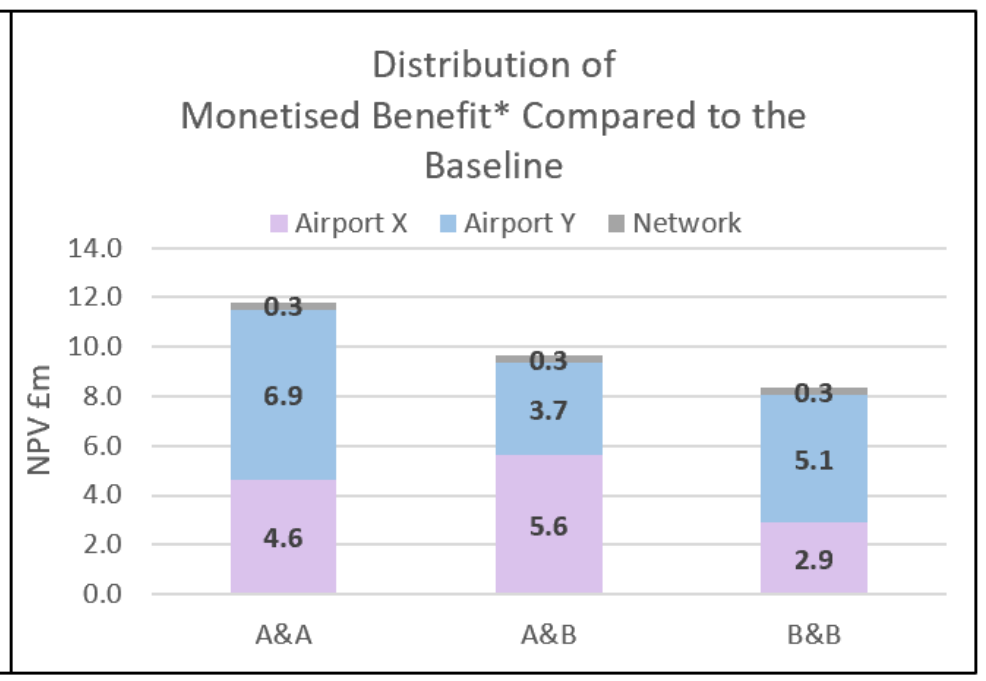
Table B4: CAF2 Collective Impact for the Cluster for Each Viable Combination

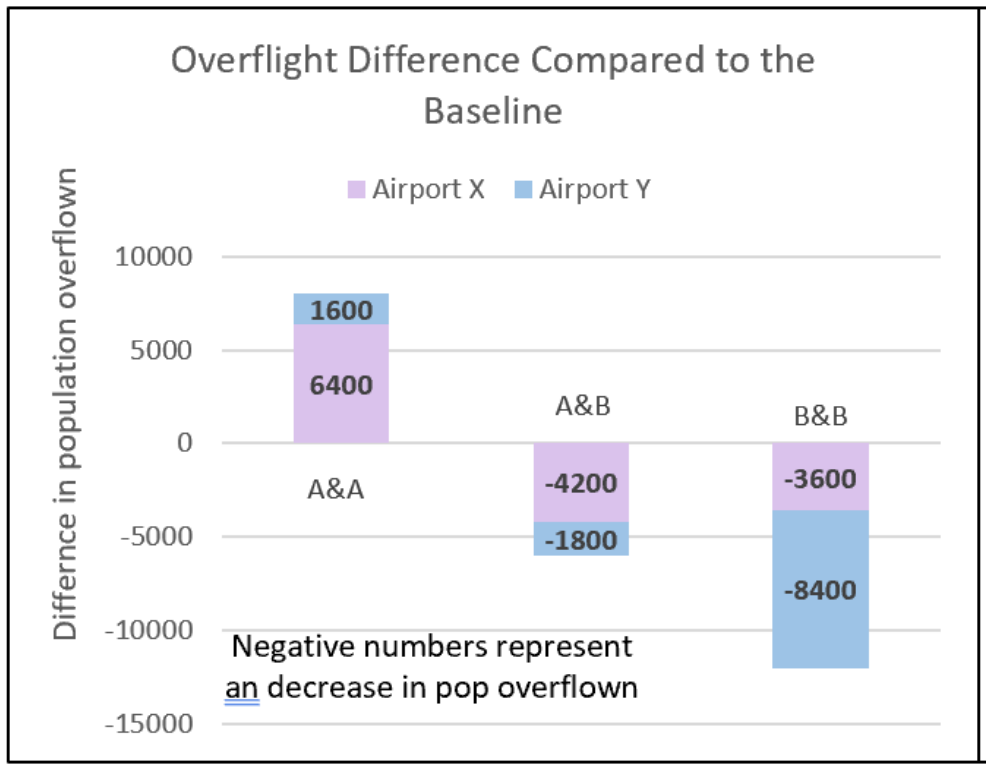
CAP1616 Impacts on Communities	A&A vs Baseline	A&B vs Baseline	B&B vs Baseline
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Noise impact on health and quality of life	TAG NPV of noise reduction: £2.5 m	TAG NPV of noise reduction: £2.1 m	TAG NPV of noise reduction: £1.5 m
Air Quality (AMS4, MF5)	0	0	0
CAP1616 Impacts on Wider Society	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Greenhouse gas impact (AMS4, MF5)	TAG NPV of CO2 avoided: £2.5 m	TAG NPV of CO2 avoided: £2.0 m	TAG NPV of CO2 avoided: £1.8 m
Capacity / resilience (AMS3, MF2)	All scenarios reduce en-route and airport delay by the same amount - this is quantified below under 'Economic Impact from increased effective capacity'	-	-
Tranquillity	Increase in designated areas overflown: 30 km^2	Increase in designated areas overflown: 40 km^2	Increase in designated areas overflown: 35 km^2
Biodiversity	0	0	0
CAP1616 Impacts General Aviation	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Access (AMS2, MF3)	0	0	0
CAP1616 Impacts on General Aviation/Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Economic impact from increased effective capacity (AMS3)	NPV of delay avoided: £0.5 m	NPV of delay avoided: £0.5 m	NPV of delay avoided: £0.5 m
Fuel burn (AMS3, MF2)	NPV: +£6.3 m	NPV: +£5.0 m	NPV: +£4.5 m
CAP1616 Impacts on Commercial Airlines	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Training Costs (MF3)	0	0	0
Other Costs (MF3)	0	0	0
CAP1616 Impacts on Airports/Airports Navigation Services Provider	Airport X eastbound departure	Airport Y Arrival	Collective Impact
	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics	Beneficial and/or Detrimental Characteristics
Infrastructure Costs (MF4)	0	0	0
Operational Costs (MF4)	0	0	0
Deployment Costs (MF4)	0	0	0

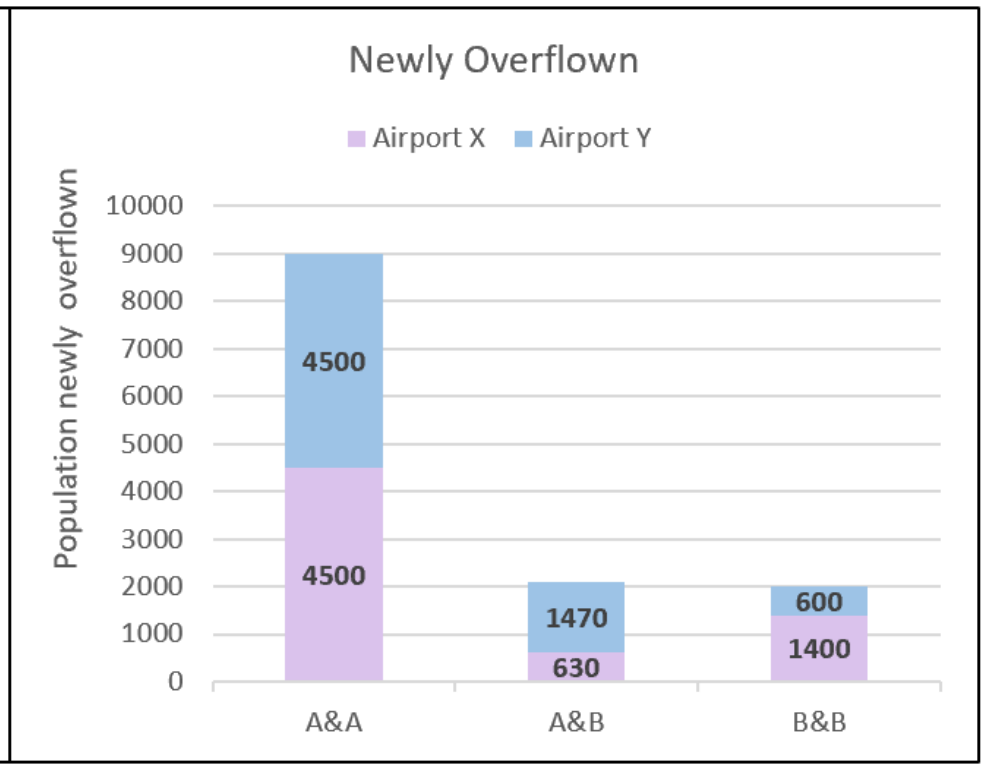
Design Principles	Airport X eastbound departure	Airport Y Arrival	Collective Impact
Impact	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**	**Beneficial and/or Detrimental Characteristics**
BDP Environment (Noise - Total Overflight) - the ACP should minimise the total number of people overflown below 7,000 ft (AMS 4, MF5)	+8,000 (Difference in population overflown)	-6,000 (Difference in population overflown)	-12,000 (Difference in population overflown)
DDP Environment (Sharing of Noise) - the ACP should disperse traffic on multiple routes which can potentially provide relief or respite (AMS 4, MF5)	Some respite is reduced (supported by communities currently overflown)	0 (respite routes not in baseline or combination)	0 (respite routes not in baseline or combination)
BDP Environment (Noise - New Overflight) - the ACP should minimise the number of people newly overflown below 7,000 ft (AMS 4, MF5)	People newly overflown: 9,000	People newly overflown: 2,100	2,000 people newly overflown

CAF2 Collective Impacts – Graphs







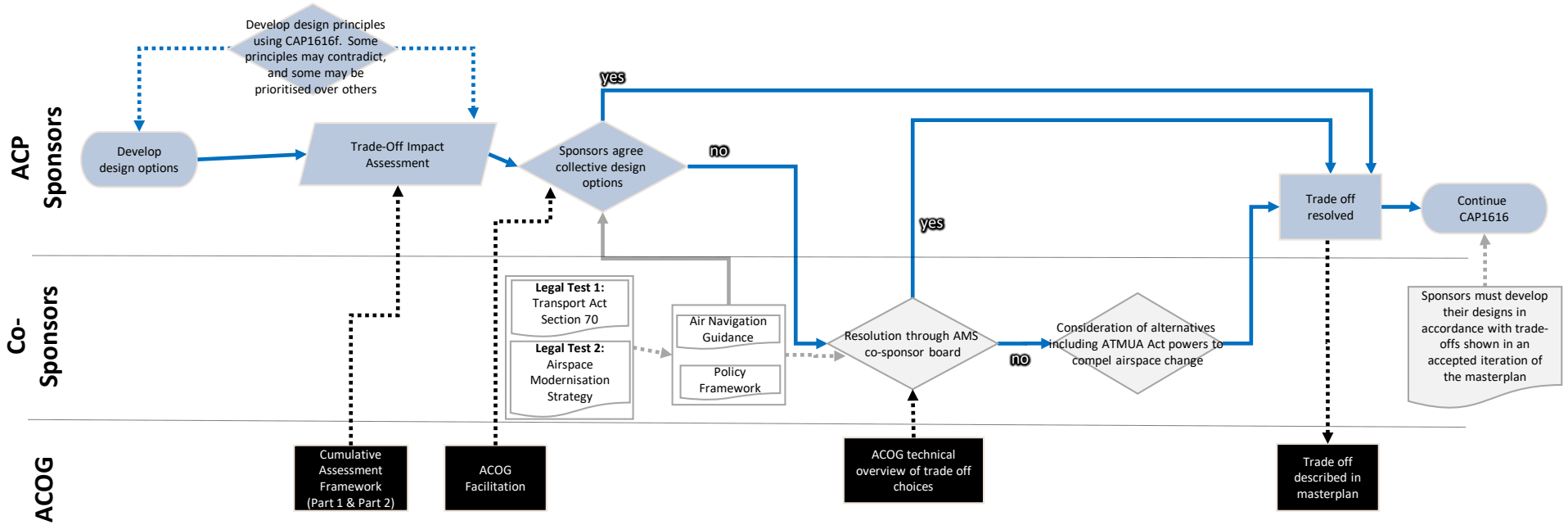


Trade-Off Conclusions

- The sponsors consider the impacts against the beneficial and detrimental characteristics in **Appendix A**, and their design principles.
- Combination A&A has the highest NPV capturing monetised aspects of in terms of monetised capacity/delay reduction benefit, adverse noise impacts and CO_2 reduction.
- However, combination A&A is detrimental terms of the overflight and newly overflown design principles when compared to either of the alternatives. Furthermore, consultation responses indicated significant objection to combination A&A from the overflown communities, in particular those newly overflown.
- On this basis, all sponsors therefore agreed that combination A&A should be discontinued.
- Airport X favours combination A&B because the option gives them the best NPV and set of broader results, whereas Airport Y favours combination B&B for the same reasons.
- In this example, the sponsors may propose to the CAA to select combination A&B as the final cluster-wide design for their coordinated submissions in Stage 4, having concluded that this combination is anticipated to provide a greater collective benefit than combination B&B, while still creating benefits locally in terms of the overflight and newly overflown design principles (when compared to combination A&A).
- Alternatively, the sponsors may propose combination B&B over combination A&B to the CAA based on the decrease in population overflown in the context of the sponsors' design principles and evidence from the consultations, despite the lower NPV.
- In all cases, the choice must be evidenced and made considering the strategic objectives of the AMS, the material factors in section 70 of the Transport Act and the design principles.

APPENDIX C

Trade-off Flow Chart for Masterplan ACPs



Description: This is a flow chart of the Masterplan trade-off process. It shows the key stages as described in this procedure. A sponsor first develops design principles and design options. Where there are interdependent and conflicting designs between ACPs, the relevant sponsors carry out a trade-off impact assessment, informed by the CAF1 and CAF2 frameworks. Based on that assessment, the sponsors agree collective design options, facilitated by ACOG (as needed). Where trade-offs are unable to be resolved by sponsors in coordination with ACOG, the problem may be brought before the CAA and the DfT, as co-sponsors, to propose a resolution. Once the trade-off is resolved, the sponsors continue with the next stages of CAP 1616 process.