UK Airspace Change

Masterplan Iteration 2

Version 2.2, March 2022

ACOG

Revision history

Minor revisions were made to this document in March 2022 to create version 2.2 that:

- Made adjustments to improve the accessibility of the document
- Addressed minor typos and administrative corrections, including an update to Luton airports annual passenger numbers in Table 8 from 18.2m to 17.9m (to align with Luton airports rolling 12 month total passenger statistic report - December 2019)

Contents

List of tables

List of figures

Foreword

This document represents the first tangible step towards a nationwide plan to redesign and upgrade the UK's national airspace system, our invisible infrastructure in the sky. The network of routes allows thousands of aircraft to fly through the UK every year, in the same way that our roads and railways keep people and goods moving on the ground.

While the current airspace has served the aviation sector successfully for more than 70 years, it has remained largely unchanged and is now inefficient and out-dated. It was never envisaged that our airspace would need to cope with the volume of flights – over 2.5 million a year – that it did in 2019 and will have to once more as traffic levels recover and continue to grow still further. Nor is it only commercial flights that need to be accommodated in the national airspace system. General and Business Aviation (worth approx. £3Bn per annum to the UK economy), military defence requirements and the rapid increase of new entrants like commercial drones will increase pressure on this scarce resource, as will meeting the industry's sustainability ambitions.

The national airspace needs to modernise dramatically to cope with these increasing capacity pressures while remaining safe, resilient and driving out the many and varied inefficiencies that characterise the current system.

The need to upgrade airspace was laid out in the UK's Airspace Modernisation Strategy (AMS) published in December 2018. It requires the main airports to redesign their airspace (below 7000ft) and for NATS, the UK's main navigation service provider, to modernise the network that sits above, known as en-route airspace The Airspace Change Organising Group (ACOG) was set up in 2019 under the direction of the UK Government Department for Transport and Civil Aviation Authority to coordinate the national programme and create a strategic coordinated Masterplan for UK airspace

This second iteration of the Masterplan follows an initial master plan that was produced by NATS in 2019 and sets out the first system wide view of the component airspace change proposals being developed by the 21 commercial airports taking part in the programme. It has been submitted to the CAA and DfT as co-sponsors of the AMS with a view to being formally accepted into the AMS via the CAA's published process CAP 2156a. It is envisaged that there will be at least a further two iterations of the Masterplan which will be developed as the participating airports further develop their airspace change proposals.

With the programme only remobilising in April 2021 following the Covid-19 pandemic, this iteration of the Airspace Masterplan is predominantly a qualitative series of judgements on potential interdependencies, conflicts and their effects on all aviation stakeholders and communities that might be affected by change.

Section A sets out where, when and why changes are needed and the sequence of those changes. The programme comprises four 'clusters' of change based on the geographical location of airports' terminal airspace structures by region (known as terminal manoeuvring areas or TMAs). These are: the West Terminal Airspace (WTA); the Manchester TMA (MTMA); the Scottish TMA (STMA); and the London TMA (LTMA) and have been identified by NATS as needing alignment with its medium and upper airspace programmes. There are no specific dependencies between the clusters hence the ability to manage the Masterplan in iterative “bite sized chunks”.

Section B sets out the programme plan and the deployment sequence of the clusters using a modular approach to drive early benefits into the overall programme. It is envisaged that the less complex WTMA and STMA could deploy in early 2025, with the MTMA and LTMA following in 2026 out to 2029. This section also demonstrates potential interdependencies, their implications and the prospects for trade-offs and solutions where designs compete for airspace.

As the programme has yet to develop definitive airspace change designs, the content is necessarily qualitative and illustrative at this stage. This section also describes the approach used to engage with stakeholders on the development of the current iteration and provides information on the approach to a public engagement exercise to be carried in 2022 as part of developing the next iteration. Stakeholders will be able to contribute views on interdependencies, highlight gaps and suggest improvements to the Masterplan.

This section concludes by describing the impact of the proposed changes on other airspace users such as general and business aviation including rotary, gliders and military and commercial Unmanned Aerial Vehicles (UAVs). It explores how current initiatives might generate benefits and mitigate the risks associated with change for all those that require access to the UK’s airspace.

This has been a significant undertaking over the last year in very demanding circumstances as the aviation industry has been tackling the fallout from the pandemic. With £5.5m of Government funding granted in 2021 and the potential for a further £2.5m in 2022, ACOG remains on target to deliver on this critical national infrastructure programme which will future proof the UK’s skies and support the industry meet their net zero ambitions.

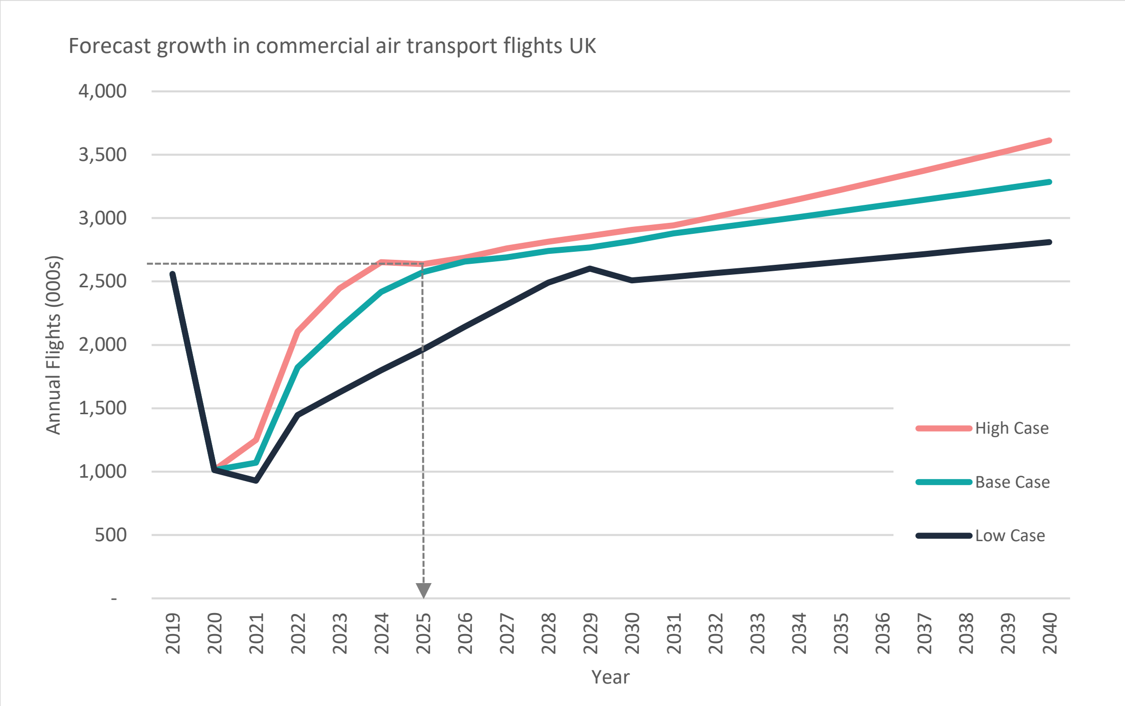
INTRODUCTION

1.1. Strategic Rationale for Airspace Modernisation

1. Aviation keeps people connected and provides the international access that the UK needs for business, tourism and overall economic growth. The UK's airspace served over 2.6 million commercial air transport flights in 2019, prior to the Covid-19 pandemic. Approximately 300 million passengers travelled through the UK's airports that year, together with over 2 million tonnes of freight (40% of all UK imports and exports by value). The UK already enjoys strong global air connectivity. Over 80% of all transatlantic flights pass through the UK's airspace in normal times. Although this has changed temporarily with the Covid-19 pandemic, it remains critical that the UK maintains its place as a global aviation hub. Aviation forecasts from May 2021 estimate that total annual traffic in the UK's airspace will return to pre-pandemic levels during 2025. Assuming unconstrained demand, growth is then estimated to continue at a rate of approximately 1.5% per year (base case) to 2040, where commercial air transport is predicted to reach approximately 3.3 million flights (a 28% increase on 2019), as illustrated in Figure 1.[1]

Figure 1: Forecast growth in commercial air transport flights in the UK's airspace, 2021 - 2040

[1] EUROCONTROL STATFOR forecast (2021 to 2025). NERL forecast growth estimates (2026 to 2040). The assumptions underpinning the base, low and high case scenarios are set out in Appendix D.



2. The General Aviation (GA) sector is also an important user of the UK's airspace. There are over 20,000 GA aircraft registered in the UK covering business aviation, pilot training and emergency services as well as sports, leisure and other private flying. Collectively, the GA sector contributes c. £3 billion to the overall worth of UK aviation.[2] In addition, the military is an important airspace user and air navigation service provider that plays a leading role in the development of innovative new approaches to air traffic operations and the flexible use of airspace. More recently, a new range of operators, including unmanned aerial systems (UAS), advanced air mobility (AAM) and commercial space flights are pioneering the next generation of aviation products and services that will need access to the UK's airspace.

3. All forms of aviation are dependent on the quality and performance of the airspace to meet the increasing demand for air travel and flying generally. At the same time, the aviation sector as a whole is experiencing growing pressure to reduce the environmental impact of flights and help the UK to achieve its commitment to net zero emissions. The Government set out its proposed approach and principles to reach net zero aviation by 2050 in its 2021 Jet Zero consultation. The approach aims to decarbonise aviation in a way that preserves the benefits of air travel and maximises the opportunities that decarbonisation can bring. It is envisaged that a suite of new policies will be introduced following the consultation covering the measures required to:

- Improve the efficiency of the existing aviation system
- Accelerate the development and deployment of sustainable aviation fuels
- Support the development of zero emission flight
- Ensure we use markets to drive down emissions in the most cost-effective way

[2] The General Aviation Strategy, Department for Transport, 2015 [link]

- Influence the behaviour of consumers

4. The Government expects that a significant proportion of the required emissions reductions will come from improving the efficiency of the existing aviation system, including aircraft, airports and airspace. Given the lead times associated with other measures, such as sustainable aviation fuels and zero emissions flight, improving the efficiency of our current aviation system offers the best opportunities for short to medium-term reductions in emissions. It is crucial that the Masterplan enables the airspace changes needed to ensure emissions savings are realised and also supports the plans for airspace modernisation to introduce zero emissions flight. At lower altitudes, the most significant environmental impact of commercial air transport is aircraft noise. Local communities are demanding more action to deal with the adverse impacts of aviation, for example by offering more predictable relief from noise.

5. In 2017 the Government published its strategic rationale for airspace modernisation.[3] This explained the need to upgrade the UK's airspace structures, the routes that aircraft fly, and the technologies and procedures used by pilots and air traffic controllers for air navigation. Together, these concepts are referred to as the UK's airspace system. The system is an essential, but invisible, part of our national transport infrastructure, and is also one of the most complex volumes of airspace in the world. When the core of the UK's Airspace System was designed in the 1950s, it was never envisaged that it would need to cope with the volume of flights that it did in 2019 and will have to once more as traffic levels recover from the impact of the Covid-19 pandemic. Over time, the route network has evolved to accommodate the growth in commercial air transport, but the out-dated airspace infrastructure is struggling to keep pace with demand.

6. This has created several fundamental issues with the existing Airspace System that will worsen without some wholesale changes being made – specifically:

   a) Airspace capacity issues, traffic bottlenecks and passenger delays.

   b) Extended flight paths and inefficient aircraft climb and descent profiles that generate excess emissions and noise impacts.

   c) Constraints on the aviation sector's ability to deliver safety benefits that would further enhance the UK's excellent safety record.

   d) Constraints on the aviation sector's ability to limit and potentially reduce the impacts of overflight at lower altitudes.

   e) The trend towards expansion in the net volume of controlled airspace that is effectively segregated for commercial air transport and may limit access for other airspace users to conduct their operations safely and efficiently.

   f) Poor resilience of the airspace system against bad weather and unexpected events.

   g) Reliance on out-dated communications, navigation and surveillance infrastructure.

[3] Upgrading UK Airspace, Strategic Rationale, Department for Transport, 2017 [link]

h) Reliance on significant levels of tactical vectoring to compensate for the out-dated network design.

These issues that create the need for airspace modernisation are described in more detail in the sections below.

1.1.1. Airspace capacity issues, traffic bottlenecks and passenger delays

7. From 2010 the UK experienced strong growth in the demand for commercial air transport. This peaked in 2019 with approximately 2.6 million flights operating in the UK's airspace. At this level of traffic, the demand for flights began to reach, and sometimes exceed, the capacity of the existing airspace system. Airspace capacity is determined by the design of the route network and the ability for air traffic controllers to safely manage the flow of traffic through a given volume of airspace. The route network in the existing airspace system is designed with reference to the location of ground navigation beacons. Aircraft have to fly towards and over the physical location of each beacon. The total number of beacons is limited (there are currently around 40 in operation across the UK) so multiple routes often converge in the same places.
8. The beacons are treated like junctions in the network, with multiple routes feeding into one place, creating the potential for bottlenecks. Only one aircraft at a time can be on the route centreline overflying a beacon at any given altitude. If routes based on ground beacons were the only source of airspace capacity, the network would become severely constrained. To create additional capacity air traffic controllers can either separate flights vertically, at 1000ft. intervals, or intervene tactically and take aircraft off their planned routes – through a process known as vectoring: Controllers instruct pilots to follow radar headings, or vectors, instead of the network routes, creating a supply of additional tracks that allow aircraft to safely share the same airspace. Today's system is heavily reliant on vectoring, especially in the terminal airspace (from the ground to c.25,000ft.) where there are many flights simultaneously climbing and descending to and from multiple airports.
9. When vectoring, controllers relay instructions to pilots verbally via radio transmissions. Each instruction is read back by the pilot to check it has been correctly received. The higher the number of instructions, the more congested the radio frequencies become. During peak times, radio frequencies can reach their limit where no more instructions can be given or read back. At this point and coupled with the limitations on air traffic controllers' ability to manage high workloads, the airspace system is considered to be at capacity. The capacity of a given portion of airspace can also be reached when its physical size, and the requirement to maintain a safe distance between aircraft, effectively caps the flow of traffic that controllers can manage safely. Today's airspace system is reaching its capacity limit. During busy periods, in certain parts of the network the limit has already been reached. Aircraft cannot stop in mid-air when demand begins to exceed capacity. Instead controllers must carefully manage the flow of traffic, by:

   - Slowing flights down and vectoring aircraft on to longer, less efficient flight paths;
   - Directing inbound traffic into holds delaying their scheduled arrival; and
   - Instructing outbound traffic to hold on the ground, delaying their scheduled departure.

These actions can disrupt passengers and create additional aircraft noise and emissions that worsen disproportionately as traffic levels grow.

10. Without the introduction of additional airspace capacity the existing airspace system will continue to struggle with the increasing demand, which will inevitably lead to more acute congestion, increased delays and ultimately will limit the growth of aviation in the UK. Prior to the Covid-19 pandemic, analysis produced by NATS (En route) plc (NERL) showed that if the airspace system was not upgraded, passenger delays were expected to increase sharply as traffic levels continued to grow beyond their 2019 peak. The analysis forecast that by 2030, passengers could face an average delay of 30 minutes on over 30% of all flights if no action is taken.[4] With traffic levels expected to recover to 2019 levels in the next five years and grow thereafter, there is an urgent need to introduce additional airspace capacity across the airspace system.

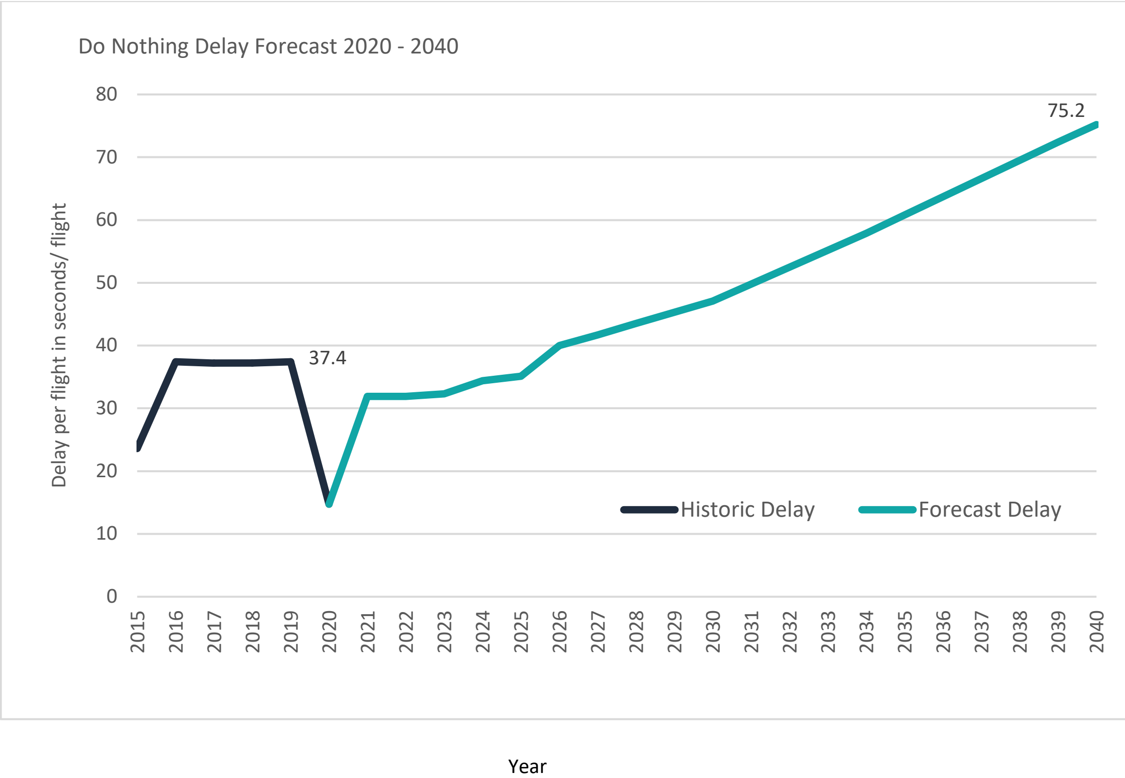
11. NERL has produced an updated analysis using the May 2021 traffic growth forecast set out in Figure 1. It predicts that passenger delays are likely to increase rapidly up to 2040 and disproportionately to the expected increase in traffic levels following recovery from the Covid-19 pandemic. For example, the average delay per flight in 2019 was 37.4 seconds across 2.6 million annual flights. In 2040, the updated NERL analysis estimates that, if no additional capacity is added to the existing system, average delays may increase by over 200% to 75+ seconds per flight, as traffic levels increase by 28% to 3.3 million annual flights, as illustrated in Figure 2. To put the forecast into context, the 2019 total of 1.6 million minutes of delay would grow to 4.1 million minutes by 2040. At this level, approximately 20% of flights experiencing disruption would be delayed by over 45 minutes and 12.5% flights would be delayed by over an hour.

12. Based on this forecast, the aggregate delay incurred over the period 2021 to 2040 as a consequence of a lack of airspace capacity is likely to reach c.19 million minutes, at a cost to airlines and passengers of over £1.1 billion.[5] This do-nothing scenario offers an indication of the scale by which the delays might increase without the introduction of additional airspace capacity and assumes that operators accept any length of delay without taking remedial action. In a situation where the existing airspace system reaches its capacity limits as the analysis suggests, it is highly likely that airlines, given the unacceptable levels of delays and flight cancellations, will choose not to schedule services that they might otherwise have provided. These flights can be characterised as lost connectivity, the absence of which will carry significant societal costs and have an impact on UK GDP, beyond the direct costs falling on airlines and passengers.

[4] Upgrading UK Airspace, Strategic Rationale, Department for Transport, 2017 [link]

[5] Calculated using the Standard Inputs for Cost-Benefit Analyses, 8th Edition, EUROCONTROL, 2018. [link]

Figure 2: Forecast growth in delays per flight if no additional airspace capacity is added, 2021 – 2040



- Historic delay is based on average delay per flight inclusive of ATC capacity, ATC staffing, airspace management, weather, aerodrome capacity and aerodrome services.
- Forecast delay is based on the predicted growth in capacity related delays in a do- nothing scenario plus a static delay assumption for aerodrome capacity/services, ATC staffing, airspace management and weather.
- The do-nothing scenario offers an indication of the scale by which the delays might increase without the introduction of additional airspace capacity and assumes that operators accept any length of delay without taking remedial action.
- A static quantity of delay (based on historic data) in each year has been assumed to account for the impact of aerodrome capacity/services, ATC staffing, airspace management and weather. This is due to limitations in modelling these variables.
- The delay is a conservative estimate. In a do-nothing scenario it is likely that these delays would either be: greater as traffic increases, or traffic growth would limited as airlines choose not to schedule services that they might otherwise have provided.

1.1.2. Extended flight paths and inefficient aircraft climb and descent profiles

13. Aircraft routinely fly longer than necessary at sub-optimal altitudes, profiles and speeds, because of the limitations of the existing airspace system and the reliance on vectoring to manage large volumes of traffic. Flight paths are determined by the available sequence of waypoints, linked to the location of ground navigation beacons, rather than the shortest most direct routes. A range of factors influence the flight paths that aircraft plan to follow, including the weather, delays elsewhere in the network and the location of segregated areas of airspace. Today's rigid network of waypoints linked to ground navigation beacons creates an inherent degree of environmental inefficiency in terms of excess CO_2 emissions generated by commercial air transport operations. The inefficiencies are greatest in the medium level terminal airspace where the network has evolved to become a complex web of intersecting flight paths to and from busy airports. Almost 50% of all the environmental inefficiency in the UK airspace system, as recorded by NERL in 2019, arose in the terminal airspace, generating c.1.5 million tonnes of excess CO_2 emissions.[6]

14. The terminal airspace extends from the ground to c.25,000ft and is the busiest, most complex portion of the existing airspace system. For example, in 2019 over 3500 flights per day used the terminal airspace that serves airports in London and the south-east. The terminal airspace structure and route network is designed to manage high volumes of traffic, climbing and descending between individual airports and the upper airspace.

15. Ideally, outbound traffic would climb through the terminal airspace quickly and continuously, minimising emissions and reaching higher altitudes as soon as possible to mitigate the impact of aircraft noise. However, in the existing airspace system flights routinely level off at lower altitudes, interrupting their climbs, to avoid crossing traffic. Similarly, inbound flights would ideally descend continuously to the runway with minimal engine thrust, but in practice arrivals are routinely directed into arrival holds.

16. Controllers use the holds to absorb delays, maintain high landing rates at busy airports and manage traffic bottlenecks. They are an expensive and inefficient solution. The size of the segregated airspace structures needed to protect aircraft in the holds creates large blockages in the overall network design. In the existing airspace system, departures often level off below 7000ft. to avoid the base of the holds and in doing so fly longer and potentially noisier routes. Without significant changes to the system, increased congestion, vectoring and arrival holding will lead to a further degradation in environmental efficiency as traffic levels grow, with average per flight CO_2 emissions expected to rise by between 8% and 12% by 2030 compared to current levels.[7]

17. The Government set out its proposed approach and principles to reach net zero aviation by 2050 in its 2021 Jet Zero consultation. The approach aims to decarbonise aviation in a way that preserves the benefits of air travel and maximise the opportunities that decarbonisation can

[6] NERL measure the horizontal and vertical inefficiency of all flights in the UK's controlled airspace. [link]

[7] Sustainable Aviation Decarbonisation Roadmap, 2019. [link]

bring. It is envisaged that a suite of new policies will be introduced following the consultation covering the measures required to:

- Improve the efficiency of the existing aviation system
- Accelerate the development and deployment of sustainable aviation fuels
- Support the development of zero emission flight
- Ensure we use markets to drive down emissions in the most cost-effective way
- Influence the behaviour of consumers

18. The Government expects that a significant proportion of the required emissions reductions will come from improving the efficiency of the existing aviation system, including aircraft, airports and airspace. Given the lead times associated with other measures, such as sustainable aviation fuels and zero emissions flight, improving the efficiency of our current aviation system offers the best opportunities for short to medium-term reductions in emissions. It is crucial that the Masterplan enables the airspace changes that are necessary to ensure emissions savings are realised and supports the plans for airspace modernisation to account for the introduction of zero emissions flight.

1.1.3. Further enhancements in safety performance

19. The existing airspace system limits the aviation sector's ability to further enhance safety by reducing the complexity of the route network and introducing new technologies that can help to manage the residual risks. The UK has an excellent aviation safety record that is underpinned by a well-established set of rules and procedures. As traffic levels recover and continue to grow, the potential for these rules and procedures to deliver further safety improvements at a system-wide level is limited. The UK's airspace safety goal is that there are no accidents involving commercial air transport that result in serious injuries or fatalities, as well as no serious injuries or fatalities to third parties as a result of any aviation activities.[8] The complexity of the existing airspace system, forecast growth in commercial air transport and the introduction of new users like UAS operating alongside conventional aircraft, creates residual risks that must be managed effectively if the UK is to maintain its excellent record and consistently achieve the safety goal.

20. The overriding principle of air traffic control and airspace design is that safety is paramount. Controllers keep aircraft safely separated by set distances; for example, aircraft flying in controlled airspace under radar surveillance are normally kept three nautical miles apart horizontally or 1,000ft vertically. The high workload placed on controllers to manage high complexity and crossing traffic within the existing airspace system introduces safety risks that are managed by limiting the flow of traffic. If the capacity constraints affecting the existing system are not addressed as traffic levels grow, the need to maintain safety will by necessity require aircraft to be delayed more often on the ground or held in arrival holds before they land.

[8] Aviation 2050, the future of UK aviation, Department for Transport, 2018. [link]

1.1.4. Impacts of over flight at lower altitudes

21. The capabilities of modern aircraft and new operational procedures to create opportunities to mitigate the environmental impacts of over flight at lower altitudes are often held back by today's rigid network design and the reliance on vectoring to deliver safe, efficient operations at scale. As traffic levels recover, the growth in air transport must be accompanied by opportunities to limit and where possible reduce the environmental impacts of over flight at lower altitudes, in terms of noise, air quality, tranquillity and biodiversity. Disturbance from aircraft noise, in particular, has negative impacts on the health and quality of life of people living near airports and under existing flight paths. There is also evidence that the public is becoming more sensitive to aircraft noise, to a greater extent than noise from other transport sources, and that there are health costs associated from exposure to this noise.[9]

22. The management of impacts at lower altitudes is a complex issue. It is recognised that while airspace modernisation may bring noise benefits for many people, including opportunities to better avoid noise sensitive areas, new routes can also create increased noise for others. Similarly, where the overall level of noise may be reduced by changes to the existing system, the effects may become more concentrated, increasing the impacts in specific areas. It is therefore essential that airspace modernisation at lower altitudes incorporates as many routes as possible within a coherent process to examine the cumulative impacts of the proposed changes to balance the impacts appropriately. Local communities are engaged in the development of airspace design options and the assessment of their potential impacts as part of the regulatory process for changing the airspace design known as CAP1616. [10]

1.1.5. Expansion in the use of controlled airspace

23. The UK's airspace is a scarce national resource. Historically, individual changes to the existing network were not subject to any coherent approach that intended to optimise the utility of the system as a whole, with all airspace users in mind. Decisions about the use of a specific volume of airspace must consider the direct impacts on all users, but are often made without an assessment of the second order effects that arise when multiple similar decisions are integrated into the overall system. The sustained growth in commercial air transport has resulted in some airports taking responsibility for comparatively large volumes of controlled airspace to support the increase in traffic levels. In isolation, many of the decisions to introduce new controlled airspace are justified, but at a system-wide level the trend has reduced the amount of available uncontrolled airspace (in areas that satisfy their requirements), potentially creating choke points where aircraft are funnelled together or pushed closer to the sea or terrain. Over time, without a coherent approach to the modernisation of the existing system, users outside controlled airspace risk becoming further squeezed into smaller regions with associated safety risks and potential consequences for the sustainability and growth of many GA operators and aerodromes. The mechanism by which unused or under-utilised controlled airspace is

[9] Survey of Noise Attitudes 2014, second edition, UK CAA, 2021. [link]

[10] Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information, CAA CAP 1616, edition 4, March 2021. [link]

considered for release is the remit of the CAA Airspace Classification Team. The CAA has the necessary processes in place to make changes to the established airspace design where justified.

1.1.6. Operational resilience

24.The capacity constraints in the existing airspace system, described in section 1.1.1. have led to degradation in the resilience of the operation against bad weather and unexpected events. In general terms, poor resilience is the product of the lack of spare capacity across the system to handle an unplanned increase in traffic or temporary airspace closures. Resilience is pivotal to the reliable operation of the network. The existing system's ability to resist, respond to and recover from disruption is constrained by today's rigid network and the lack of flexible options to manage surges in traffic that arise from problems elsewhere in the UK's airspace, across Europe and globally. Unexpected events often lead to significant delays. Normal service is typically only resumed on the next day of operations and relies on the quieter nighttime period to recover. The introduction of additional capacity offers controllers, operators and airports the opportunity to plan strategically, spreading the peaks in traffic and improving resilience through better demand management.

1.1.7. Reliance on out-dated infrastructure

25.The existing airspace system was developed around the out-dated infrastructure of VHF radio transmissions for communications, ground beacons for navigation and primary radars for surveillance. New technologies, like data link (text message) communications between controllers and pilots, satellite-based navigation and electronic surveillance solutions are becoming more widespread. However, the route network has not changed fundamentally to maximise the benefits that a modern infrastructure can offer.

26.As described in section 1.1.1. today's route network is designed with reference to a grid of ground navigation beacons distributed across the UK. These beacons are out-dated and reaching the ends of their lives. Meanwhile, 99% of the current commercial air transport fleet operates almost exclusively using avionics that rely on satellite navigation. Aircraft are able to follow routes designed to more advanced navigation standards (known as Performance-based Navigation or PBN) with greater precision than conventional ground navigation.

27.As a result, NERL are leading a programme to decommission two thirds of the existing ground beacons, leaving a core grid for resilience. At higher altitudes (above c.7000ft.), NERL has decoupled the conventional routes from the relevant ground beacons and replaced them with alternatives designed and operated to a more advanced PBN standard. At lower altitudes, most airport arrival and departure routes have yet to be replaced so the beacons remain in place, delaying the transition to a modern air navigation infrastructure.

1.1.8. The need for greater systemisation

28.The widespread deployment of routes designed to PBN standards is a cornerstone of airspace modernisation. The opportunity to design a new network of PBN routes with far greater accuracy and flexibility offers the potential to address many of the issues set out in the Government's strategic rationale. Significant improvements in airspace capacity and efficiency can be achieved by positioning routes so that they are safely separated and optimised by design. This process is known as systemisation, removing the reliance on vectoring, breaking the link with ground navigation beacons and enabling closer spaced routes with the potential to reduce controlled airspace where appropriate. The Airspace Change Masterplan (ACM) described in this document aims to unlock the potential for systemisation to increase capacity, reduce track miles, improve flight profiles, better manage the impacts of over flight, offer greater airspace access, enhance safety performance and strengthen operational resilience.

29. In a systemised operation designed and operated using PBN standards, outbound flights will be able to follow a number of set departure routes up to 7000ft where each requires less controlled airspace. Between 7000ft and 9000ft they will join a systemised network of flight paths, each safely separated by design, which will guide aircraft through the complex terminal airspace up to 25,000ft. Inbound flights entering the terminal airspace will follow the systemised network down to 7000ft. where they will be directed on to a number of set arrival routes to the final approach for landing. On arrival, increased airspace capacity and network management tools will allow air traffic controllers to slow down inbound flights that may be subject to delays before they arrive in the UK's airspace, rather than putting them into arrival holds.

30. Aircraft already use PBN technology on a daily basis because it allows operators to navigate much more accurately, but the UK's airspace system at lower altitudes and in the terminal airspace requires fundamentally upgrading so as to fully realise the benefits of systemisation. More precise routes can be used to avoid noise sensitive areas but may also concentrate the impacts of overflight. For this reason, the use of multiple route options that can distribute the impacts more equitably, or be configured to offer predictable relief from noise, must be considered in consultation with local stakeholders when routes are being developed for deployment at lower altitudes.

1.2. Airspace Modernisation Programme

1.2.1. CAA Airspace Modernisation Strategy

31. Following the publication of the strategic rationale for airspace modernisation, the Government directed the Civil Aviation Authority (CAA) to, "prepare and maintain a coordinated strategy and plan for the use of UK airspace up to 2040, including its modernisation."[11] As a result, in 2018 the CAA published the Airspace Modernisation Strategy (AMS), which replaced the earlier 2011 Future Airspace Strategy.[12] The AMS sets out the initiatives required to modernise the existing airspace system and tackle the issues described in section 1.1. by upgrading the airspace design, technology and operations. The CAA is in the process of reviewing the AMS and expects to publish an updated version of the strategy in Spring 2022. The Department for Transport and CAA co-sponsor the implementation of the AMS, meaning they work together to deliver a shared objective for airspace modernisation - to "deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace". The parameters of the objective are grouped into six broad themes that align with the issues set out in section 1.1. and are summarised in Table 1.

Table 1: Parameters of the Airspace Modernisation Strategy Objective organised by theme

Theme	Parameters of the AMS Objective
1. Safety	Maintaining a high standard of safety has priority over all other objectives to be achieved by airspace modernisation.
2. Capacity and Efficiency	Create sufficient airspace capacity to deliver safe, efficient and resilient growth of commercial air transport.
3. Noise	Progressively reduce the noise of individual flights, through quieter operating procedures and, in situations where planning decisions have enabled growth that may adversely affect noise, require noise impacts are considered through the airspace design process and clearly communicated.
4. Controlled Airspace	Use the minimum volume of controlled airspace consistent with safe and efficient air traffic operations.
5. Access and Integration	In aiming for a shared and integrated airspace, facilitate safe and ready access to airspace for all legitimate classes of airspace users, including commercial air transport, general aviation and the military, and new entrants such as UAS, AAM and spacecraft.
6. Defence and security	Do not conflict with national security requirements, temporary or permanent, specified by the Secretary of State for Defence.

[11] CAA Air Navigation Directions 2017 [link]

[12] UK Airspace Modernisation Strategy, CAA CAP1711, 2018 [link]

32. Two of the most important initiatives required to achieve the AMS objective are known as FASI (Future Airspace Strategy Implementation) South and FASI North. Together these initiatives are considered the UK's Airspace Change National Infrastructure Programme (the Programme). The Programme encompasses the requirement to fundamentally redesign the airspace system at lower altitudes and in the terminal airspace that serves commercial air transport across the busiest regions of the UK, making the most of the capabilities of modern aircraft and satellite-based navigation technology.

1.2.2. ACOG and the requirement for an Airspace Change Masterplan

33. The number, complexity and overlapping scope of the individual airspace change proposals (ACPs) needed to deliver the Programme requires a strategic coordination mechanism in the form of a single joined-up implementation plan or Masterplan. In their capacity as co-sponsors of airspace modernisation, the Department for Transport and CAA commissioned NERL to create the Masterplan.

34. Given the large number of organisations involved (including the airports and NERL itself), the co-sponsors also required NERL to set up an impartial body, The Airspace Change Organising Group (ACOG) to develop the Masterplan, coordinate the Programme and lead the necessary engagement with external stakeholders. In this context, ACOG was established in 2019 as a unit within NERL, separate and impartial from the organisation's other functions. The ACOG team is made up of airspace change programme and communications specialists. Their activities are overseen by an independent steering committee with representatives from the airlines, airports, general aviation, NERL and the Government's Infrastructure and Project Authority.

35. Collectively, the ACPs that are included in the Masterplan are referred to as the 'constituent airspace change proposals'. The ACPs are sponsored by the airports (for the local arrival and departure routes below 7000ft.) and by NERL (for the airspace structures and route network above 7000ft.). Each individual ACP is developed following the same detailed process steps laid out in the CAA's guidance for changing the airspace design – known as CAP1616.[13] The process covers the activities required of sponsors from the conception of an ACP, the development and assessment of airspace design options and the engagement and consultation with affected stakeholders. Other ACPs may be included during the development of Iteration 3 of the Masterplan to deliver a broader range of benefits.

36. The CAA is obliged to evaluate the progress of every ACP through each stage of the process, via a series of regulatory gateways and make decisions on whether to approve further development and ultimately the implementation of the proposed changes. The Masterplan does not set out the details of the individual airspace design options. However, ACOG will use the information created by the constituent ACPs to identify airspace interdependencies, examine the potential

[13] Guidance on the regulatory process for changing the notified airspace design and planned and permanent redistribution of air traffic, and on providing airspace information, CAA CAP 1616, edition 4, March 2021. [link]

for design conflicts or enablers and consider the concepts and trade-offs that may be needed to resolve them. In this context, enablers refer to airspace designs developed through one ACP that are necessary for another interdependent ACP to progress.

1.2.3. The iterative approach to Masterplan development

37. Airspace modernisation is a long and complex process. The timelines for the development of the constituent ACPs are difficult to align at a Programme level. Some of the ACPs originated in 2017 and 2018 prompted by the publication of the AMS. Others only started (or re-started) in the summer of 2021 when the Programme remobilised following the Covid-19 pandemic. Larger ACPs with many interdependencies can take longer to develop than smaller ones with fewer interactions. As a consequence, ACOG proposed (and the co-sponsors accepted) that the final Masterplan is developed through a series of iterations. The iterative approach recognises that different information and levels of detail will be available at different times. ACOG may have an insufficient level of detail about some ACPs to make firm conclusions and need to make assumptions that are refined in later iterations. It also means that the Masterplan remains flexible and responsive to accommodate the evolving context for airspace modernisation, such as changes arising from the AMS review, new policy directions or unanticipated events.

38. ACOG envisages a minimum of four iterations of the Masterplan. Each iteration must be accepted separately into the AMS, except Iteration 1, which was a high-level plan that has already been assessed and published. Table 2 summarises the scope and purpose of each iteration of the Masterplan and the stakeholder engagement activities required to inform its development. Section 1.2.5. explains the assessment process in more detail.

Table 2: Scope, purpose and engagement associated with each Masterplan iteration

	Iteration 1	Iteration 2	Iteration 3	Final Iteration(s)
Scope	Based on CAP1616 Stage 1 information, a high-level description of the overall concept and plan for airspace modernisation, including key risks and opportunities.	Based on CAP1616 Stage 2 information, an Identification of the constituent ACPs with the scope now extended to the whole of the UK & description of the system-wide view of the potential design interdependencies	Based on CAP1616 Stage 3a information, more detail on the options developed by the constituent ACPs when viewed as a collective and how specific design trade-offs could be resolved conceptually, including the assessment of cumulative	Incorporating the feedback and responses arising from the public consultations on constituent ACPs during CAP1616 Stages 3 and 4, the final version of the Masterplan may require several further iterations offering a complete,

		conflicts & enablers.	impacts It3. does not include actual solutions or final flight paths.	detailed description of the proposed airspace system.
Purpose	To set out the programme of interdependent ACPs needed for modernisation in Southern England.	ACPs will be unable to pass through the CAP1616 stage 2 gateway until the potential design interdependencies and conflicts are represented in an accepted Iteration 2.	ACPs will be unable to proceed to public consultation on proposed option(s) for the ACP until a system-wide airspace design of the proposed options and their cumulative impacts are represented in an accepted Iteration 3.	The Final Iteration(s) will set out how trade-off decisions to resolve conflicts have been made, describe the final timelines for implementation and the anticipated cumulative impact of the Programme as a whole.
Engagement	Sponsors of the constituent ACPs	In addition to the ACP sponsors, AMS stakeholder representatives were engaged at a strategic level. The engagement strategy for the final Masterplan is set out in Iteration 2.	Public call for information and associated engagement exercise to seek feedback on the system-wide design and input on gaps and improvements, including additional constituent ACPs. Engagement will also make stakeholders aware of the ACP public consultations and	ACOG will continue to inform stakeholders about the evolving content of the Final Iteration(s), including the progress of ACP implementation and any changes, new requirements or technical advances which may affect the anticipated cumulative impact of the

		how to influence trade-off decisions.	Programme as a whole.

1.2.4. Developing Iteration 2 of the Masterplan

39. This document sets out Iteration 2 of the Masterplan. It has been developed by ACOG between August and November 2021 in collaboration with the constituent ACP sponsors and influenced by engagement with representative AMS stakeholders.[14] The purpose of Iteration 2 is to provide a system-wide view of the scope of the constituent ACPs and identify the potential interdependencies between the proposals. The content of Iteration 2 has been developed in parallel with the constituent ACPs and derives from the work conducted by each of the sponsors during Stages 1 and 2 of the CAP1616 process.

40. During the development of Iteration 2, most of the constituent ACPs were progressing through the second half of Stage 1 (Step 1B – the development of Airspace Design Principles) or the first half of Stage 2 (Step2A – the development of a comprehensive list of airspace design options). The assessment of the interdependencies between the constituent ACPs remains at a high level in Iteration 2 because most of the sponsors have yet to produce a comprehensive list of airspace design options. Potential design conflicts, possible solutions and the associated trade-offs are described qualitatively, and at a system level, with case study examples included to offer additional context.

41. As described in Table 2, ACP sponsors will be unable to progress through the Stage 2 gateway of the CAP 1616 process until the potential interdependencies and conflicts between the constituent ACPs are represented in an accepted Iteration 2 of the Masterplan.

1.2.5. Masterplan assessment and acceptance

42. The co-sponsors have set out what the Masterplan is intended to achieve in three commissioning letters to NERL in November 2018 to request the formation of ACOG, July 2019 following the submission of Iteration 1, and in May 2021, when the Programme remobilised following the Covid-19 pandemic.[15] In order to confirm that the Masterplan is consistent with this commission, government policy and the CAA's own statutory airspace functions, the co-sponsors must assess ACOG's progress during the development of each iteration. Based on that assessment, the CAA must decide to formally accept each iteration of the Masterplan into the AMS (apart from Iteration 1 which is only a high level plan).

43. Once accepted, the Masterplan becomes, together with the CAP 1616 process, the legal basis against which individual airspace change decisions are made by the CAA. Therefore, the CAA's

[14] These stakeholders are the wide range of representative groups identified in the airspace modernisation governance structure. These representative groups are listed in the governance annex to the Airspace Modernisation Strategy, published in December 2018 www.caa.co.uk/cap1711b, as updated by page 7 of CAP 1862 Airspace Modernisation – 2019 Progress Report. [link]

[15] Airspace Change Masterplan, Acceptance Criteria, CAP 2156a, CAA, August 2021. [link]

decisions on airspace change proposals will need to ensure that there is no misalignment with the Masterplan. The considerations and process that the CAA will follow when assessing each iteration of the Masterplan are set out in CAP 2156b.[16] The criteria against which the CAA will decide to accept an iteration of the Masterplan are set out in CAP 2156a – referred to as the Masterplan Acceptance Criteria. By accepting the Masterplan into the AMS, the CAA must apply its airspace change decisions in accordance with the Masterplan and therefore in the best interests of the overall airspace system and not just in the interests of the individual ACP sponsor.

44. Table 3 summarises how the information provided in the following sections of Iteration 2 meet the Masterplan Acceptance Criteria and the terms of the original co-sponsor commission that the criteria are based on.

Table 3: Iteration 2 compliance with the Masterplan Acceptance Criteria and co-sponsor commission.

Theme	Criterion	Information provided in Iteration 2
Drivers for airspace modernisation. (November 2018 commission letter, paragraph 5).	Set out how airspace modernisation can address a wider set of drivers, not just airspace capacity increases.	Section 1.1. Identifies how, in addition to the need to increase airspace capacity, the changes to the existing airspace system proposed in Iteration 2 are required to increase environmental efficiency, continue to enhance safety, limit and where possible reduce the impacts of overflight, release controlled airspace, improve access, strengthen resilience, and introduce new technology.
Where, when and why airspace changes are needed, and in what sequence. (CAP2156a, page 8 Criterion A)	A1: In the light of forecast growth in demand, and airspace bottlenecks, where delays could be alleviated by the introduction of additional airspace capacity. (November 2018 commission letter, paragraph 6a)	Section 2.1.1. Describes where and when bottlenecks in the existing system are expected to increase because of airspace capacity constraints as traffic levels grow. Sections 2.1.3. – 2.1.6. Describes where airspace changes are needed in regional clusters across the country based on the current performance of

[16] Airspace Change Masterplan Assessment Framework, CAP2156b, CAA, August 2021. [link]

		the system and identifies the interdependencies between the ACPs.
	A2: Areas where planned developments on the ground require new airspace designs. (November 2018 commission letter, paragraph 6a)	Section 2.1.8. Describes the relationship between the forecast growth in traffic levels, planned airport developments on the ground and the constituent airport-led ACPs.
	A3: Areas where more direct routes are possible. (November 2018 commission letter, paragraph 6a)	Section 2.1.2. Describes how and where environmental inefficiency in the existing system helps to determine the regional clusters of airspace change required in the terminal airspace.
	A4: Areas where ACPs are needed to deliver a safety benefit. (November 2018 commission letter, paragraph 6b, i)	Section 1.1.3. Describes how the features of the existing airspace system are limiting the aviation sector's ability to further enhance the UK's excellent safety record and how airspace changes can unlock safety benefits. Section 3.4. Describes how safety is paramount in the course of trade-off decisions to optimise the system-wide airspace design. Iteration 3 will provide more detail on the Integrated Approach to Safety Assurance that the Programme will develop to systematically reduce and where possible remove safety risk factors as part of airspace modernisation.
	A5: Areas where ACPs can limit the total adverse effects of noise. (November 2018 commission letter, paragraph 6b, ii)	Section 2.1.9 Describes the opportunities for airport-led airspace changes at lower altitudes to limit the total adverse effects of noise. More information will be included in Iteration 3 when the constituent ACPs

		have completed appraisals of the noise impacts of their shortlist of preferred airspace design options.
	A6: Areas where ACPs can deliver air quality or fuel efficiency benefits. (November 2018 commission letter, paragraph 6b, iii)	Section 2.1.2. Describes how and where environmental inefficiency in the existing system helps to determine the regional clusters of airspace change required in the terminal airspace.
	A7: Areas where ACPs are needed to improve access to airspace. (November 2018 commission letter, paragraph 6b, iv)	Section 3.7. Describes how airspace changes can improve access for other airspace users by reducing the net volume of controlled airspace and enabling integration, in conjunction with the widespread adoption of electronic conspicuity technology.
	A8: Areas where ACPs are needed to enable Military access to airspace for training and national security. (November 2018 commission letter, paragraph 6b, v)	Section 3.7.6. Describes the Military requirements for suitably sized, sited and available airspace to train, exercise, trial and evaluate extant, and new generation air systems, weapon systems and emerging technologies.
	A9: Where ACPs are needed to introduce new technology. (November 2018 commission letter, paragraph 6b, vi)	Section 2.1.10. Describes the requirement for the Masterplan ACPs to introduce routes designed and operated using Performance-based Navigation standards, as a technological cornerstone of airspace modernisation.
	A10: Identify the operational concepts required to deliver the airspace changes. (November 2018 commission letter, paragraph c)	Section 2.1.11. Describes the four main operational concepts and supporting technology enablers required for airspace modernisation.

Information about the airspace changes needed. (CAP2156a, pages 9 to 11, Criterion B1 to B9)	B1: A credible and implementable plan for the necessary airspace changes.	Section 3.1. Describes the planned timescales for each regional cluster of airspace changes against each step of the CAA's CAP1616 process and the current sequence of ACP deployments by regional cluster. Appendix A sets out the programme plans for each regional cluster in detail.
	B2: Strategic environmental assessment and Habitats Regulations assessment	A strategic environmental assessment and a Habitats Regulations assessment are fundamental parts of the development of the Masterplan to ensure that environmental and sustainability impacts are integrated into the Programme. These assessments will be produced together with the development of Iteration 3.
	B3: Potential Interdependencies between the constituent ACPs.	Section 3.2. Identifies the areas of overlap between the interdependent airport-led ACPs and examines the potential for design conflicts and enablers to arise in each area.
	B4: Potential solutions to interdependencies.	Section 3.3. Sets out the likelihood that airspace design conflicts or enablers may arise in each regional cluster, along with a description of the possible nature of the interdependencies and the implications for solutions developed as part of Iteration 3.
	B5: Trade-off decisions to resolve interdependencies.	Section 3.4. Considers the framework for trade-off decisions required to resolve interdependencies in Iteration 3.
	B6: At a system level, potential implications for government policy objectives of the proposed solutions	The potential implications of proposed solutions for government policy objectives will be considered as part of the development of Iteration 3. Section 3.4. of Iteration 2 provides some

		illustrations of how effective trade-off decisions between options can be made in the form of example case studies.
	B7: Stakeholder Engagement Strategy, including: • Evidence of engagement with the sponsors of the Constituent ACPs. • Evidence of engagement with the AMS stakeholder representatives.	Section 3.5. Provides an overview of the Masterplan Stakeholder Engagement Strategy and sets out the programme of stakeholder engagement conducted to support the development of Iteration 2. Appendix B: Provides a record of stakeholders' feedback during the development of Iteration 2.
	B8: Iterative development of the Masterplan.	Section 3.6. Summarises the plan for the development of Iteration 3 of the Masterplan.
	B9: General Aviation Impact Assessment.	Section 3.7. Provides a high-level and largely qualitative assessment of the impact of the Masterplan on other airspace users including general and business aviation, military aviation and UAS and AAM operators.
Key assumptions and risks. (November 2018 commission letter, paragraph 6c)	The set of assumptions on which the proposed changes are based and are dependent.	Appendix D: Provides a record of the key assumptions that the content of Iteration 2 is based on.
	The key risks associated with delivering the plan and how they could be mitigated.	Appendix C: Examines the key risks associated with the Masterplan at Iteration 2.
Commitment of the ACP sponsors. (November 2018 commission	The party responsible for taking each individual airspace change forward and the degree of commitment	Appendix E: Sets out the degree of commitment from each ACP sponsor to progress their respective proposals and contribute to the Masterplan.

letter, paragraph 6c)	offered by each individual party.

45.ACOG's plan for developing the content of Iteration 3 in line with the acceptance criteria and Masterplan commission is set out in section 3.6. The Iteration 3 plan will be refined based on the co-sponsors feedback following their assessment of Iteration 2, with a particular focus on the areas and criterion where further work or more detail is required.

1.2.6. Principles for Masterplan development

46. ACOG has collated the terms of the Masterplan commission, the assessment framework and acceptance criteria into a clear set of principles that are intended to guide the construction of the Masterplan when coordinating the constituent ACPs and identifying and evaluating interdependencies. The Masterplan Development Principles are set out in Table 4 and are not presented in priority order.

Table 4: ACOG Masterplan Development Principles

#	Title	Principle
1	Policy-led	Creation and maintenance of the UK Airspace Masterplan is policy led and national in scope and ambition.
2	Airspace Design Process	Sponsors are obliged to adhere to the CAA CAP 1616 process. ACOG will mediate ACP design conflicts, escalating if required.
3	Incorporating Arising ACPs	There will be provision for relevant and endorsed arising ACPs to be incorporated into the UK Airspace Masterplan.
4	Airspace Integration	The UK Airspace Masterplan will advance the concept of airspace Integration.
5	Benefits and Negative Impacts	The UK Airspace Masterplan should balance benefits across stakeholders and assure negative impacts are mitigated and managed proportionately.
6	Leveraging Technology	Contemporary and near future technological capabilities will be leveraged to optimise architectures and drive broad benefits.
7	Design Dependencies and Conflicts	The Masterplan will highlight dependencies and conflicts between constituent ACPs and propose mitigating design adjustments.
8	CAA Assessment & Acceptance	The CAA will formally assess each Iteration of the Masterplan against pre-defined criteria and assure alignment with Government Policy.

47. Each principle and its application to the development of the Masterplan is explained in greater detail below.

48.**Principle 1:** Creation and maintenance of the UK Airspace Masterplan (UKAM) is policy led and national in scope and ambition:

- In support of the AMS National Infrastructure Programme, creation and maintenance of the Masterplan will seek to balance the requirements of users and affected stakeholders in a proportionate way;
- The UKAM will encompass all ACPs that contribute to the UKAM's Goal and whose coordination is deemed necessary by ACOG because they share dependencies, present conflicting demands, or are on the critical path;
- Individual ACPs with no shared dependencies and conflicts will not be in the scope of the UK Airspace Masterplan (UKAM) and may proceed in isolation.

49.**Principle 2:** Sponsors are obliged to adhere to the CAA CAP 1616 process. ACOG will mediate ACP design conflicts, escalating them if required.

- Sponsors are responsible for their individual ACPs and their progression through CAP 1616 in terms of time and quality, including reflecting local community engagement and other airspace user needs;
- In the event of conflicting design solutions between sponsors, ACOG will mediate to resolve conflicts and, where appropriate, advise on and recommend trade-offs;
- Where conflicts are unable to be resolved satisfactorily or put the UK Airspace modernisation goal at risk, ACOG will report to the Steering Committee for guidance and escalation if required.

50.**Principle 3:** There will be provision for relevant and endorsed arising ACPs to be incorporated into the UK Airspace Masterplan. In line with this Principle, ACOG should:

- Provide airspace users with the opportunity to highlight gaps and dependencies in contemporary iterations of the Masterplan and to offer solutions via an ACP or suggested design alterations.
- Make provision for relevant and endorsed arising ACPs to be integrated into the UKAM to balance the needs of all airspace users appropriately.

51.**Principle 4:** The UK Airspace Masterplan will advance the concept of Airspace Integration (rather than segregation) via:

- Optimisation of the links between new routes at lower altitudes and the terminal airspace designs;
- Coherence with the on-going modernisation of the European network coordinated by EUROCONTROL;
- Facilitating efficient and proportionate levels of access for users that predominately operate outside controlled airspace.

52. **Principle 5:** The UK Airspace Masterplan should balance benefits across stakeholders and assure negative impacts are mitigated and managed proportionately.

- The Masterplan should evaluate at a programme level whether the benefits and/or disadvantages are proportionate across stakeholder groups and that negative impacts are managed and mitigated proportionately;
- Evaluation should consider where adjacent and interdependent ACPs may create cumulative negative impacts and how such situations should be resolved.

53. **Principle 6:** Contemporary and near future technological capabilities will be leveraged to optimise architectures and drive broad benefits. In line with this principle, designs will be optimised to deliver:

- A fundamentally safe and more resilient system, enabled by PBN design solutions at the programme level;
- Wider beneficial outcomes for society, such as contributing to net zero and designing for sustainable growth;
- The UKAM should be designed cognisant of high-confidence near-future technological solutions to minimise drag from ACP re-engineering.

54. **Principle 7:** The UK Airspace Masterplan will highlight dependencies and conflicts between constituent ACPs and propose design adjustments to mitigate conflicts.

- As part of its mediation role and when required, ACOG will actively pursue and propose trade-offs and design amendments, such as:
  - Alternative sequencing of the proposed changes;
  - Displacement of routes by location/profile and/or time; and
  - In extremis, termination of problematic options.

55. **Principle 8:** The CAA will assess each Iteration of the UK Airspace Masterplan against pre-defined criteria formally and assure alignment with Government Policy.

- Subject to their assessment, Iterations of the UKAM will be incorporated formally by the CAA into their regulatory framework of CAP1616 and associated publications;
- As part of the approval process, any subsequent ACPs will be assessed against the incorporated Iteration of the UKAM to identify any dependencies and/or conflicts.

SECTION A

2.1. Where, when and why airspace changes are needed

56. Section A sets out where, when and why airspace changes are needed and in what sequence. The information in Section A is provided to meet criterion A of the Masterplan Acceptance Criteria (CAP2156a, page 8) articulated in paragraphs 6 and 7 of the November 2018 co-sponsor commissioning letter (as amended by the subsequent commissioning letters in July 2019 and May 2021).

2.1.1. Airspace changes to address capacity and bottlenecks

57. The forecast growth in commercial air transport flights up to 2040 is set out in section 1.1. Total annual traffic in UK airspace is expected to return to the 2019 (pre-pandemic) peak of 2.6 million flights per year during 2025. Traffic levels are predicted to continue growing to 3.3 million flights per year in 2040 – a net 28% increase on the 2019 peak. Section 1.1.1. summarises the latest analysis produced by NERL for Iteration 2 of the Masterplan, which predicts that flight delays will increase disproportionately, at a far greater rate than traffic levels, if additional airspace capacity is not introduced to accommodate the growing number of flights. The analysis indicates that average delays per flight will increase by 550% in 2040 compared to 2019, in response to 28% more traffic. The associated costs of the delays, flight cancellations and lost connectivity would be significant. NERL's analysis also highlights the poor resilience of the existing airspace system against bad weather and unexpected events at 2019 traffic levels because of the lack of spare capacity. The resilience issues facing today's operation would intensify significantly if additional airspace capacity were not introduced in response to growing traffic levels.

58. NERL has produced a series of images that represent where and when bottlenecks in the existing system are expected to increase because of airspace capacity constraints as traffic levels grow. The images illustrate the evolution of commercial air transport demand versus maximum airspace capacity during the busiest hour of the day for each sector in 2019 and 2040.

59. Figure 3 illustrates the demand versus capacity evolution at lower altitudes (c.9000ft.) in the terminal airspace above South East England. The left side of the chart clearly highlights the capacity constraints facing the existing airspace system in 2019. Bottlenecks arise in most of the airspace sectors above London and the south-east during the peak hours, with traffic demand usually 110% to 120% above the maximum capacity. On the right side of the chart, by 2040 with forecast traffic growth and no additional capacity the bottlenecks become significantly more acute. Demand in the peak hours exceeds maximum capacity by 130% in some sectors.

Figure 4 presents the same analysis for a broader region of airspace across the south of the UK at higher altitudes (c.30,000ft.), where traffic to and from UK airports is interacting with overflights en route to other global destinations. Similarly, figure 5 illustrates the same issue (albeit less acute) for the key airspace sectors in Northern England and Scotland at higher altitudes.

Figure 3: Traffic demand vs maximum airspace capacity, lower altitudes, South East England 2019 & 2040

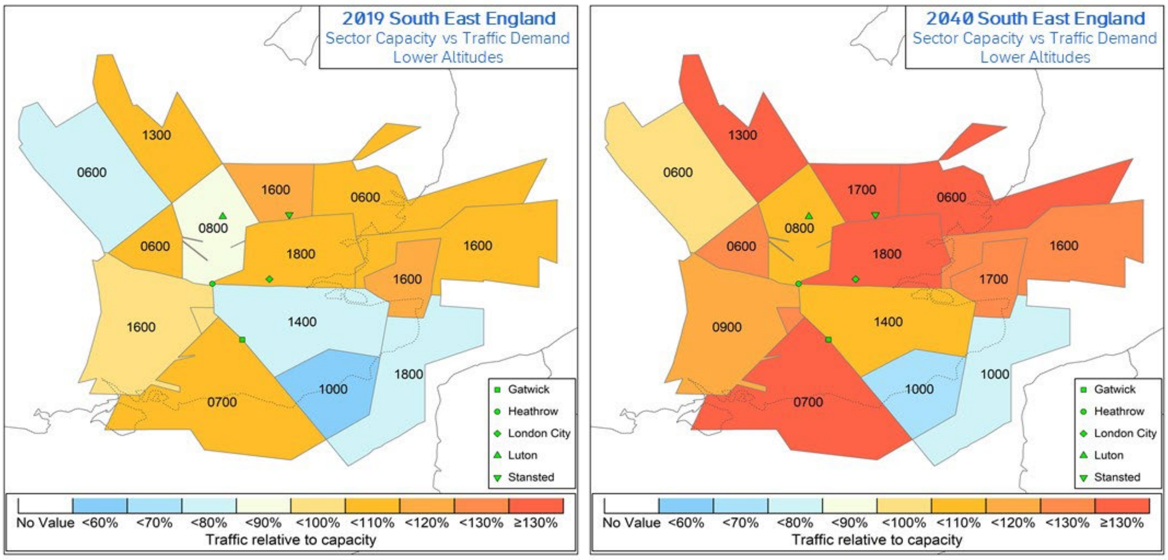
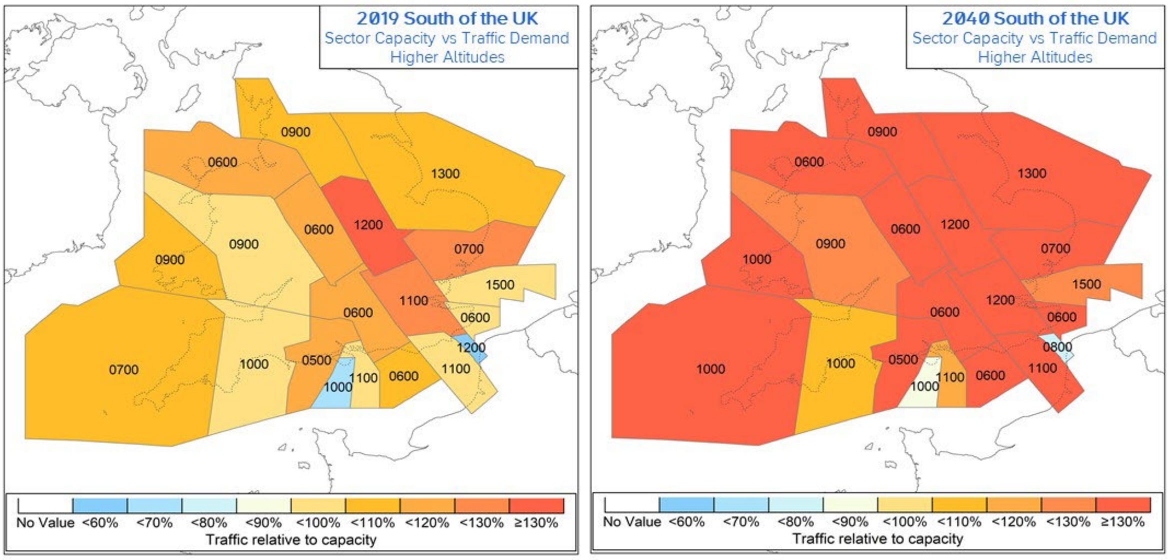


Figure 4: Traffic demand vs maximum airspace capacity, higher altitudes, South of the UK 2019 & 2040



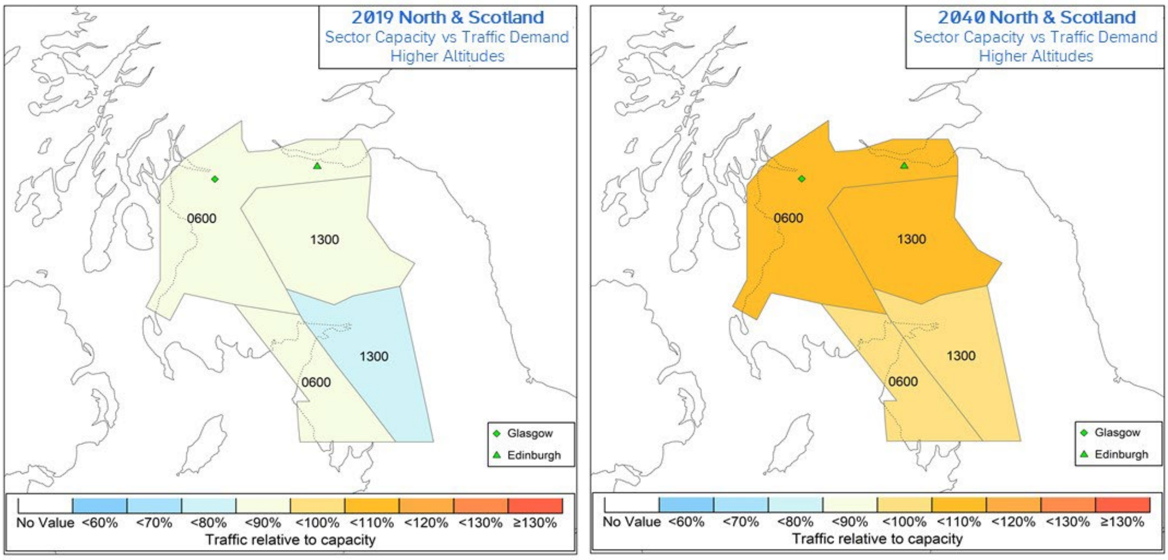


Figure 5: Traffic demand vs maximum airspace capacity, Northern England and Scotland 2019 & 2040

2.1.2. Airspace changes to address environmental inefficiency

60. Environmental inefficiency in the existing network above 7000ft. is another important factor that helps to determine the regions where airspace changes are needed. In this context, environmental inefficiency refers to aircraft following longer flight paths and sub-optimal climb and descent profiles. NERL tracks the level of environmental inefficiency in the network using a metric known as 3Di, which compares the actual flight paths of each aircraft against a theoretical optimum (i.e. the shortest distance and most efficient profile).[17] The issue of flight inefficiency is intrinsically linked to the demand and capacity bottlenecks explained above, where traffic is routinely directed on to longer, less efficient flight paths to avoid sectors that are reaching maximum capacity.

61. As part of the Masterplan development, NERL has identified four regional clusters of change in the medium level terminal airspace (from 7000ft up to 25,000ft) that are needed to upgrade the network, introduce additional capacity, alleviate bottlenecks and tackle environmental inefficiency. The network upgrades in each cluster share interdependencies with several important lower altitude airspace changes (below 7000ft.) that are sponsored by the main airports served by the terminal airspace above. The NERL-led network ACPs and airport-led lower altitude ACPs must be developed in collaboration to optimise the overall airspace system in each cluster and mitigate the negative impacts of aviation effectively. The four regional clusters are referred to as:

- The West Terminal Airspace (WTA)
- The Manchester Terminal Manoeuvring Area (MTMA)
- The Scottish Terminal Manoeuvring Area (STMA)
- The London Terminal Manoeuvring Area (LTMA)

62. The geographical dimensions of some of the regional clusters overlap with others at a network level. As a result, minor changes may be required in one region, to facilitate changes in another however these changes are not anticipated to have a material effect on the airspace design. In addition, NERL anticipates this 'change on change' to occur throughout the network as the process of airspace modernisation evolves.

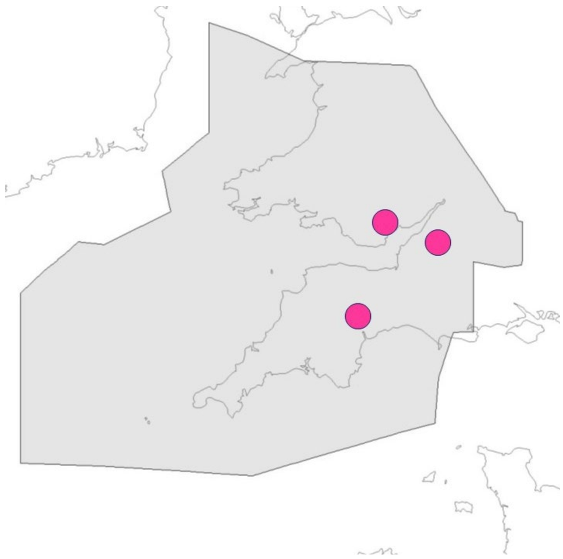
63. The performance of the existing network in each cluster is described in the section below, highlighting the current issues with the airspace, the proportion of overall UK-wide bottlenecks, delays and environmental inefficiency they are each responsible for and the interdependencies with airport-led lower altitude ACPs in each region. Much of the remainder of the environmental inefficiency not attributable to the four clusters arises in the en route network and is largely attributable to overflights.

[17] Summary explanation of the 3Di score, NERL, 2021. [Link]

2.1.3. The West Terminal Airspace

64. The West Terminal Airspace (WTA) extends over 20,000sq. miles in size and stretches from the French border in the south, to the interface with Manchester airport in the north. Viewing it from east to west, the WTA starts just west of the London TMA and ends midway across the Irish Sea where there are interfaces with the airspace managed by Dublin and Shannon air traffic control centres. Figure 6 illustrates the dimensions of the WTA region, highlights the main airport interdependences for airspace modernisation and summarises the current performance of the airspace using analysis produced by NERL for Iteration 2.

Figure 6: WTA dimensions, airport interdependencies and current performance



	% of total 2019 UK environmental inefficiency	2.5%
	Annual excess emissions in 2019 (tonnes of CO_2)	81,000
	Interdependent Masterplan ACPs: • Bristol • Cardiff • Exeter • NERL LD1	

65. The main traffic flows in the WTA are as follows:

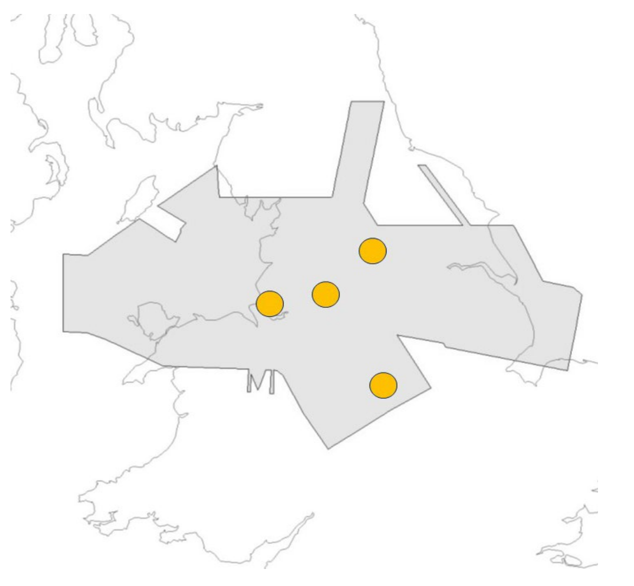
- Westbound traffic departing south-east UK airfields and European airports routeing either to Ireland or crossing the Atlantic to North, South and Central America.
- Eastbound traffic from Ireland or coming off Oceanic airspace to south-east UK airports and European airports.
- Northbound traffic from Southern Europe to Northern UK.
- Southbound traffic from Northern UK to Southern Europe.

66.The existing routes in the WTA are designed to a PBN specification known as RNAV5 (a navigation standard that assures aircraft track keeping accuracy is equal to or better than +/- 5 nautical miles). The deployment of new routes designed to an RNAV1 specification (a track keeping accuracy standard of +/- 1 nautical mile) addresses the drivers for greater airspace capacity and environmental efficiency by enabling more direct and closely spaced routes. The current constraints, set by 5 mile route spacing and indirect tracks, increase the frequency with which controllers tactically vector aircraft to create the required capacity (rather than leaving aircraft to fly their planned routes). The deployment of new RNAV1 routes that are designed to follow more efficient flight profiles allows the network in the WTA to become more systemised (i.e. the routes are deconflicted and optimised by design, significantly reducing the requirement for controller intervention).

2.1.4. The Manchester Terminal Manoeuvring Area

67.The Manchester Terminal Manoeuvring Area (MTMA) extends from the base of controlled airspace to c.20,000ft and was established to support operations to and from Manchester, Liverpool, Leeds Bradford and East Midlands airports. The MTMA also serves commercial air transport operations at several smaller aerodromes, including Hawarden and Warton near Blackpool. Figure 7 illustrates the dimensions of the MTMA region, highlights the main airport interdependencies for airspace modernisation and summarises the current performance of the airspace in terms of environmental inefficiency.

Figure 7: MTMA dimensions, airport interdependencies and current performance



% of total 2019 UK environmental inefficiency	2.7%
Annual excess emissions in 2019 (tonnes of CO_2)	87,500
Interdependent Masterplan ACPs: • Manchester • Liverpool • East Midlands • NERL MTMA • Leeds Bradford	

68.The existing airspace system in the MTMA was designed approximately 30 years ago. Manchester Airport is responsible for the majority of flights but the growth in commercial air transport operations at surrounding airports, most importantly Liverpool, Leeds Bradford and East Midlands is adding greater complexity to the traffic flows in the region and generating increasing levels of environmental inefficiency. The current MTMA route network is based on the location of ground navigation beacons resulting in capacity constraints that lead to a heavy reliance on controller vectoring during peak times.

69. The objective of the network upgrades planned for the MTMA region is to deliver a balanced increase in both airspace capacity and environmental efficiency by optimising the configuration of arrival and departure routes serving each airport and deconflicting the main traffic flows by design (i.e. network systemisation). The upgrades also aim to remove existing airspace interactions between Manchester and Liverpool arrivals and departures and improve the sequencing of inbound traffic into the region.

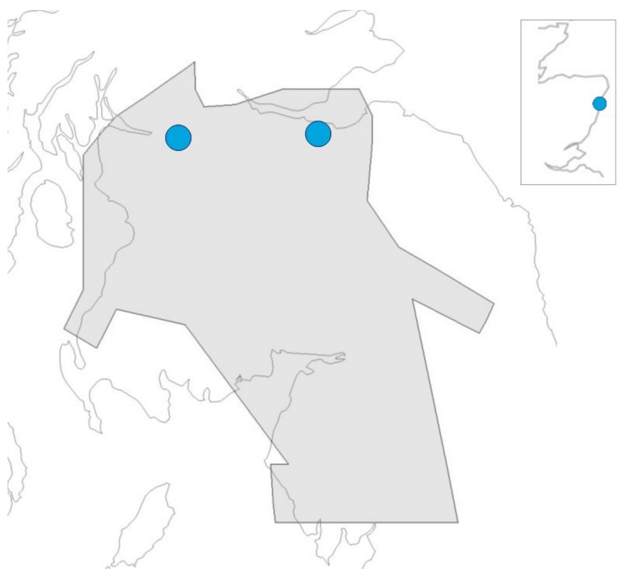
70. The optimisation of the airspace system in the MTMA region is dependent on a series of coordinated changes to the existing arrival and departure routes at lower altitudes that support operations at Manchester, Liverpool, Leeds Bradford and East Midlands airports. This level of co-ordinated undertaking supports the development of route designs that deconflict from one another below 7000ft. (i.e. systemisation at lower altitudes), generating safety benefits and the potential to mitigate the impact of aircraft noise, enable greater access for other users, whilst also enabling the removal of dependencies on the outdated ground navigation beacons.

2.1.5. The Scottish Terminal Manoeuvring Area

71. The Scottish Terminal Manoeuvring Area (STMA) extends from the base of controlled airspace to c.25,000ft and was established to support operations to and from Glasgow and Edinburgh airports. The STMA also serves commercial air transport operations at several smaller airports including Glasgow Prestwick, Dundee, Cumbernauld and RAF Leuchars Airfield, and on the region's periphery, flights to and from Aberdeen. Similar to the MTMA, the existing airspace system in the STMA has remained relatively unchanged for the past 30 years and is based around the locations of outdated ground navigation beacons. The diverse nature of the traffic operating in this region, including significantly different aircraft capabilities and speeds creates a heavy reliance on controller vectoring to safely separate inbound and outbound flights.

72. Figure 8 illustrates the dimensions of the STMA region, highlights the main airport interdependencies for airspace modernisation and summarises the current performance of the airspace in terms of environmental inefficiency.

Figure 8: STMA dimensions, airport interdependencies and current performance



% of total 2019 UK environmental inefficiency	1.1%
Annual excess emissions in 2019 (tonnes of CO_2)	35,651
Interdependent Masterplan ACPs: • Aberdeen • NERL STMA • Glasgow • Edinburgh	

73. The aim of the network upgrades above 7000ft. in the STMA region is to offer a balance between increased capacity and greater environmental efficiency by improving aircraft climb and descent profiles and reducing the existing level of airspace complexity that generates the need for controller vectoring.

74. The potential to optimise the airspace system in the STMA will be maximised through the coordinated development of lower altitude ACPs sponsored by the three largest airports in the region - Glasgow, Edinburgh and Aberdeen. This coordinated approach is expected to improve the management of aircraft noise below 7000ft. enhance access for other airspace users, remove the dependencies on ground navigation beacons and ensure the integration between the routes at lower altitudes and the network upgrades above 7000ft. are as efficient as possible.

2.1.6. The London Terminal Manoeuvring Area

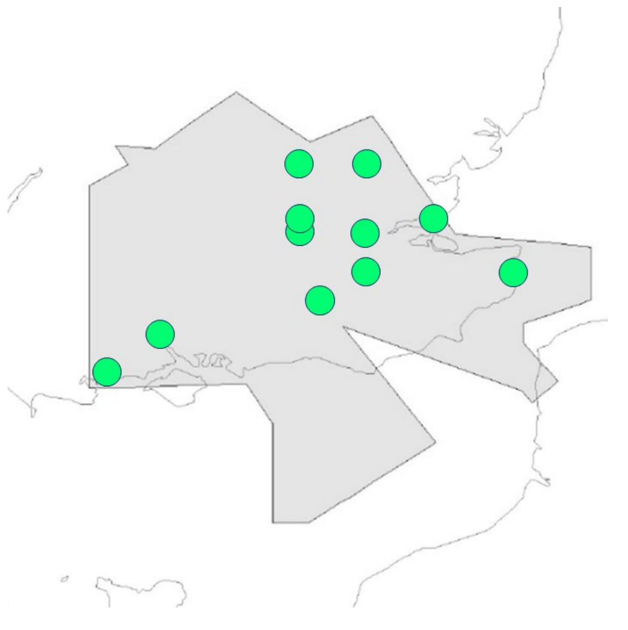
75. The London Terminal Manoeuvring Area (LTMA) is one of the busiest and most complex airspaces in the world. The LTMA region extends across much of South East England. It is bounded by the English Channel in the south, Bedford in the north, Oxford to the west and the North Sea to the east. Contained within this region are some of the world's busiest traffic flows and commercial air transport airports, including Heathrow, Gatwick, Stansted, Luton and London City, along with large numbers of business jet operations at Farnborough and Biggin

Hill, military operations at RAF Northolt and other large airports on the periphery of the region like Southampton, Bournemouth, Southend and (subject to planning permission) Manston.

76. The routes to and from the airports in the LTMA region frequently overlap, creating an almost complete reliance on controller vectoring during peak times. The LTMA region is responsible for by far the largest proportion of total environmental inefficiency and airspace capacity delays across the UK airspace system. Similar to the other regional clusters, the network design itself is based around the location of ground navigation beacons. In the LTMA network, this has created significant bottlenecks because of the number of airports and the intensity of the operations. Traffic from multiple airports frequently converge in the same areas of airspace. These interactions routinely prevent traffic at one LTMA airport from departing until flights from a neighbouring airport have cleared, generating unnecessary delays for operators and passengers, ground congestion for the airports, and significant network complexity. It also leads to aircraft flying at lower levels for extended periods across the region, creating an unnecessary increase in the environmental impact of over flights and excess aircraft emissions.

77. Figure 9 illustrates the dimensions of the LTMA region, highlights the main airport interdependencies for airspace modernisation and summarises the current performance of the airspace in terms of environmental inefficiency.

Figure 9: LTMA dimensions, airport interdependencies and current performance



% of total 2019 UK environmental inefficiency	38.1%
Annual excess emissions in 2019 (tonnes of CO_2)	1,234,765

Interdependent Masterplan ACPs:

- Biggin Hill
- RAF Northolt
- Bournemouth
- Southampton
- Gatwick
- Southend

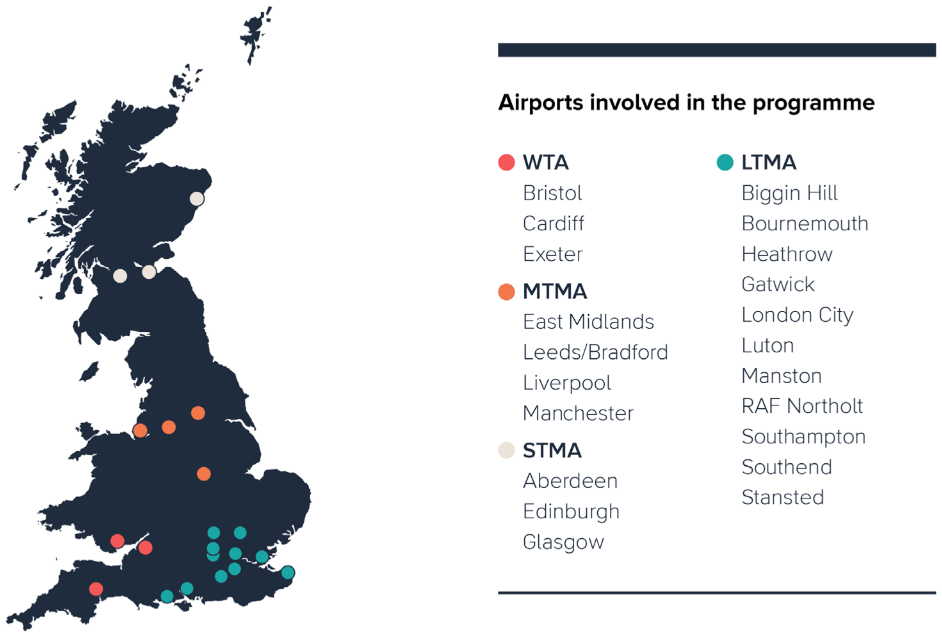
	• Heathrow • Stansted • London City • NATS LD2 • Luton • NATS LD3 • Manston • NATS LD4

78. The network upgrades in the LTMA region aim to fundamentally redesign the existing airspace system through the widespread adoption of systemised routes that are designed to an advanced PBN standard, enabling significantly greater precision and flexibility. Additional airspace capacity is expected from the implementation of more closely spaced arrival and departure routes that are dedicated to each airport and are separated by design (i.e. they are systemised). As a result, the interdependent airport-led ACPs in the LTMA region must be closely coordinated with the network upgrades. The precision and flexibility of PBN routes creates significant opportunities to reduce aircraft emissions per flight in the LTMA region and better manage the impacts of aircraft noise. These opportunities must be balanced against the challenges created by more precise flight paths that concentrate aircraft noise into narrower contours.

2.1.7. Lower altitude airport-led airspace changes

79. The network upgrades planned in the four clusters, offer the opportunity to better integrate flights to and from the neighbouring airports in each region reducing the number and complexity of traffic interactions above 7000ft. A coordinated approach to the optimisation of the overall airspace system in each cluster is expected to unlock significant benefits at lower altitudes as well - reducing track miles, improving flight profiles, mitigating the environmental impacts of overflight, enabling greater access for other users and strengthening operational resilience. However, it may not be possible to achieve benefits in all these areas simultaneously and difficult trade-off decisions will need to be made during the process of optimisation. To achieve this the airport-led ACPs below 7000ft. must participate in a highly synchronised process of options development, assessment and consultation that determines the optimum route design, in-conjunction with the network upgrades. Figure 10 illustrates the 21 lower altitude airport-led ACPs that share airspace design interdependencies in the four regional clusters and should follow a coordinated approach as part of the Masterplan. Airport-led ACPs share interdependencies with sponsors in the same cluster.

Figure 10: 21 interdependent airport-led ACPs by regional cluster



80. The tables below provide more information about the interdependent airport-led ACPs in each regional cluster. Each table lists the CAA IDs for the relevant ACPs (which can be used to access more information about the proposals from the UK Airspace Change Portal[18]) along with a description of their size and current status in the CAP1616 process. The tables also set out the annual number of flights and passengers affected by each ACP (based on 2019 actual data)[19] and where available the existing number of people currently impacted by aircraft noise at each airport (based on the 2016 population exposed to an average of more than 55 decibels over 24 hours).[20] The size of the ACP is determined by the following definitions:

- **Very Large** – the ACP affects over 190,000 annual flights, includes all of the existing arrival and departure routes below 7000ft. in scope and shares interdependencies with a NERL-led network upgrade and two or more other airport-led proposals.
- **Large** – The ACP affects between 40,000 and 190,000 annual flights, includes some or all of the existing arrival and departure routes below 7000ft. in scope and shares interdependencies with a NERL-led network upgrade and one or more other airport-led proposal(s).

[18] The CAA's UK Airspace Change Portal hosts all published information relevant to each ACP. [link]
[19] Annual aircraft movements and passenger numbers, CAA airport data, 2019. [link]
[20] Population impacted by noise, Airport Noise Action Plans 2016. Source DEFRA.

- **Medium** – The ACP affects fewer than 40,000 annual flights, includes some or all of the existing arrival and departure routes below 7000ft. in scope and shares interdependencies with a NERL-led network upgrade and one or more other airport-led proposal(s).

Table 5: WTA cluster interdependent airport-led ACPs

Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
Bristol	**ACP-2018-55: LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	69,434
		Passengers pa. (2019)	9m
		Pop. impacted by noise	c.3,000
Cardiff	**ACP-2019-41: MEDIUM** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	31,881
		Passengers pa. (2019)	1.7m
		Pop. impacted by noise	Not readily available
Exeter	**ACP-2018-47: MEDIUM** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	44,306
		Passengers pa. (2019)	1m
		Pop. impacted by noise	Not readily available

Table 6: MTMA cluster interdependent airport-led ACPs

Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
Manchester	**ACP-2019-23: VERY LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	202,892
		Passengers pa. (2019)	29.4m
		Pop. impacted by noise	c. 102,000
East Midlands	**ACP-2019-44: LARGE**	Flights pa. (2019)	74,566
		Passengers pa. (2019)	4.7m

Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
	In Stage 2 developing and assessing airspace design options.	Pop. impacted by noise	c. 12,000
Leeds Bradford	**ACP-2021-066: MEDIUM** In Stage 1 developing airspace design principles with representative stakeholders.	Flights pa. (2019)	35,641
		Passengers pa. (2019)	4m
		Pop. impacted by noise	c. 18,800
Liverpool	**ACP-2015-09: MEDIUM** Paused at Stage 4, following a Public consultation on a preferred airspace design.	Flights pa. (2019)	58,968
		Passengers pa. (2019)	5m
		Pop. impacted by noise	c. 4,500

Table 7: STMA cluster interdependent airport-led ACPs

Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
Edinburgh	**ACP-2019-32: LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	131,617
		Passengers pa. (2019)	14.7m
		Pop. impacted by noise	c. 13,800
Glasgow	**ACP-2019-46: LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	91,812
		Passengers pa. (2019)	8.8m
		Pop. impacted by noise	c. 47,000
Aberdeen	**ACP-2019-82: MEDIUM** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	91,248
		Passengers pa. (2019)	2.9m
		Pop. impacted by noise	c. 16,150

Table 8: LTMA cluster interdependent airport-led ACPs

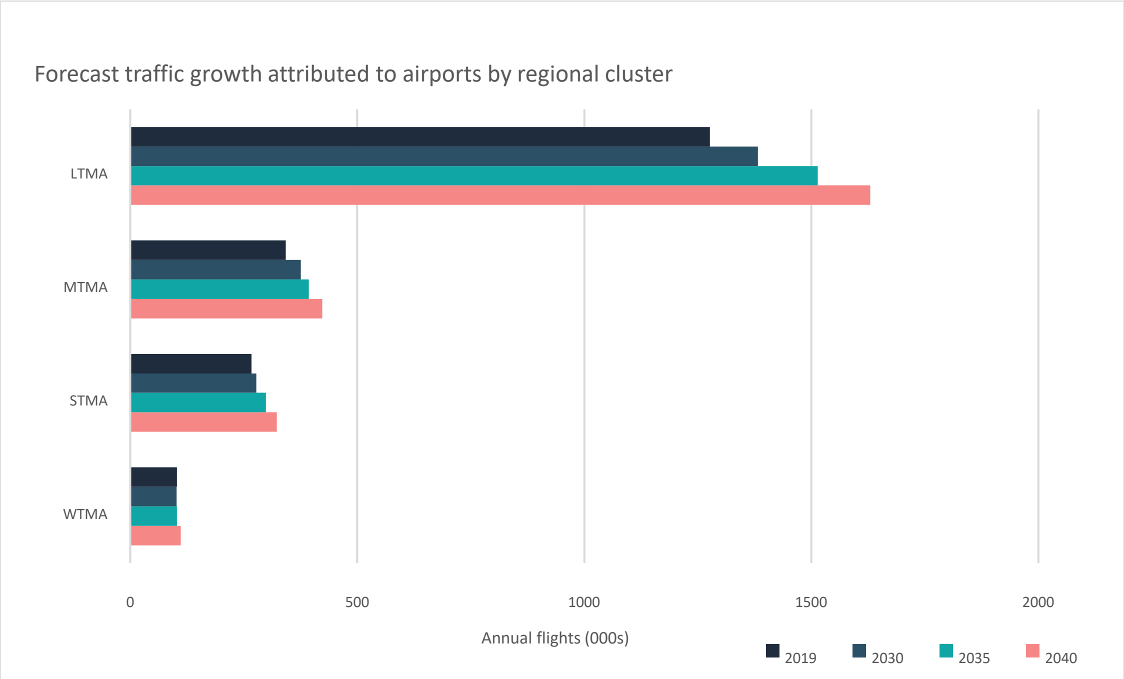
Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
Heathrow	**ACP-2021-056: VERY LARGE** In Stage 1 developing Airspace Design Principles with representative stakeholders.	Flights pa. (2019)	478,059
		Passengers pa. (2019)	81m
		Pop. impacted by noise	c. 683,700
Gatwick	**ACP-2018-60: VERY LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	284,987
		Passengers pa. (2019)	47m
		Pop. impacted by noise	c. 13,500
Stansted	**ACP-2019-01: VERY LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	199,925
		Passengers pa. (2019)	28.1m
		Pop. impacted by noise	c. 8,700
Luton	**ACP-2018-70: LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	141,858
		Passengers pa. (2019)	17.9m
		Pop. impacted by noise	c. 17,000
London City	**ACP-2018-89: LARGE** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	84,260
		Passengers pa. (2019)	5.1m
		Pop. impacted by noise	c. 75,200
Biggin Hill	**ACP-2018-69: MEDIUM** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	39,390
		Passengers pa. (2019)	Not readily available
		Pop. Impacted by noise	Not readily available
RAF Northolt	**ACP-2018-66: MEDIUM**	Flights pa.	c. 16,400

Airport	ACP ID, Size and Status	Flights, Passengers & Noise Impact	
	In Stage 2 developing and assessing airspace design options.	Passengers pa.	Not readily available
		Pop. impacted by noise	Not readily available
Southend	**ACP-2018-90: MEDIUM** In Stage 1 developing Airspace Design Principles with representative stakeholders.	Flights pa. (2019)	36,327
		Passengers pa. (2019)	2m
		Pop. impacted by noise	c. 2,200
Bournemouth	**ACP-2019-43: MEDIUM** In Stage 1 developing Airspace Design Principles with representative stakeholders.	Flights pa. (2019)	38,540
		Passengers pa. (2019)	803k
		Pop. impacted by noise	c. 400
Southampton	**ACP-2019-03: MEDIUM** In Stage 2 developing and assessing airspace design options.	Flights pa. (2019)	36,473
		Passengers pa. (2019)	1.8m
		Pop. impacted by noise	c. 5,600

2.1.8. Airspace changes and planned developments on the ground

81. NERL has attributed the forecast growth in commercial air transport flights out to 2040 described in section 1.1. across the airports that are sponsoring interdependent ACPs as part of the Masterplan, using a series of economic models that predict where passengers will choose to fly from. The models include parameters for the number of people living close to an airport, the reasons for travel and the capacity of the airports' runways. The largest increases in flights are predicted at the airports that have historically experienced the highest volumes of traffic, most notably in the LTMA region. The growth in traffic in this already heavily congested region (see figures 3 and 4) will further increase the pressure on scarce airport and runway infrastructure. Figure 11 illustrates the forecast number of commercial air transport flights in 2030, 2035 and 2040 attributed across the airports in each regional cluster and highlights the pressure on the LTMA region.

Figure 11: Forecast traffic growth attributed to airports by regional cluster



82. To accommodate the forecast growth in traffic levels, key airport expansion projects are expected, with additional capacity required in London and the south-east. For example, in the forecast presented here, the south-east is predicted to have excess demand in the region of 200,000 to 265,000 flights by 2040. The forecast presented in this section assumes a new third runway at Heathrow. It should be noted that this expansion project is not guaranteed, but has been included here as an example of the expected capacity increase which will be provided by the airports in the region through either maximising existing, or developing new, infrastructure.

83.The Airports National Policy Statement (ANPS) sets out "The Government's policy on the need for new airport capacity in the south-east of England".[21] The Government simultaneously sets out its policy for existing airport infrastructure in a separate document 'Beyond the horizon: The future of UK aviation - Making best use of existing runways'.[22]

84.Although the ANPS sets out government policy, it is facilitative rather than compelling, and does not require anyone to bring forward proposals. In addition, it does not identify the appropriate person or persons to carry out the preferred scheme. The ANPS and associated policies may be reviewed following the outcome of the Jetzero consultation which is planned to be published by the end of 2021. Before accepting the Masterplan into the AMS, the co-sponsors must, amongst other things, assess if the iteration in question is consistent with government policy. In their latest commissioning letter (May 2021), the co-sponsors note that government transport policy could be revised, and that an iterative approach can help to deal with any change in policy.

85.Heathrow Airport had intended to deliver airspace modernisation as part of its expansion project in line with the ANPS. However, the expansion is on pause as the airport's current priority is to recover from the impact of the Covid-19 pandemic. Heathrow remains committed to airspace modernisation and it is therefore progressing the changes required to keep pace with the wider UK programme via a new ACP, based on its existing two runways. As a result, Heathrow has paused the Expansion ACP that focused on a future three runway operation at Step 2a (options development) of the CAP1616 process. A new ACP to modernise airspace, focusing on the existing two runway operation, was launched by Heathrow in 2021 and is progressing through Step 1b (design principles) with a Stage 1 gateway planned for February 2022.

2.1.9. Airspace changes with the potential to limit the total adverse effect of noise

86.One of the most important environmental impacts associated with the airspace at lower altitudes is the effect of aircraft noise. Overall, airspace modernisation is expected to see a reduction in average noise levels per flight, but the redistribution of noise impacts between different areas may lead to disruption for communities living under flight paths. The effects of new, more frequent or more concentrated noise may increase the risks of causing general annoyance, sleep disturbance, lower levels of productivity and health impacts, which each contribute to the total adverse effects.

87.Aviation noise performance has improved significantly in recent decades, driven by the introduction of quieter aircraft. However, some communities experience more noise due to the continued growth in traffic levels. In addition, the introduction of PBN routes can bring more intense levels of aircraft concentration and therefore noise.

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[21] Airports National Policy Statement: New runway capacity and infrastructure at airports in the south-east of England. Department for Transport, 2018. [link]

[22] Beyond the horizon, the future of UK aviation, HM Government, 2018. [link]

88. The precision and flexibility offered by PBN routes also create opportunities to deploy new operational techniques that can improve the management of aircraft noise, for example by introducing multiple flight paths for noise dispersion and more predictable respite. As part of the AMS, the co-sponsors encourage these opportunities to be exploited wherever feasible, taking into account local circumstances and community preferences.

89. In general terms, airspace changes offer four main techniques to limit the total adverse effects of aircraft noise as part of the system-wide airspace modernisation process – Traffic Dispersion, Traffic Concentration, Noise Respite and Noise Redistribution.

- **Traffic Dispersion** refers to airspace changes that enable departing traffic to follow the same general routeing but fly a variety of different flight paths when measured over the ground. And to deploy similar traffic distribution techniques for inbound traffic.
- **Traffic Concentration** is the opposite of dispersion and is a consequence of airspace changes that exploit the accuracy of PBN routes, where aircraft avionics are coded to automatically follow the same flight paths consistently and fly very similar tracks over the ground. The accuracy and predictability associated with PBN routes means it is possible to make more efficient use of the airspace by allowing larger volumes of traffic to fly through smaller areas, potentially avoiding population centres. The disadvantages of traffic concentration may however fall to the minority of stakeholders that are affected by more frequent and intense noise impacts.
- **Noise Respite** involves the development of airspace changes to enable greater planning and predictability of aircraft noise impacts. For example, the planned use of different arrival routes at different times of day, providing communities with predictable relief from the noise impacts of inbound traffic. Another example could be alternating flights between multiple departure routes according to a pre-planned schedule. Respite can be designed into airspace structures more easily once arrival and departure routes are upgraded to PBN standards because flight paths can be designed with greater accuracy and flexibility, although there are limitations on the number of respite routes that may be deployed due to safety considerations and the technical constraints of air traffic control systems and aircraft avionics.
- **Noise Redistribution** refers to airspace changes that focus on the redesign of airport arrival and departure routes at lower altitudes to allow for existing noise impacts to be redistributed away from more sensitive areas. Of course, this assumes that there are adjacent areas that are less sensitive to noise that the routes can be moved over to. The relative noise sensitivity of areas is difficult to estimate and must be carefully considered as part of a coherent and transparent trade-off process when the re-distribution is the goal.

90. More information about the potential for airspace changes to limit the total adverse effects of aircraft noise will be included in Iteration 3 of the Masterplan, when the constituent ACPs have assessed the noise impacts of their shortlisted airspace design options.

2.1.10. Airspace changes needed to introduce new technology

91. The widespread deployment of new routes designed and operated to more advanced PBN standards is a technological cornerstone of the Masterplan ACPs. Significant improvements in airspace capacity and efficiency can be achieved by positioning PBN routes that are safely separated, optimised by design and flown without the need for routine tactical intervention from air traffic controllers. In general terms, there are three standards of PBN available to support the airspace changes required for modernisation:

    - **RNAV1 –** the basic standard for new routes in the terminal airspace, which refers to the use of area navigation (RNAV) with a track keeping accuracy of +/- 1 nautical mile.
    - **RNP1** – a more advanced standard for new routes in the terminal airspace, which refers to a Required Navigation Performance (RNP) with a track keeping accuracy of +/-1 nautical mile and additional avionics functionality to improve precision in the turn, monitor the aircraft's navigational performance and automatically alert the pilot if there is a divergence.
    - **RNP-AR** – the most advanced standard specifically for the final approach phase, which refers to Required Navigation Performance Authorisation Required (i.e. the authorisation from the regulator for the specific pilot training needed to use the routes), enabling track-keeping accuracy of between 0.3 and 0.1 nautical miles and the flexibility to fly curved approaches.

92. The lateral distance required between PBN routes to assure safe separation is lower for the more advanced standards, offering more design flexibility for the ACPs that adopt them. Practically all aircraft operating in the UK's terminal airspace are capable of operating on routes designed to an RNAV1 standard. However, there is expected to be a portion of the fleet still operating in 2025 that may not have the avionics capability to conduct RNP1 operations. Similarly, some aircraft will not be capable of flying RNP-AR routes when the concept is first deployed. There is also an additional cost to the operators associated with RNP-AR linked to activating the functionality on some aircraft types and the costs associated with flight crews that are required to conduct specialist training and obtain dedicated authorisation from the regulator.

93. Generally, if successive departures follow the same initial track, they must be separated by two minutes, creating limitations on runway utilisation. In the existing system, if routes designed to a conventional navigation standard diverge by an angle of more than 45 degrees shortly after take-off then the time between successive departures can be reduced to as low as one-minute, improving runway utilisation. The requirement for a minimum 45-degree angle of divergence to achieve one minute departure separations is a significant limitation on the flexibility of the airspace design. ACPs with routes designed to a PBN standard offer the opportunity to reduce the angle of divergence, increasing the range of potential flight path options available. It is expected that the technology which enables reduced angles of divergence on departure will be incorporated into all Masterplan ACPs to increase the potential for respite arrangements and

multiple track configurations for outbound traffic that may be used to distribute noise and share impacts, depending on the local circumstances.

2.1.11. Operational concepts required to deliver airspace changes

94. The AMS sets out an innovative and ambitious concept for the modernisation of the terminal airspace based on three important goals, that:

- Each airport in the terminal area is served by its own dedicated set of arrival and departure routes between the ground and the en route network.
- All routes in the terminal airspace are separated by design, do not interact with one another as much as today, and can be operated more independently.
- In routine operations, aircraft in the terminal airspace fly the routes as designed. Air traffic controllers are not required to intervene tactically, take aircraft off their planned routes and vector to manage crossing traffic, absorb delays or create airspace capacity.

95. The operational concepts that are required for airspace modernisation when it is first planned for deployment (between 2025 and 2029) and as it evolves (between 2030 and 2040) can be grouped into four areas:

- The introduction of new air traffic systems that improve flight information and automate controller tasks.
- The use of air traffic tools and procedures to manage arrival delays.
- The use of air traffic tools and procedures that enable time-based operations for the sequencing and spacing of traffic.
- The evolution of aircraft airframes, avionics and flight management systems (FMS).

New air traffic systems that improve flight information and automate controller tasks

96. NERL is upgrading the flight data processing (FDP) systems used by its controllers to monitor the progress of flights and manage the performance of the network. The new generation of FDP systems offer controllers significantly more flight information and automate some routine tasks so that they have more time and more options to manage the flow of traffic across the network. The FDP upgrades are a complex, multi-year programme with large scale IT transformation, systems integration and controller training phases. Some of the FDP systems used to manage traffic in the en route phase of flight have already been upgraded in support of airspace modernisation in the en route network, demonstrating the benefits of the advanced functionality. Once complete, the upgrades to FDP systems used by controllers in the terminal airspace is expected to significantly increase airspace capacity and efficiency by improving the accuracy of information provided about forecast flight positions, profiles, route adherence and potential conflicts. The new route network for the terminal airspace is expected to be deployed alongside the existing FDP systems that have been in use for many years to ensure the

technology platform is stable while the airspace structure is changing. However, the Masterplan ACPs should be designed to maximise the potential benefits of the new FDP systems, which are expected to enter full operational service after the new route network for the terminal airspace is deployed.

The use of air traffic tools and procedures to manage arrival delays

97. Arrival holds are used in the existing airspace system to absorb airborne delays that arise when the demand for an airports' runway exceeds the available capacity and where inbound traffic to the terminal airspace does not arrive in an efficient order for landing. The holds are used to create a pool of inbound aircraft that can be streamed by controllers to deliver an efficient flow of traffic for landing. In the existing system, this has proved to be an effective method to maintain high runway throughput but is not environmentally efficient, creating excess emissions and noise impacts. The concept for modernisation of the terminal airspace relies on the greater use of arrival management tools and procedures that enable flights to absorb delays during the en route phase of flight, using accurate speed controls, and stream traffic into an efficient order for landing, reducing the reliance on conventional arrival holds. Arrival management tools and procedures have been in operation for traffic inbound to Heathrow and Gatwick for several years. Further development is planned by NERL (working closely with the airlines and airports) to enhance the capability of the tools (increasing their range, functionality and the amount of delay that can be absorbed) and integrate the existing procedures into the overall concept for terminal airspace systemisation.

Tools that enable time-based operations for sequencing and spacing

98. Once flights leave the arrival hold and begin the intermediate and final approach, they must be organised by controllers into an efficient sequence for landing. From the operators' perspective, an efficient sequence is one where aircraft are safely spaced at an optimal distance so that the runway is fully utilised (so there is minimal redundancy) and the aircraft are not delayed in the air for longer than necessary. In the existing system controllers create and maintain this sequence using vectoring – some aircraft are given longer flight paths, and some shorter, so that the spacing between them when they line up for the final approach is optimised. This method creates a degree of variability in the tracks flown by aircraft at lower altitudes from the hold to the final approach with the potential to create excess emissions and noise impacts across a wider area.

99. The concept for modernisation includes the option for greater use of technologies that enable time-based operations (TBO). One of the main goals of TBO is to organise the arrival sequence some distance from the airport at higher altitudes, where it is generally more efficient, and thereby reduce the need for vectoring at lower altitudes. A coordinated approach to the management of inbound traffic flows, using accurate target times for flights to arrive at specific points in the network, enables controllers to create an initial sequence and tackle common issues that generate inefficiency in today's system, such as aircraft arriving from multiple directions, variations in aircraft performance and the effects of the weather on air speed.

Controllers can offset and stagger arrivals in response to the operational conditions, reducing the spacing between aircraft and the size of the areas between the hold and final approach that may be subject to overflight from vectoring. Over the long term as TBO technology develops and is more widely adopted, controllers and pilots may be able to manage the arrival time of most flights to within a few seconds, enabling aircraft to land without the need for any airborne holding or approach vectoring in routine operations.

Aircraft airframes, avionics and flight management systems

100. NERL and the airports that are sponsoring the Masterplan ACPs are working closely with aircraft manufacturers to understand the timescales for airframe and avionics developments across the fleet. It is clear that a portion of the fleet operating at the time that the airspace changes are first deployed will not have the airframe or avionics capabilities needed to maximise the performance of the new route network and that further benefits will be released over time as the technology used across the fleet evolves. Iteration 1 of the Masterplan presented a new concept to enhance the performance of the terminal airspace by deploying a large number of arrival and departure routes that are safely separated from one another by design. Aircraft would use PBN capable avionics to fly the routes following a series of horizontal and vertical restrictions that effectively contain their flight paths within dedicated 3-dimensional tubes. The tubes would be designed to climb and descend continuously.

101. The tube concept requires aircraft to follow a defined geometric path. Similar technology is in use today for aircraft on final approach, where the FMS is coded to follow a vertical path angle and descend at a consistent gradient. Avionics will need to be developed to allow for the coding of descent gradients in this way outside of the final approach phase. This is also the case for the avionics capability required to define a climbing geometric path for a departure route. When the airspace changes are first deployed, the new PBN routes designed as part of the Masterplan ACPs must meet certain criteria that ensure all aircraft required to use them can do so in all scenarios. Air traffic controllers will still be required to intervene tactically to provide the vertical separation between any new routes that are not laterally separated (rather than the flights being fully contained within a 3D tube). The vertical separation between routes may still need to be quite broad to account for the differences in climb performance and the capability of the aircraft avionics across the fleet. As technology develops and FMS operations are better understood, the vertical constraints associated with each departure route may be narrowed and the requirement for controller intervention should steadily reduce as full vertical containment within a 3D tube becomes operational.

SECTION B

3.1. Programme Plan of airspace changes (B1)

102. This section sets out the programme plan and deployment sequence that the constituent ACPs included in Iteration 2 of the Masterplan are expected to follow. The anticipated timescales, delivery assumptions and the critical path will be further refined during the development of Iteration 3 when most of the constituent ACPs are progressing through the second half of Stage 2 or the first half of Stage 3 of the CAP1616 process.

103. In general terms;

- The constituent ACPs are needed as soon as possible where they offer the potential to limit or reduce the environmental impacts of aviation, enable greater access for other airspace users, enhance operational resilience and deliver safety benefits.
- The constituent ACPs identified in Iteration 2 of the Masterplan are needed between 2025 and 2029 where they are required to introduce additional capacity that enables the operation to accommodate the forecast recovery and growth in traffic levels outlined in section 1.1. and alleviate airspace bottlenecks.

104. The timeline and sequencing of the Masterplan ACPs are complex issues. It is not considered feasible for all the constituent ACPs in the Programme to be developed and deployed at the same time. A modular approach to deployment is preferable, in line with each of the four regional clusters, emphasising coordination and strong programme management discipline to mitigate the risks of design conflicts, technical misalignments and a lack of transparency for external stakeholders.

3.1.1. Sequencing deployment into regional clusters

105. At this comparatively early stage in the Programme, there are a variety of options regarding the programme plan and deployment sequence for the ACPs in each regional cluster to manage the interdependencies between the proposals and address external drivers (such as the plans to decommission ground navigation beacons explained in section 1.1.7.). However, it is clear that the delivery timelines for some of the constituent ACPs will be unavoidably misaligned. The organisation of the Programme into four regional clusters is intended to address this misalignment.

106. Large scale ACPs are usually difficult to develop and deploy because of the complexity of the existing airspace design, the intensity of the current operation and the potential impacts on

communities, the environment and other airspace users. The Masterplan ACPs bring additional deployment challenges associated with airspace design interdependencies and the widespread introduction of PBN routes, which will replace well established ATC procedures based on controller vectoring with the comparatively new concept of systemisation. Other factors being equal, the greater the complexity of the existing airspace design, and the more interdependencies, the more difficult the ACPs will be to deploy.

107. The four regional clusters identified in section 2.1. can be organised from lowest complexity to highest complexity determined by the existing airspace design and the nature of the interdependencies between the constituent ACPs, as follows:

- WTA (lower complexity)
- STMA (moderate complexity)
- MTMA (high complexity)
- LTMA (very high complexity)

108. On the whole, the smaller the ACP and the lower the complexity of the existing airspace design, the quicker the proposal will be to develop and deploy. The correlation between complexity and ACP duration introduces a degree of misalignment to the timelines and deployment sequence included in the Masterplan. Some of the constituent ACPs will take much longer to develop and deploy than others. At one end of the spectrum, Heathrow's ACP to upgrade the arrival and departure routes for the two runway operation, is expected to take the longest to develop because it is the largest proposal in the Masterplan, with the most extensive interdependencies and will be deployed into very high complexity airspace. Conversely, the ACPs sponsored by Bristol, Cardiff and Exeter are smaller, focus on lower complexity airspace and are expected to be quicker and easier to develop.

109. In addition to the inherent misalignments created by the relative size, complexity and interdependencies of the proposals, the Masterplan ACPs are each at different points in the CAP1616 process. Some ACPs, those sponsored by Heathrow, Leeds Bradford, Southend and Bournemouth are working through Stage 1 at the beginning of the CAP1616 process during 2021 and maybe up to 18 months behind the development timelines of other interdependent proposals in the same clusters.

110. The Masterplan will be deployed separately in the four clusters because of the relative size and complexity of the ACPs in each region. The ACPs in the WTA cluster will be deployed concurrently as part of a single integrated deployment. Similarly, the ACPs included in STMA cluster will be deployed together. Although the MTMA cluster ACPs bring greater complexity and more extensive interdependencies that the WTA and STMA clusters, they too can be deployed together in a single integrated deployment providing that no other large scale Masterplan ACPs are deployed in the same time window. The LTMA cluster will require a minimum of three separate deployment windows to implement the full set of proposed changes because of the very large size, high complexity and extensive interdependencies of the constituent ACPs.

3.1.2. Key programme plan and deployment sequence assumptions

111. Each cluster of ACPs will be implemented in a defined deployment window. All changes to the existing airspace design are deployed through the Aeronautical Information Regulation and Control (AIRAC) process. The AIRAC process is a 28-day cycle that manages the updating of aeronautical information globally. Typically there are four AIRAC changes each year where significant airspace changes can be deployed. For operational reasons, it is undesirable to deploy major airspace changes in the summer period due to the peak in air traffic levels across the UK, requiring the Air Navigation Service Provider (ANSP) to be at full capacity to deliver a safe, efficient, and effective service. Deploying airspace changes just after the summer is also undesirable due to the requirement to train controllers over the summer period (when they are required to handle peak traffic levels).

112. The length of controller training required to support the larger more complex deployments means that the LTMA and MTMA clusters are planned for deployment on AIRAC dates in Q1 and the early part of Q2 of the relevant year prior to the busy summer period. It is possible for the WTA and STMA clusters to deploy on AIRAC dates in Q4 of the relevant year because of the smaller training requirements.

113. The deployment timescales for each individual ACP within a cluster are determined by the size, complexity and interdependencies of the proposal and a series of important programme planning assumptions regarding the activities that controllers and operators must conduct to prepare for changes to the airspace structure and route network, specifically:

- The ANSP's ability to release controllers from the current operation to support the ACP implementation activities, while maintaining an acceptable level of service.
- The optimisation of the allocation of airspace as a scarce national resource, in consultation with other airspace users.
- The size of the technical adaptations required to the ANSP's flight data processing systems and associated ATC tools.
- The capacity of ANSP's simulation facilities, route management, testing and development facilities to accommodate the airspace change.
- The length of training required for each air traffic control validation affected by the airspace change.
- Aircraft flight management system adaptations to implement new instrument flight procedures.
- Flight crew training and adaptations to Standard Operating Procedures.

114. Due to the rules governing how controllers are trained and the demand on NERL's facilities, it is usually not possible to train controllers for longer than 26 weeks before an airspace change. NERL expects that, in isolation, the Heathrow ACP (the largest in the Masterplan) will take a significant amount of training to prepare controllers for implementation. In practice, the

training burden associated with the Heathrow ACP will be much greater because of the number of other interdependent ACPs that must be deployed concurrently as part of the LTMA cluster. As a result, the full implementation of the Heathrow ACP must be divided into phases that are each deployed in separate windows, alongside batches of the other interdependent LTMA proposals.

115. It is assumed that these batches of LTMA airspace change are deployed in 12-month intervals, to allow enough time for the previous year's change to stabilise, manage peak traffic levels during the summer season, train controllers on the next set of changes and make the associated system adaptations. The larger LTMA ACP deployments may also need to be deconflicted from the implementation of the ACPs in the MTMA cluster because the combined rate and scale of the changes may be too great for the operation to accommodate safely. It is assumed feasible to implement all the MTMA ACPs in a single deployment window, providing that the changes are sufficiently deconflicted from the larger LTMA deployments.

116. The airspace changes expected in the WTA and STMA are comparatively smaller and less complex. For this reason, the ACPs in the WTA and STMA may be deployed concurrently if required.

117. Air traffic simulation, route management and testing activities for the LTMA and MTMA deployments will be large in scale and the time required in the simulator is likely to be considerable. Each simulation will require a development phase, which will require multiple test activities involving both controllers and specialist air traffic engineering resources. The NERL simulation facility is also required to carry out on-going, high priority activities to support the current operation, including important controller licencing obligations. Even if the entire simulation facility were at the disposal of the Programme it is unlikely to be able to support two separate, large scale projects at the same time, reinforcing the assumption that the deployment windows for the larger LTMA deployments and the MTMA deployment must be sufficiently deconflicted.

118. From an airspace design perspective, the Masterplan assume a blank canvas where all aspects of the existing structure and route network are within scope to be changed if justified. From a deployment perspective, the changes in each cluster will be implemented in a sequence. Each successive deployment must be compatible with the rest of the existing airspace system that it sits within. In general, the arrival structures within the airspace, such as arrival holds, sit above the departure routes. A logical deployment sequence for making fundamental changes to complex parts of the existing Airspace System is to raise the vertical profile of the arrival structures, releasing the constraints currently placed on the climb profiles of the departure routes below. This sequence implies deploying portions of the ACPs that focus on arrivals before (or, if possible, at the same time) as the portions that focus on departures. For example, in the LTMA, the optimisation of the existing airspace system is constrained by the position and vertical restrictions on the Heathrow arrival holds, which sit at a base of c.7000ft. These holds constrain the departure routes for many of the airports in the LTMA cluster and would have to move before some large portions of the LTMA ACPs could be deployed.

119. The deployment sequence will be determined in coordination with the ACP sponsors as the options development and assessment process evolves. More information about the deployment sequence for the core of the LTMA cluster will be included in Iteration 3.

3.1.3. Programme plan and deployment sequence included in Iteration 2

120. ACOG has worked closely with the ACP sponsors to understand the likely timescales to progress through the stages of the CAP1616 process for each regional cluster. The work is based on some key assumptions, including that all gateways are successfully passed, there is no break before the next stage begins, and the CAA can allocate sufficient resources for the regulatory assessments. When combined with the assumptions in section 3.1.3, the timescales analysis has identified three important constraints:

- Deployments in the MTMA cluster are unlikely to occur before 2026 at the earliest.
- Deployments in the LTMA cluster are unlikely to occur before 2026 at the earliest.
- LTMA deployments that include Heathrow, must be divided into a minimum of three windows, separated by 12-month intervals and cannot begin before 2027.

121. Figure 12 illustrates the high-level sequence of deployment windows across the four regional clusters based on the planning information and assumptions included in Iteration 2. A more detailed plan for each regional cluster, aligned to the deployment sequence in figure 12 and the CAP1616 stages is set out in Appendix A. The plans will be further refined in Iteration 3.

Figure 12: Deployment sequence based on planning information available for Iteration 2

Q1 - 2025	**WTA Cluster (Q1 – 2025)** • Bristol • Cardiff • Exeter • NATS LD1.2 Network Deployment	**Deployment Window #1: WTA** The WTA cluster ACPs can be deployed as early as spring 2025, assuming regulatory approval is achieved in Q3-2024.
Q4 - 2025	**STMA Cluster (Q4 – 2025)** • Glasgow • Edinburgh • Aberdeen • NATS STMA Network Deployment	**Deployment Window #2: STMA** The MTMA ACPs can deploy alongside an early LTMA change in Q1 2026.
Q1 - 2026	**MTMA Cluster (Q1 – 2026)** **Early LTMA Deployment (tbc)**	**Deployment Window #3** The MTMA ACPs can deploy alongside as early LTMA change in Q1 2026.
Q1 - 2027	**Deployment Window #4** The first core LTMA cluster ACPs can deploy no earlier than Q1-2027	**Core-LTMA-A (Q1 – 2027)** • Sequence of LTMA-A ACPs tbc • NATS LD3 Network Deployment
Q1 - 2028	**Deployment Window #5** The second deployment of core LTMA ACPs must take place at least 12 months after deployment 4.	**Core-LTMA-B (Q1 – 2028)** • Sequence of LTMA-B ACPs tbc • NATS LD4 Network Deployment
Q1 - 2029	**Deployment Window #6** The third LTMA cluster deployment must take place 12 months after deployment 5. A fourth LTMA deployment may be required.	**Core-LTMA-C (Q1 – 2029)** • Sequence of LTMA-C ACPs tbc • NATS LD5 Network Deployment

3.2. Potential interdependencies (B3)

3.2.1. Approach to identifying interdependencies between constituent ACPs

122. This section identifies the areas of overlap between the interdependent airport-led ACPs and examines the potential for design conflicts and enablers to arise in each area. Every airport-led ACPs in each cluster shares interdependencies with the NERL-led network ACPs above 7000ft. As highlighted in section 2, The NERL-led network ACPs and airport-led lower altitude ACPs must be developed in collaboration to optimise the overall airspace system in each cluster and mitigate the negative impacts of aviation effectively. The Masterplan development process will support ACP sponsors to work together to solve design conflicts that arise between their respective options and improve the overall airspace structure. In this context, Iteration 2 of the Masterplan enables the CAA to clearly understand the extent to which their regulatory decisions on individual ACPs need to be made in a coordinated way. The CAA has emphasised that the coordination between ACP sponsors should be conducted transparently, as part of the Masterplan development process, not via private bilateral agreements.

123. At this stage in the Masterplan development process, most sponsors have yet to define a comprehensive list of options (an output of Step 2a). As a result, this section of the Masterplan identifies the interdependencies between the airport-led ACPs listed in section 2 based on an analysis of the broad sections of airspace where a flight path could conceivably be positioned within the scope of each proposal. The scope of each airport-led ACP is determined by the definition of separate arrival and departure areas for each runway end from the ground to 7000ft. The definition of the arrival and departure areas assumes a blank sheet approach that is not constrained by any existing airspace restrictions, for example, those associated with the current number and location of connecting points with the route network above 7000ft. or the interactions with traffic to and from neighbouring airports. Such constraints and their potential impact on the airspace design options will be introduced during Iteration 3.

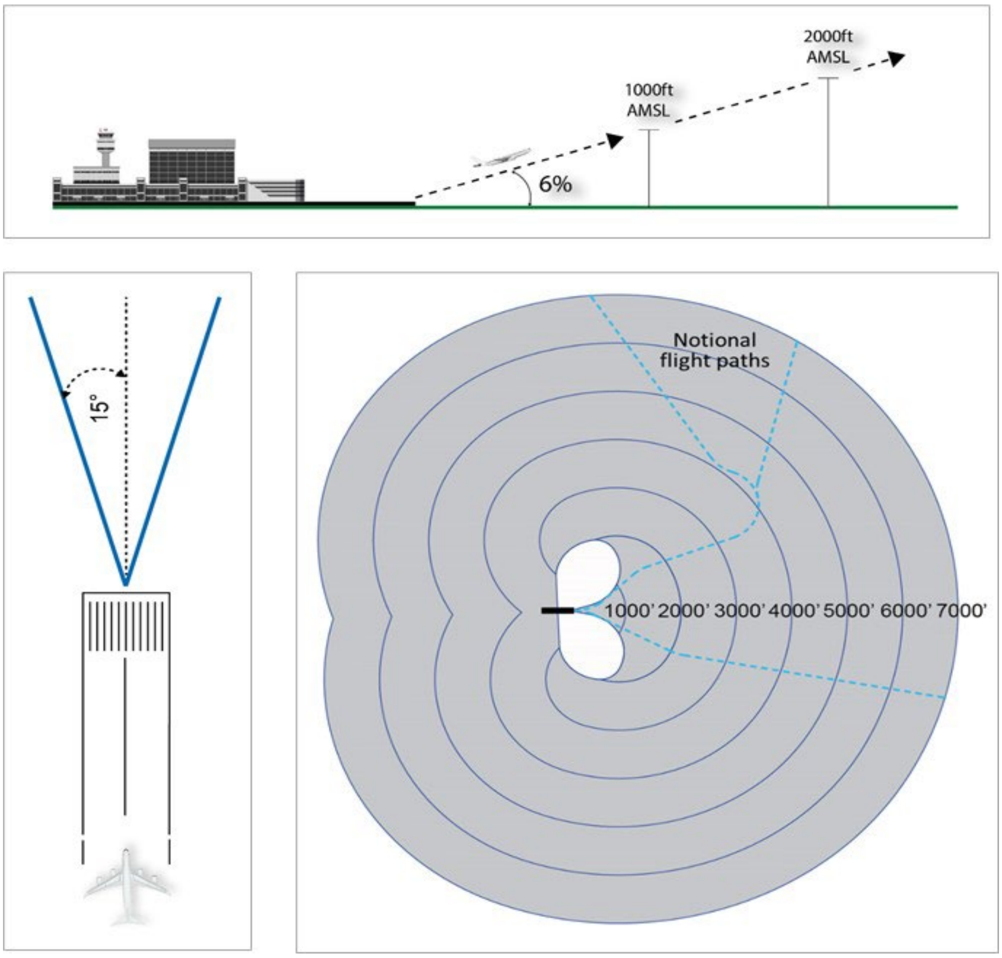
124. These sections of airspace, the associated arrival and departure areas, and the notional flight paths that may be positioned with them are not airspace design options. They are features of a first system-wide assessment of the interdependencies between the airport-led ACPs that is intended to identify overlapping segments where future airspace design options are likely to interact. The output of this assessment does not imply that flight paths will be spread across the entire extent of the areas in question. Only that they define the full potential area where a final integrated design option may lead to a flight path being positioned.

125. The sections of airspace within the scope of each airport-led ACP are defined between the ground and 7000ft. assuming a common climb and descent gradient. For departures, the sections of airspace start at the runway threshold, which for consistency is assumed to be at 0ft. above mean sea level (AMSL). In practice, the runways are at higher altitudes because of terrain. For example, Leeds Bradford Airport is situated 208m above AMSL, making the section of airspace in scope below 7000ft. smaller than indicated in this version of the Masterplan. A

consistent 0ft. ASML runway height applied to all airports in the Programme is considered a conservative assumption because the identified areas of overlap are comparatively large. As the Masterplan is refined during Iteration 3, the analysis of interdependencies between specific design options in each area of overlap will incorporate the effects of terrain on the potential interactions.

126. The departure areas are divided into bands representing the altitude of the aircraft based on an average climb gradient, for example 6%. In this case the length of the departure area is the total distance required for an aircraft to climb 7000ft based on a continuous climb profile of 6%. The average climb gradient assumed for each airport-led ACP varies between 4% and 10%, depending on the aircraft fleet mix. The departure area is initially determined by a 15 degree splay either side of the runway centreline followed by a turn no closer than 1NM to the runway threshold. The outer bounds of the area are determined by applying the largest rate of turn allowable by standard airspace design criteria at each altitude band. Figure 13 illustrates the features of a departure area from the end of the runway to 7000ft. assuming a 6% climb gradient.

Figure 13: Features of an example airport ACP departure area to analyse interdependencies



127. The length of the arrival areas are determined by the total distance required for an inbound flight to descend from 7000ft. to each runway end following a continual descent profile, usually of 3 degrees. The point at which the arrival area joins the final approach track is specific to each notional flight path at an intersection anywhere between 2000ft and 7000ft. Figure 14 illustrates the features of an arrival area from 7000ft. to the end of the runway assuming a 3-degree descent profile. The arrival envelopes are divided into 1000ft. bands representing the lower (more pessimistic) altitude of the aircraft with the assumptions applied.

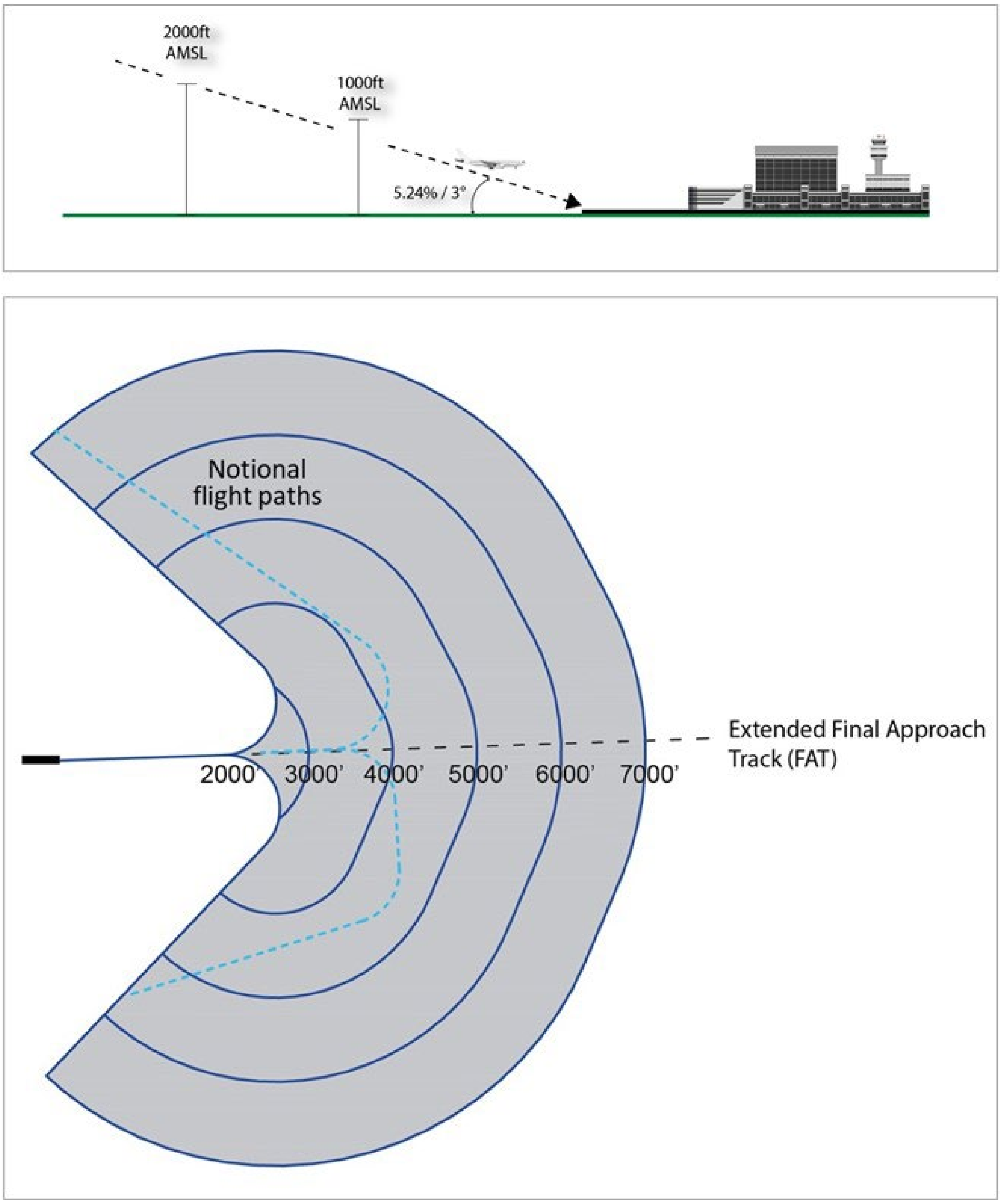
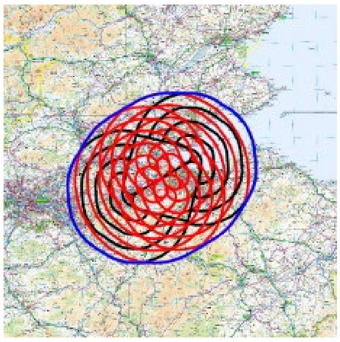
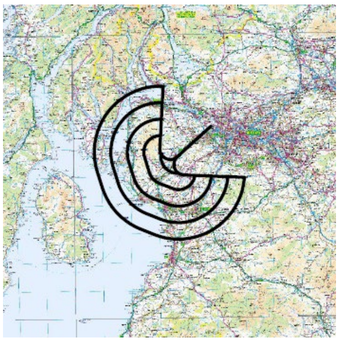
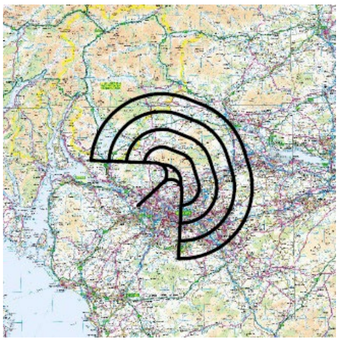
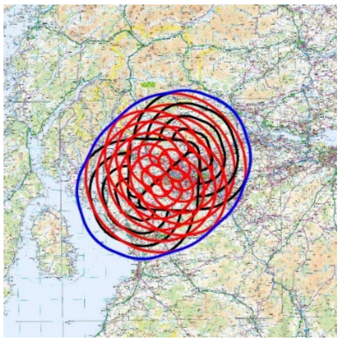


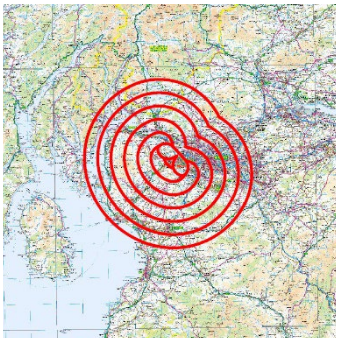
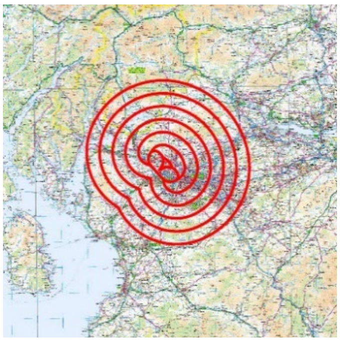
Figure 14: Features of an example airport ACP arrival area to analyse interdependencies

3.2.2. Airport-led ACP interdependencies by regional cluster

128. By way of example, Table 9 summarises how the section of airspace below 7000ft. considered within the scope of the Edinburgh Airport ACP is determined by overlaying separate arrival and departure areas for both westerly and easterly operations and captures the associated assumptions. The 7000ft. boundary is used as part of the Iteration 2 assessment to identify overlapping segments where airspace design options are likely to share interdependencies with other proposals. Table 10 summarises the same approach for Glasgow’s ACP.

<table>
<tr><td colspan="3">Table 9: Edinburgh Airport (EDI) ACP 2019-32, 7000ft boundary</td></tr>
<tr>
<td>Easterly arrival area <7000ft.
</td>
<td>Westerly arrival area <7000ft.
</td>
<td rowspan="2">EDI 7000ft. boundary

Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 06
Westerly operations RWY 24
6% climb on departure
3 degree descent on arrival
Significant navigation aid rationalisation dependencies with Glasgow, Perth and Turnberry VORs.</td>
</tr>
<tr>
<td>Westerly departure area <7000ft.
</td>
<td>Easterly departure area <7000ft.
</td>
</tr>
</table>

<table>
<tr><td colspan="3">Table 10: Glasgow Airport (GLA) ACP 2019-46, 7000ft boundary</td></tr>
<tr><td>Easterly arrival area <7000ft.
</td><td>Westerly arrival area <7000ft.
</td><td rowspan="2">GLA 7000ft. boundary


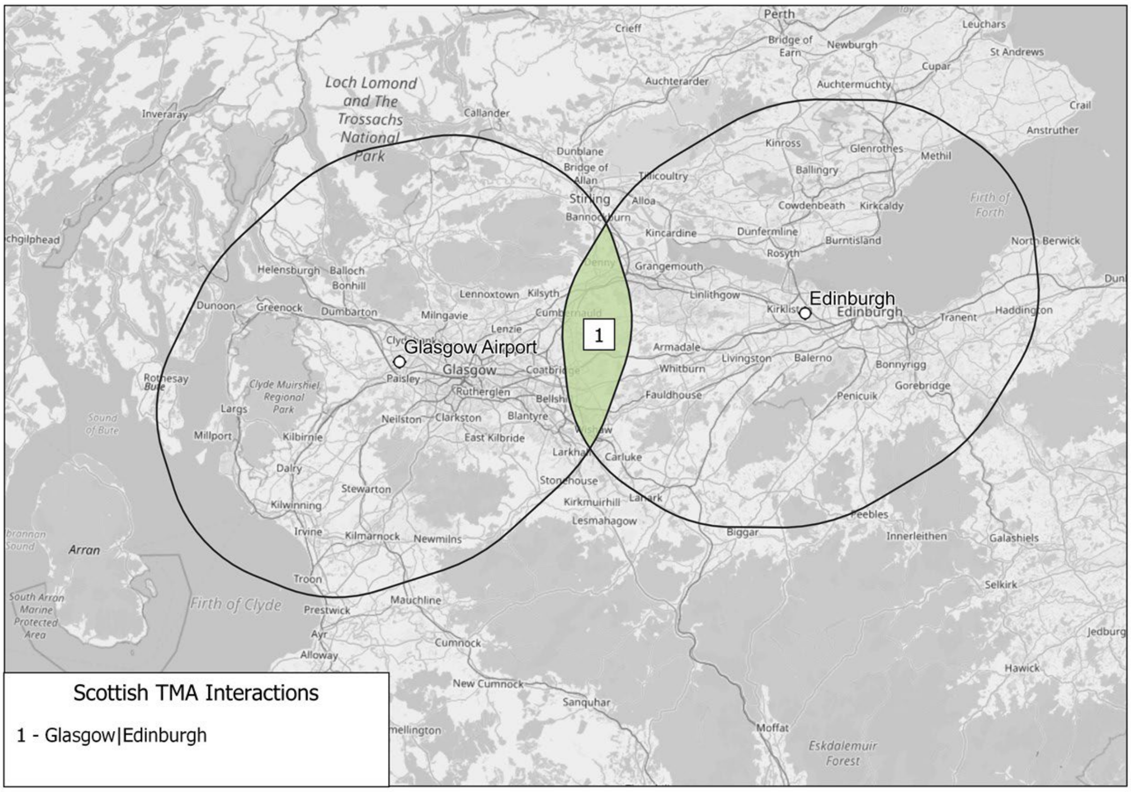
Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 23
Westerly operations RWY 05
6% climb on departure
3 degree descent on arrival
Significant navigation aid rationalisation dependencies with Glasgow, Perth and Turnberry VORs.</td></tr>
<tr><td>Westerly departure area <7000ft.
</td><td>Easterly departure area <7000ft.
</td></tr>
</table>

3.2.3. Potential interdependencies in the STMA regional cluster

129. Using the outputs of the analysis summarised in Tables 9 and 10, Figure 15 illustrates the overlapping segment between the 7000ft. boundaries for the Edinburgh and Glasgow ACPs based on the assessment produced for Iteration 2 of the Masterplan. It clearly identifies the area where potential airspace design interdependencies between the airport-led proposals in

the STMA cluster may arise. Segment 1 shaded in green highlights the area where there is the potential for airspace design conflicts to arise between options developed by the Edinburgh and Glasgow ACPs, or that some options in one ACP may be enabled by designs included within the scope of the other proposal.

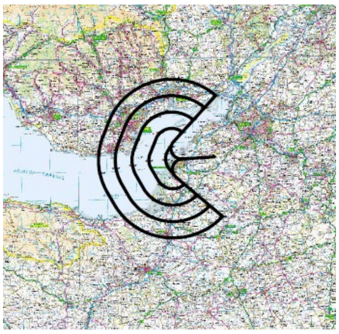
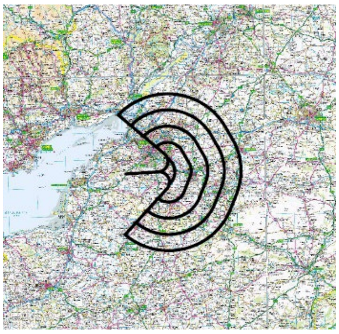
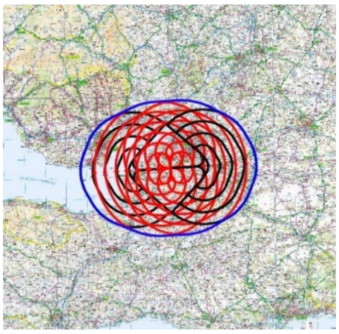
Figure 15: Potential interdependencies between airport-led ACPs in the STMA region



130. Figure 15 demonstrates that the Edinburgh and Glasgow ACPs will interact below 7000ft. and consideration must be given to the coordination of the options appraisals (to examine the potential for cumulative impacts) and public consultation (to offer stakeholders a coherent description of the overall system-wide change). The size and nature of the overlap and potential interactions, trade-offs and conflicts therein will be refined during Iteration 3 as the airspace design options for each ACP in the STMA cluster are further developed. The Programme Plan included in section 3.1. indicates that the Edinburgh and Glasgow ACPs should both generate a shortlist of airspace design options that will enable the analysis required for Iteration 3 of the Masterplan during Q2-2022. At this point, the Masterplan may require the ACP sponsors to work together to resolve the potential conflicts and/or optimise the overall airspace system in the STMA region (for example by removing bottlenecks, limiting the total adverse effects of overflight generated by both ACPs collectively and enabling the release of controlled airspace).

131. The following sections provide similar information about the potential for interdependencies between the airport-led ACPs in the other regional clusters.

3.2.4. Potential interdependencies in the WTA regional cluster

<table>
<tr><td colspan="3">Table 11: Bristol Airport (BRS) ACP 2018-55, 7000ft boundary</td></tr>
<tr>
<td>Easterly arrival area <7000ft.
</td>
<td>Westerly arrival area <7000ft.
</td>
<td rowspan="2">BRS 7000ft. boundary


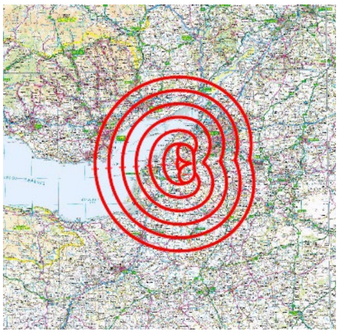
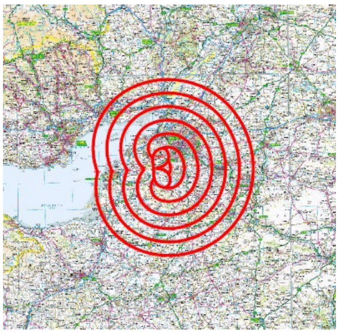
Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 09
Westerly operations RWY 27
6% climb on departure
3 degree descent on arrival
Navigation aid dependency linked to the decommissioning of the Brecon VOR.</td>
</tr>
<tr>
<td>Westerly departure area <7000ft.
</td>
<td>Easterly departure area <7000ft.
</td>
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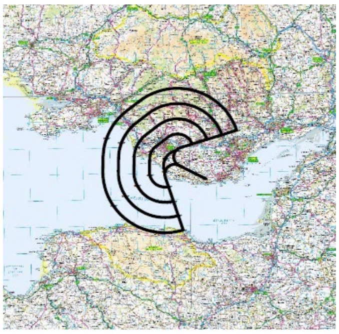
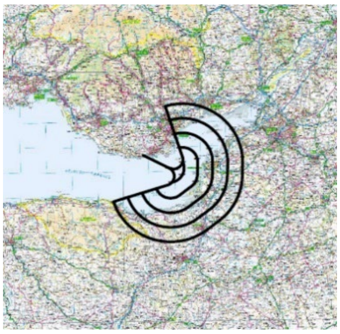
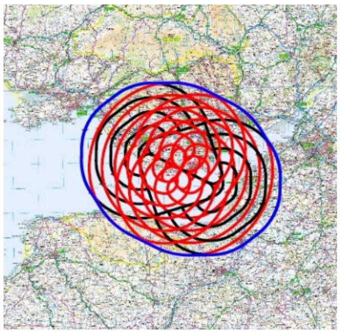
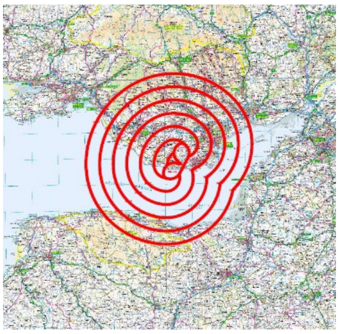
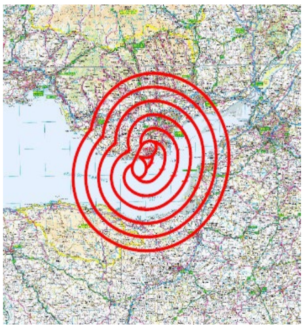
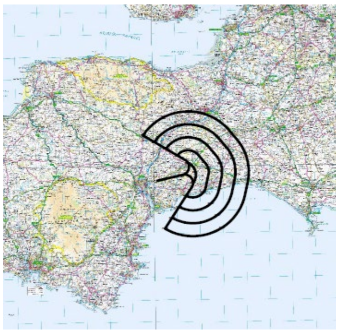
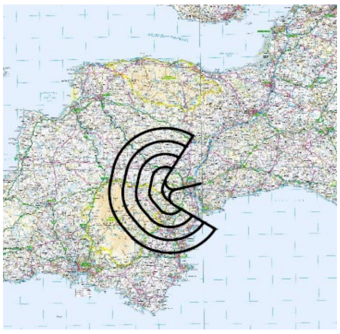
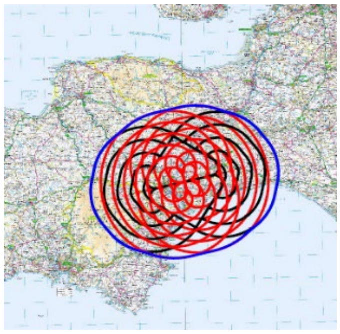
Table 12: Cardiff Airport (CWL) ACP 2019-41, 7000ft boundary		
Easterly arrival area <7000ft. 	Westerly arrival area <7000ft. 	CWL 7000ft. boundary 
Westerly departure area <7000ft. 	Easterly departure area <7000ft. 	**Assumptions** • All arrival and departure routes within scope for the ACP • Easterly operations RWY 12 • Westerly operations RWY 30 • 6% climb on departure • 3 degree descent on arrival • Significant navigation aid dependency linked to Brecon VOR.

<table>
<tr><td colspan="3">Table 13: Exeter Airport (EXT) ACP 2018-47, 7000ft boundary</td></tr>
<tr>
<td>Easterly arrival area <7000ft.
</td>
<td>Westerly arrival area <7000ft.
</td>
<td rowspan="2">EXT 7000ft. boundary


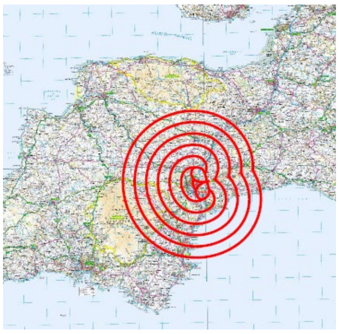
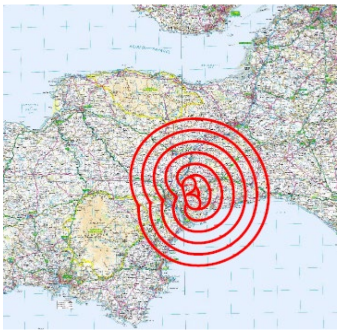
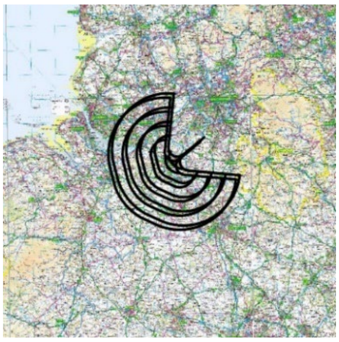
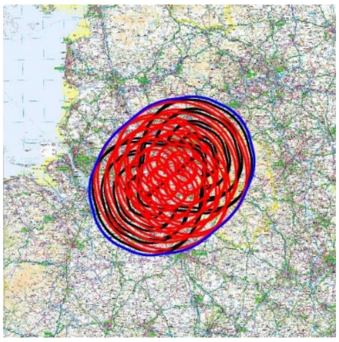
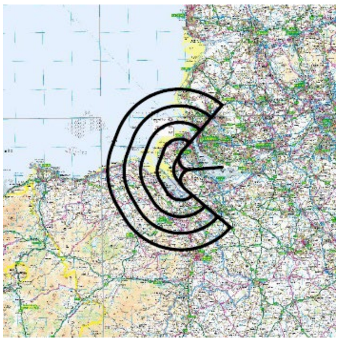
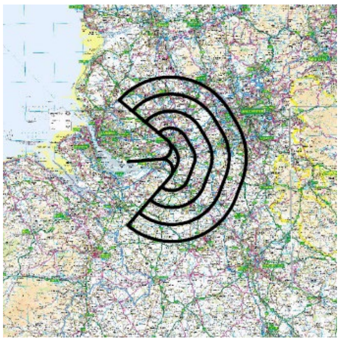
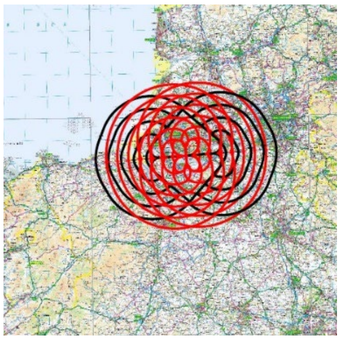
Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 08
Westerly operations RWY 26
6% climb on departure
3 degree descent on arrival</td>
</tr>
<tr>
<td>Westerly departure area <7000ft.
</td>
<td>Easterly departure area <7000ft.
</td>
</tr>
</table>

Figure 16: Potential interdependencies between airport-led ACPs in the WTA region

3.2.5. Potential interdependencies in the MTMA regional cluster

<table>
<tr><td colspan="3">Table 14: Manchester Airport (MAN) ACP 2019-23, 7000ft boundary</td></tr>
<tr><td>Easterly arrival area <7000ft.
</td><td>Westerly arrival area <7000ft.
</td><td rowspan="2">MAN 7000ft. boundary


Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 05
Westerly operations RWY 23
6% climb on departure
3 degree descent on arrival
Significant navigation aid dependency linked to the Trent and Manchester VORs.</td></tr>
<tr><td>Westerly departure area <7000ft.
</td><td>Easterly departure area <7000ft.
</td></tr>
</table>

<table>
<tr><td colspan="3">Table 15: Liverpool Airport (LPL) ACP 2015-09, 7000ft boundary</td></tr>
<tr><td>Easterly arrival area <7000ft.
</td><td>Westerly arrival area <7000ft.
</td><td rowspan="2">LPL 7000ft. boundary


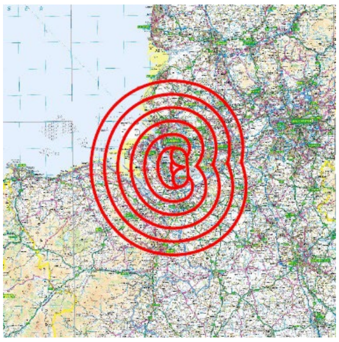
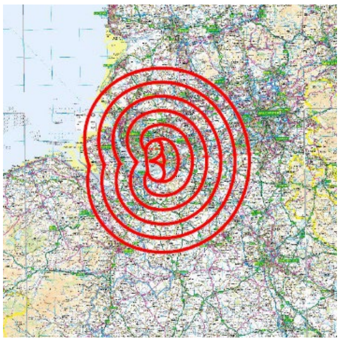
Assumptions
All arrival and departure routes within scope for the ACP
Easterly operations RWY 09
Westerly operations RWY 27
6% climb on departure
3 degree descent on arrival
Significant navigation aid dependency linked to the Trent, Manchester and Whitegate VORs.</td></tr>
<tr><td>Westerly departure area <7000ft.
</td><td>Easterly departure area <7000ft.
</td></tr>
</table>

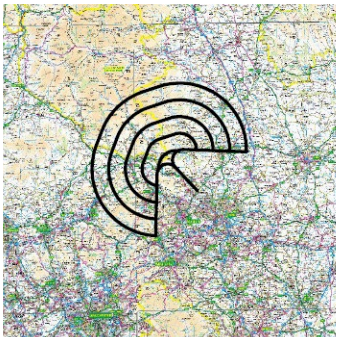
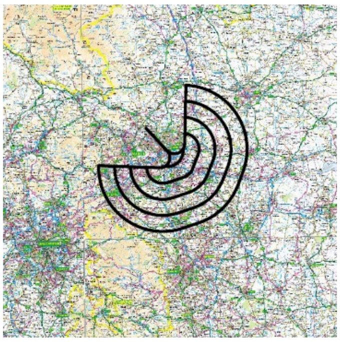
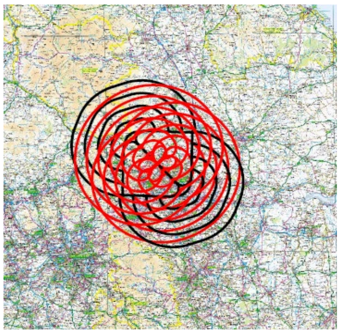
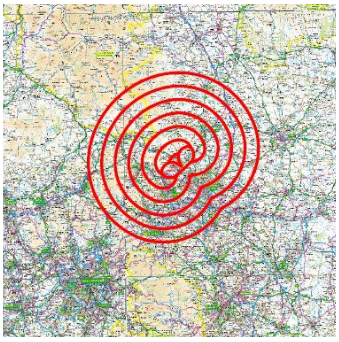
Table 16: Leeds Bradford Airport (LBA) ACP 2021-66, 7000ft boundary		
Easterly arrival area <7000ft. 	Westerly arrival area <7000ft. 	LBA 7000ft. boundary 
Westerly departure area <7000ft. 	Easterly departure area <7000ft. 	**Assumptions** • All arrival and departure routes within scope for the ACP • Easterly operations RWY 14 • Westerly operations RWY 32 • 6% climb on departure • 3 degree descent on arrival • Significant navigation aid dependency linked to the decommissioning of Gamston VOR

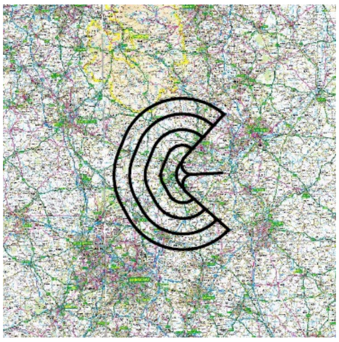
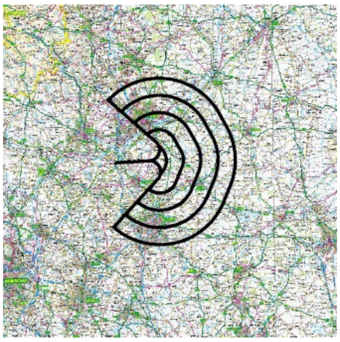
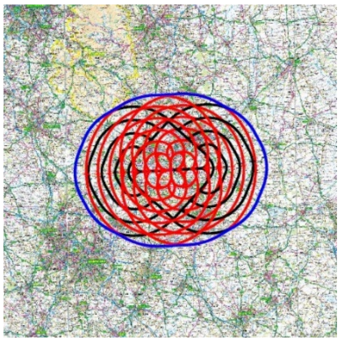
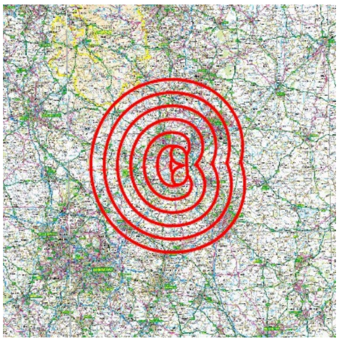
Table 17: East Midlands Airport (EMA) ACP 2019-44, 7000ft boundary		
Easterly arrival area <7000ft. 	Westerly arrival area <7000ft. 	EMA 7000ft. boundary 
Westerly departure area <7000ft. 	Easterly departure area <7000ft. 	**Assumptions** • All arrival and departure routes within scope for the ACP • Easterly operations RWY 09 • Westerly operations RWY 27 • 6% climb on departure • 3 degree descent on arrivals • Significant navigation aid dependency linked to the Trent and Manchester VORs.

Figure 17: Potential interdependencies between airport-led ACPs in the MTMA region

3.2.5. Potential interdependencies in the LTMA regional cluster

132. The potential interdependencies between the ACP boundaries in the LTMA cluster are significantly more extensive and complex than in other regions. Figure 18 illustrates the number of ACPs with overlapping scope in each area of the region.

Figure 18: Potential interdependencies between airport-led ACPs in the LTMA region

133. Figure 19 illustrates the potential interdependencies between five largest LTMA airports. Figure 20 illustrates the interdependency area between Southampton and Bournemouth airports.

Figure 19: Potential interdependencies between the big five airports in the LTMA cluster

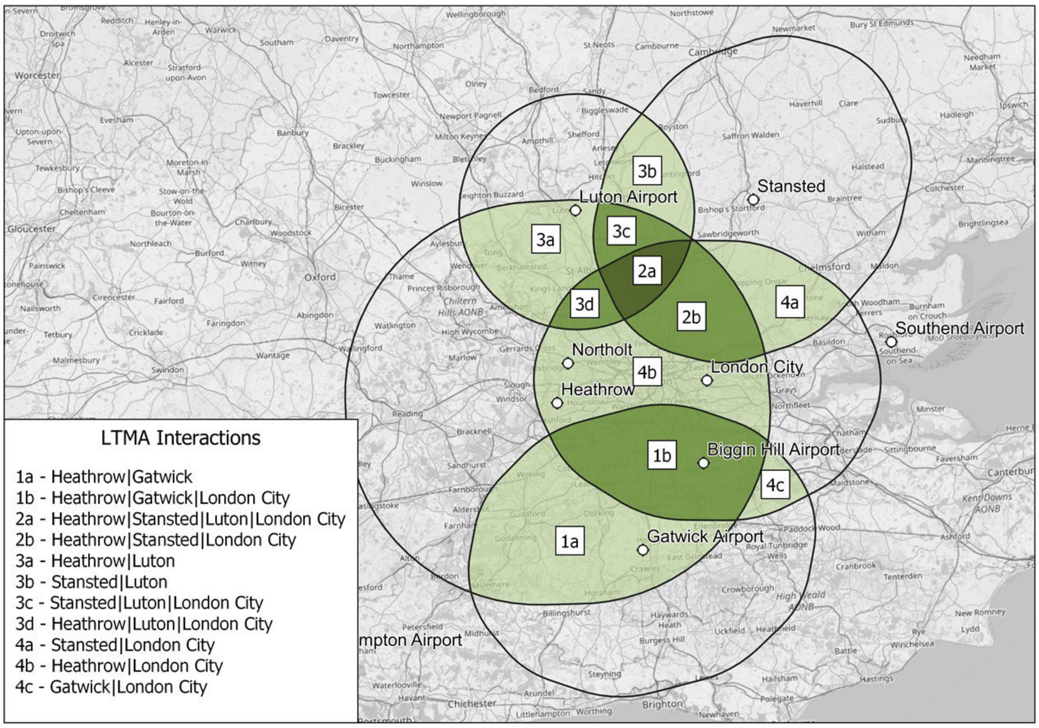


Figure 20: Potential interdependencies between Southampton and Bournemouth airports

134. Figures 21 and 22 focus on the potential interdependencies associated with the Heathrow and Gatwick ACPs specifically, as the largest most complex proposals in the core LTMA.

Figure 21: Potential interdependencies associated with the Heathrow ACP

Figure 22: Potential interdependencies associated specifically with the Gatwick ACP

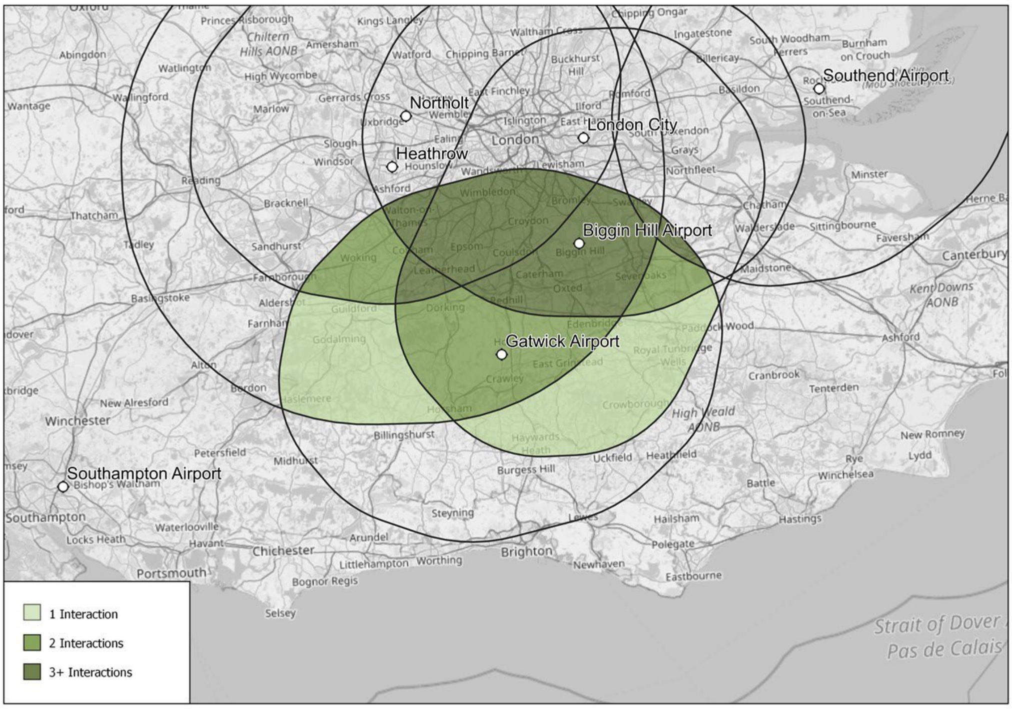


Figure 23 summarises the sections of airspace for all airport-led ACPs in the Programme and highlights the areas of overlapping scope below 7000ft. (in the portions shaded red).

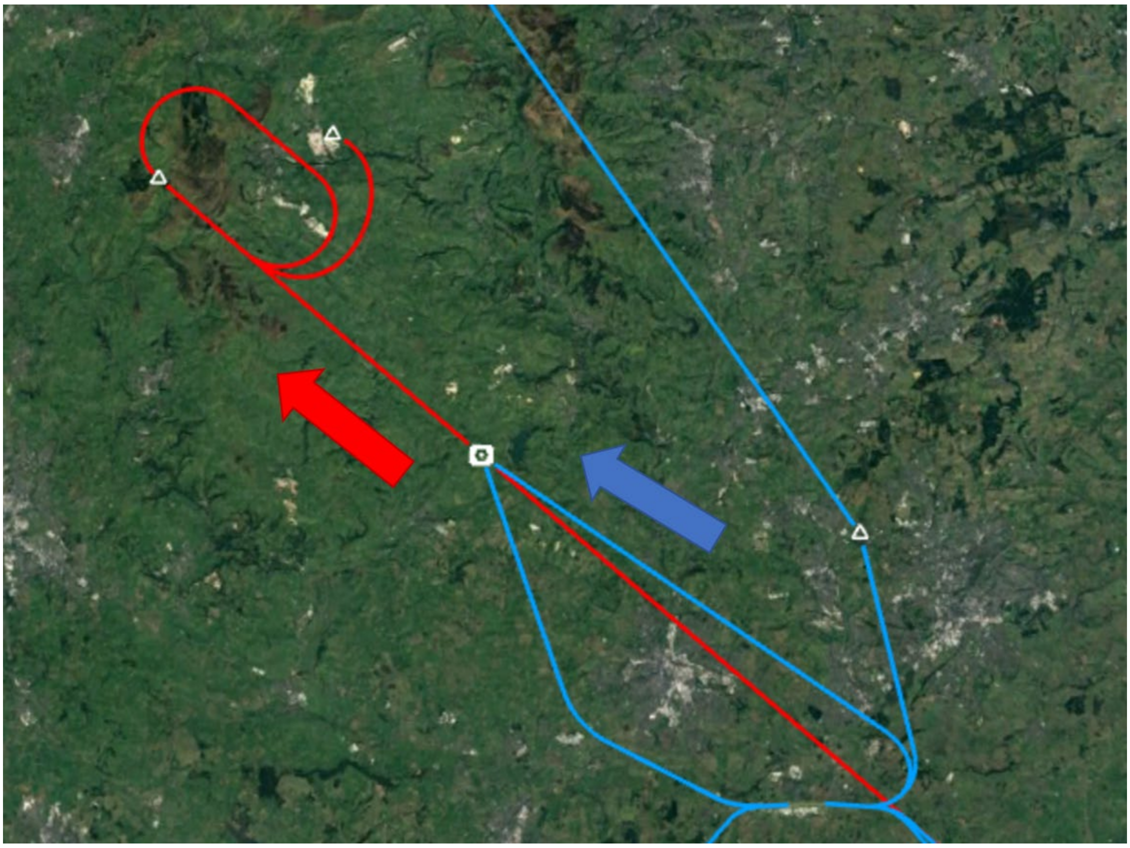
Figure 23: Summary of all airport-led sections of airspace and potential interdependencies

3.2.6. Examples of the potential interdependencies between network & airport ACPs

135. As highlighted in section 2, every airport-led ACP to upgrade arrival and departure routes below 7000ft. shares airspace design interdependencies with a corresponding NERL-led network ACP that sits above it. NERL and the airports must work together to develop the design options associated with their respective ACPs collaboratively. The methodology described in this section does not show the full extent of the interdependencies associated with each airport-led ACP, only where there is the potential for design conflicts in the overlapping portions of airspace below 7000ft. The interdependencies between an airport-led ACP and a network ACP, may create further design conflicts for other airport-led proposals in the same cluster. For example, additional conflicts would arise if new departure routes proposed by two airport-led ACPs are designed to integrate into the network at the same point above 7000ft. At this early stage in the Programme, none of the ACPs are sufficiently mature for the Masterplan to examine the number, size and nature of the airport-network ACP interdependencies or the potential conflicts, solutions and trade-offs across a cluster. This work must be conducted as part of the

development of Iteration 3. For Iteration 2, the Masterplan provides some simplified examples of common interdependencies that occur in the existing airspace system to illustrate the types of conflicts that the airport and network ACPs may have to address in each cluster. Note that the following examples are simplified illustrations of airport-network interdependencies drawn from NERL's experience of operations in the existing airspace system. Specifically, they are not drawn from options developed as part of any airport or NERL-led ACP.

Figure 24: Airport-network interdependency example, East Midlands Departures & Manchester Arrivals

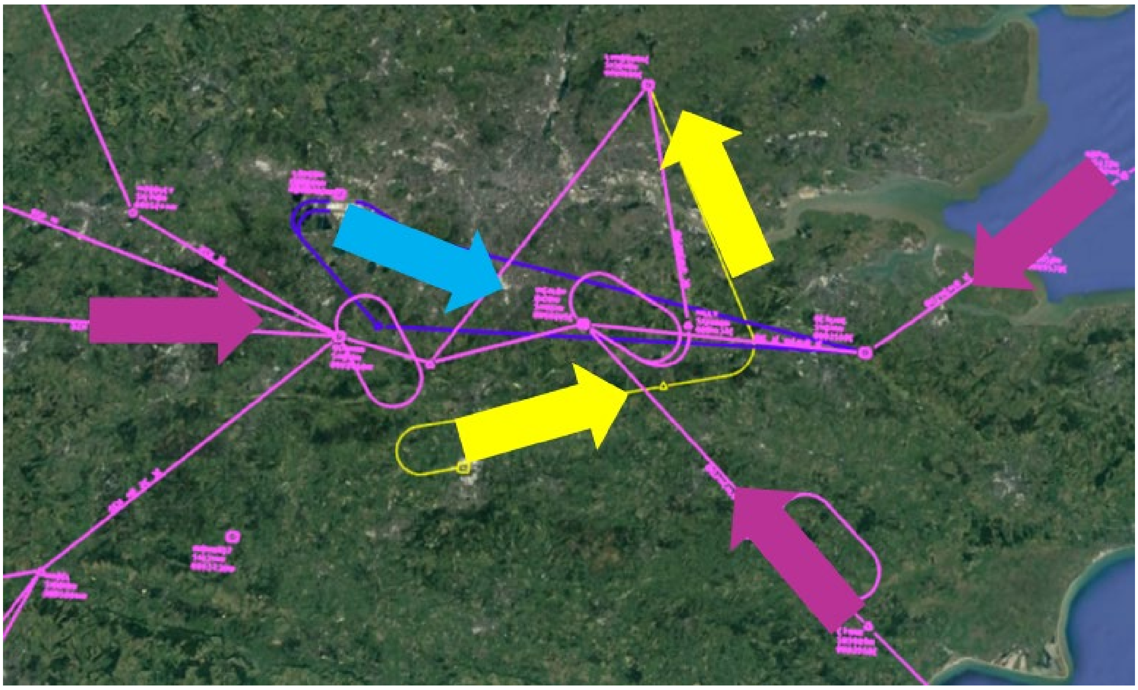


136. In this example, East Midlands outbound traffic (in blue) is heading north-west towards Manchester (the blue arrow). The East Midlands departure routes climb the traffic to 6,000ft. At the same time, Manchester inbound traffic from the south (in red) is descending from the en route network to an arrival hold at c.8000ft. Air traffic controllers are required to intervene to tactically deconflict the climbing East Midlands traffic from the descending Manchester flights. This intervention is required to resolve an interaction in the network that has arisen because of the design of the arrival and departure routes of two adjacent airports, even though there is no overlap below 7000ft.

137. This type of interaction is common in the existing airspace system. Resolving this interaction by modernising the airspace design collaboratively at lower altitudes and in the network above 7000ft. would enable continuous climbs and descents in all situations and remove workload

from the operation as controllers would no longer be required to intervene to manage the interactions.

Figure 25: Airport-network interdependency example, Heathrow Departures & Gatwick Departures

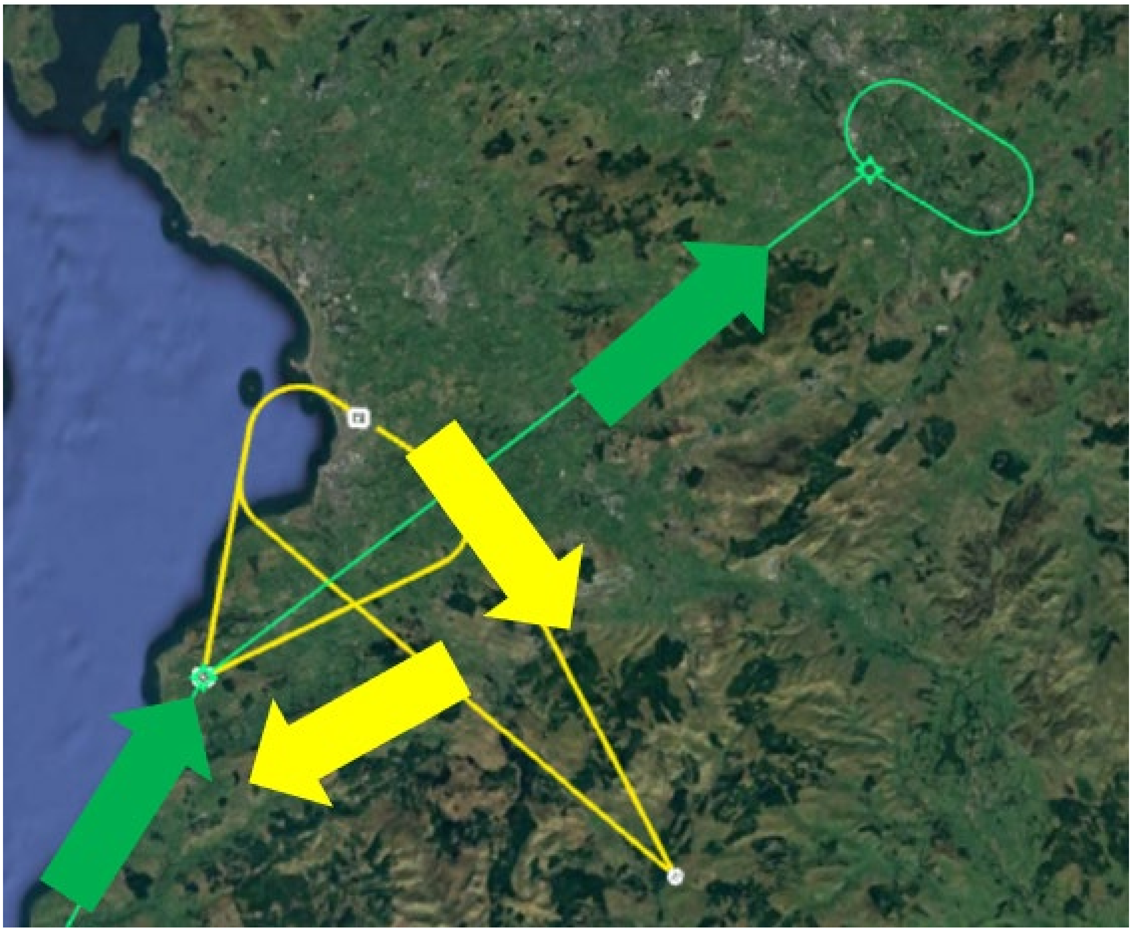


138. In this example, outbound traffic from Heathrow is departing to the south-east (the blue arrow). The existing Heathrow departure routes climb the outbound traffic to c.6,000ft, routeing underneath one of Heathrow's arrival holds (in pink) with a base of c.7,000ft. To manage this interaction efficiently and offer the outbound flights with a continuous climb, controllers intervene to vector the traffic to the north and east, avoiding the hold.

139. At the same time, outbound traffic from Gatwick is departing to the north-east (the yellow arrows). The Gatwick departures are initially capped at c.4,000ft to deconflict them from the Heathrow outbound flights in blue, and then again at c.5,000ft to avoid the descending Heathrow arrivals from the north in pink. Once again, air traffic controllers intervene tactically to enable earlier and more continuous climbs for the Gatwick departures, where and when it is safe to do so.

140. A collaborative upgrade to the route structure in both the lower altitude and network airspace could remove the need for tactical interventions in this region and enable systemised continuous climbs for both the Heathrow and Gatwick outbound traffic, reducing workload, increasing capacity and enhancing environmental performance.

Figure 26: Airport-network interdependency example, Glasgow arrivals and Glasgow Prestwick departures



141. In this example, traffic inbound to Glasgow airport from the south-west (in green) descend to c.7,000ft. when they reach the Glasgow arrival hold. Departures from Prestwick heading south-west (in yellow) climb to c.6,000ft underneath the Glasgow arrivals. Tactical intervention from controllers is required to manage the interactions between the Prestwick departure routes below 7000ft. and the Glasgow arrival routes in the network.

142. This example highlights a typical situation where the Masterplan airport-led and NERL-led ACPs will need to consider the interactions with the airspace structures that also serve other airports, which are not currently part of the Programme. Here, the airspace structure above 7,000ft that serves the Prestwick outbound flights after their initial departure are within the scope of the network ACP, but the routes to and from the airport below 7000ft. are not.

3.3. Potential solutions to interdependencies (B4)

143. This section considers the nature of the interdependencies identified in each regional cluster as set out in section 3.2, the likelihood that airspace design conflicts or enablers may arise between the constituent airport-led ACPs in each cluster, and the implications for the potential solutions that may be developed as the Masterplan process progresses into Iteration 3. In this context, the potential solutions may include moving route options laterally to resolve a conflict or vertically deconflicting the options by positioning the profile of one route above or below another. Another possible solution is for a sponsor to no longer pursue one of its design options in order to resolve an identified conflict. As described above, the ACPs are not sufficiently mature for the Masterplan to examine the number size and nature of the interdependencies between the airport-led and NERL-led proposals. It is inevitable that every airport-led ACP will share some form of interdependency with the corresponding network ACP above it. The likelihood that these interdependencies create design conflicts or enablers, and the potential solutions available to resolve them, will be examined during the development of Iteration 3.

144. The likelihood of conflicts or enablers arising between the airport-led ACPs in each cluster is determined by the following definitions:

- **Very likely** – Some or all of the airspace design options in an ACP arrival or departure area may interact with some or all of the options from two or more other proposals.
- **Likely** – Some or all of the airspace design options in an ACP arrival or departure area may interact with some or all of the options from one or more other proposals.
- **Possible** – Some of the airspace design options in an ACP arrival or departure area may interact with some of the options from one other proposal.

145. More information about the potential solutions to the interdependencies will be included in Iteration 3 as the options development and appraisal process for the constituent ACPs matures and cumulative impact assessments are conducted where design conflicts arise.

3.3.1. Potential solutions to interdependencies in the STMA regional cluster

146. With reference to figure 15 on page 53, Table 18 sets out the likelihood that airspace design conflicts or enablers may arise for each interdependency between the constituent ACPs in the STMA regional cluster, along with a description of the possible nature of the interactions and the implications for solutions developed as part of Iteration 3.

Table 18: Likelihood of design conflicts or enablers in the STMA cluster

#	Interdependency	Likelihood	Description
1	**Between the Edinburgh and**	**Likely**	It is likely that airspace design conflicts or enablers will arise between the Edinburgh and Glasgow ACPs in the overlapping segment indicated in figure 15. It is

	Glasgow design options in general.		possible that the design options developed by Edinburgh and Glasgow may remain outside this area; however, once a full analysis of all potential routes are conducted some interactions are still likely to require lateral deconfliction.
2	**Between the Edinburgh westerly departures and the Glasgow options.**	**Possible**	For The Edinburgh ACP, it is possible that departure route options for outbound traffic from the westerly runway routeing to the west will create conflicts or enablers in the overlapping segment that require lateral deconfliction. For westerly departures off the easterly runway, although most departure routes are likely to be above 7000' before reaching the overlapping segment, it is still possible that some route interactions may be considered.
3	**Between Edinburgh arrivals and the Glasgow options.**	**Very Likely**	Some arrival route options for Edinburgh's inbound traffic on approach to the easterly runway will create conflicts or enablers in the overlapping segment that require lateral deconfliction.
4	**Between Glasgow easterly departures & the Edinburgh options.**	**Likely**	It is likely that departure route options for Glasgow's outbound traffic from the easterly runway routeing to the south and east will create conflicts or enablers in the overlapping segment that require lateral deconfliction.
5	**Between Glasgow westerly departures and the Edinburgh options.**	**Possible**	It is also possible that departure route options for Glasgow's outbound traffic from the westerly runway routeing to east will create conflicts or enablers in the overlapping segment.
6	**Between Edinburgh arrivals and the Glasgow options.**	**Possible**	The consideration of arrival route options in the overlapping segment for Glasgow inbound traffic on the intermediate approach to the westerly runway has not been discounted through the CAP1616 process.

3.3.2. Potential solutions to interdependencies in the WTA regional cluster

147. With reference to figure 16 on page 55, Table 19 sets out the likelihood that airspace design conflicts or enablers may arise for each interdependency between the constituent ACPs in the WTA regional cluster, along with a description of the possible nature of the interactions and the implications for solutions developed as part of Iteration 3.

Table 19: Likelihood of design conflicts or enablers in the WTA cluster

#	Interdependency	Likelihood	Description
1	**Between the Bristol and Cardiff design options in general.**	**Very likely**	It is very likely that airspace design conflicts or enablers will arise between the Bristol and Cardiff ACPs in the overlapping segment indicated in figure 16. It is highly unlikely that the Bristol and Cardiff route options can remain outside this area.
2	**Between Bristol westerly departures and the Cardiff options.**	**Very likely**	It is very likely that departure route options for Bristol's outbound traffic from the westerly runway routeing to the west will create conflicts or enablers in the overlapping segment that require lateral deconfliction.
		Likely	It is also likely that departure route options from the westerly runway routeing to the north and south will create conflicts or enablers requiring lateral deconfliction.
		Possible	It is even possible that departure route options from the westerly runway routeing to the east may create conflicts or enablers as well.
3	**Between Bristol easterly departures and the Cardiff options.**	**Very likely**	Bristol departure options from the easterly runway routeing west are highly likely to create conflicts requiring lateral deconfliction.
		Likely	Bristol departure options from the easterly runway routeing north and south are likely to create conflicts or enablers requiring lateral deconfliction.
4	**Between Bristol arrivals and the Cardiff options.**	**Very likely**	For Bristol arrivals on to the westerly runway it is highly likely that virtually all options would involve use of the overlapping segment.
		Likely	For Bristol arrivals from the west, northwest and south-west to the easterly runway it is likely that inbound traffic on the intermediate approach will create conflicts or enablers.
5	**Between Cardiff arrivals and departures and the Bristol options.**	**Very likely**	For the Cardiff ACP, because the overlapping segment virtually includes the airport itself it is highly likely that all arrival and departure options for both runways will involve routes that create conflicts or enablers with Bristol's options. The only exception being westbound departures off the westerly runway where routes within the overlapping segment are unlikely.
6	**Between the Cardiff and Exeter ACPs**	**Possible**	It is possible that design conflicts or enablers may arise between the Cardiff and Exeter ACPs in the overlapping

			segment 2. There may however be viable options in both ACPs that do not enter this area below 7000ft. It is also possible that design conflicts or enablers arise for the NERL-led WTA network ACP when managing the treatment of Exeter operations arriving and departing to the north and the Cardiff arrival structure above 7000ft.

3.3.3. Potential solutions to interdependencies in the MTMA regional cluster

148. With reference to figure 17 on page 58, Table 20 sets out the likelihood that airspace design conflicts or enablers may arise for each interdependency between the constituent ACPs in the MTMA regional cluster, along with a description of the possible nature of the interactions and the implications for solutions developed as part of Iteration 3.

Table 20: Likelihood of design conflicts or enablers in the MTMA cluster

#	Interdependency	Likelihood	Description
1	**Between the Manchester and Liverpool design options in general.**	**Very likely**	The likelihood of design conflicts or enablers arising between the Manchester and Liverpool ACPs in the overlapping segment 1 indicated in figure 17 is very high. Because both airports are located within the overlapping segment, it is inevitable that most route options considered would involve some form of conflict or enabler requiring lateral or vertical deconfliction in this area.
2	**Between Manchester operations to the east and the Liverpool options.**	**Possible**	An exception to row 1, arrivals to Manchester from the east, and departures towards the east would have minimal requirement for consideration of routes within the overlapping segment.
3	**Between Liverpool operations to the west and the Manchester options.**	**Possible**	Similarly, for Liverpool, arrivals and departures from/to the west would also have minimal requirement for consideration of routes within the overlapping segment.
4	**Between the Manchester and Leeds Bradford design options in general.**	**Possible**	For the Leeds Bradford ACP, it is possible that arrivals or departures (on either runway) to/from the south-west may consider the use of routes within the overlapping segment 2 in figure 17. As this overlapping segment is well away from the Leeds Bradford extended centrelines deconflicting potential interdependencies should be straightforward.

#	Interdependency	Likelihood	Description
			For the Manchester ACP it is possible that arrival routes to the south westerly runways (from the west and north) could be considered in segment 2. Departure routes to the north of either runway could possibly be considered in this area as well. However, as the overall area is small deconflicting routes to avoid conflicts should be straightforward.
5	**Between the Manchester and east Midlands ACPs.**	**Likely**	It is likely that design conflicts or enablers arise for the NERL-led MTMA network ACP when managing the treatment of East Midland's departure routes to the north and arrivals inbound to Manchester from the south.

3.3.4. Potential solutions to interdependencies in the LTMA regional cluster

149. With reference to figure 18 on page 58 that summarises the potential interdependencies between the big five airports in the LTMA cluster, Table 21 sets out the likelihood that airspace design conflicts or enablers may arise for each interdependency, along with a description of the possible nature of the interactions and the implications for solutions developed as part of the Masterplan Iteration 3 in due course.

Table 21: Likelihood of design conflicts or enablers between the big 5 airports in the LTMA cluster

#	Interdependency	Likelihood	Description
1	**Between the Heathrow and Gatwick ACPs.** **(segments 1a and 1b)**	**Very likely**	It is very likely that airspace design conflicts or enablers will arise between the Heathrow and Gatwick ACPs in the overlapping segments 1a and 1b indicated in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. The potential for the airspace design options to enable Heathrow departures to climb higher quickly and/or for arrivals to stay higher for longer and for the Heathrow radar manoeuvring area to not extend further south than it does today can help to mitigate the interdependencies in this segment and increase the proportion of traffic from both airports achieving continuous climbs above 7000ft. • It is very likely that departure route options for Heathrow outbound traffic heading to the south, south-east and south-west will be considered in these segments.

			• It is also very likely that arrival route options for traffic inbound to Heathrow on the intermediate approach to RWY27 will be considered in these segments.
		Likely	It is likely that departure route options for the Gatwick traffic from RWY26 to the and west and from RWY08 to the west and north-west will be positioned in these segments, creating the requirement for lateral or vertical deconfliction or possibly other solutions.
		Possible	The consideration of arrival route options in these segments for inbound traffic on the intermediate approach to both Gatwick runway ends has not been discounted through the CAP1616 process.
2	**Between the Heathrow and Stansted ACPs. (segments 2a, 2b, 3c).**	**Possible**	It is possible that design conflicts or enablers may arise between the Heathrow and Stansted ACPs in the overlapping segments 2a, 2b and 3c indicated in figure 18. There may however be viable options in both ACPs that do not enter this area below 7000ft. • It is possible that arrival route options for traffic inbound to Stansted on the intermediate approach to RWY04 may be considered in these segments. • It is possible that departure route options for Stansted traffic outbound to the south/southwest from RWY22 may be considered in these segments. • It is possible that arrival route options for traffic inbound to Heathrow on the intermediate approach to RWY27 may be considered in these segments.
		Likely	It is likely that departure route options for Heathrow traffic outbound to the north/northeast from RWY09 may be considered in these segments.
3	**Between the Heathrow, Luton and Stansted ACPs. (segments 2a & 3c).**	**Likely**	It is likely that design conflicts or enablers will arise between the Heathrow, Luton and Stansted ACPs in the overlapping segments 2a and 3c in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. it is likely that departure route options are considered in segment 2a for Luton outbound traffic from both runway ends to the east and south-east – especially if there is a requirement to deconflict from route interactions in segment 3b.

		Possible	Although it is possible that arrival route options are considered in segment 2a for inbound traffic on the intermediate approach to RWY07, it is unlikely that the Luton ACP will contribute to an overall optimised design for the LTMA by managing inbound traffic in areas to the south of the airport.
4	**Between the Heathrow and Luton ACPs.**	**Very likely**	It is very likely that airspace design conflicts or enablers will arise between the Heathrow and Luton ACPs in the overlapping segments 3a, 3c and 3d indicated in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. Although the segments indicate the area of overlap below 7000ft. if traffic outbound from Heathrow does not reach 7000ft.+ approximately 5NM before the segment boundary there will be an impact on the ability for Luton departures to achieve continuous climb operations. • It is very likely that departure route options for Luton outbound traffic from both runway ends will be considered in segment 3a. • It is very likely that departure route options for Heathrow outbound traffic heading north from both runway ends will be considered in segment 3a.
		Possible	• It is possible that arrival route options are considered in segment 3a for Heathrow inbound traffic on the intermediate approach to RWY27.
5	**Between the Luton & Stansted ACPs.**	**Very likely**	It is very likely that airspace design conflicts or enablers will arise between the Luton and Stansted ACPs in the overlapping segments 3b indicated in figure 18, creating the requirement for lateral or vertical deconfliction. • It is very likely that departure route options for Stansted outbound traffic heading west, south-west and north-west from RWY22 will be considered in segment 3b. • It is very likely that arrival route options for Stansted inbound traffic on the intermediate approach to RWY22 will be considered in segment 3b.

			• It is very likely that arrival route options for Luton inbound traffic on the intermediate approach to RWY25 will be considered in segment 3b. • It is very likely that departure route options for Luton outbound traffic from RWY07 will be considered in segment 3b.
		Possible	• It is possible that departure route options for Luton outbound traffic from RWY25 are considered in segment 3b, especially if the climb out is constrained by the management of route interactions in segment 3a. • It is possible that arrival route options for Stansted inbound traffic on the intermediate approach to RWY04 are considered in segment 3b.
6	**Between the Heathrow, Gatwick and London City ACPs.**	**Likely**	It is likely that airspace design conflicts or enablers will arise between the Heathrow, Gatwick and London City ACPs in the overlapping segment 1b in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. For the London City ACP it is likely that departure routes from the westerly runway to the south and east may be considered through segment 1b and possible that departure routes to the north and west may even use this segment. Departure routes to the east from the easterly runway are unlikely to use segment 1b, however, it is possible that departure routes in all other directions may be considered in this segment. An arrivals structure for London City is likely to avoid segment 1b by utilising airspace to the east of the airport. However, to avoid interactions with potential route structures for other LTMA airports (particularly Biggin Hill and Southend) it is possible that London City arrivals could be considered in segment 1b. For the Heathrow ACP departure routes from the westerly runway to the south are highly likely to be considered in this area, departure routes to the east and west are likely to be considered and routes to the north could be possible in segment 1b. Departure routes from the easterly runway to the east and south are highly likely to be considered in segment 1b too. The arrivals structure for the westerly runway is highly likely to use segment 1b. The arrivals structure for the

			easterly runway could possibly use this segment although an arrivals structure with appropriately high continuous descent profiles would probably avoid the necessity for using this area (below 7000’).
7	**Between the Luton, Stansted and London City ACPs.**	**Likely**	It is likely that airspace design conflicts or enablers will arise between the Luton, Stansted and London City ACPs in the overlapping segment 2a in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. • For the Stansted and Luton ACPs it is highly likely that conflicts and enablers will arise in segment 2a (and 3c) as described above. • For the London City ACP, it is possible that departure routes to the north and east from the westerly runway would be considered within segment 2a.
8	**Between the Heathrow, Luton and London City ACPs.**	**Likely**	It is likely that airspace design conflicts or enablers will arise between the Heathrow, Luton and London City ACPs in the overlapping segment 3d in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. • For the Heathrow and Luton ACPs the highly likely interdependencies that will be considered in segment 3d are described above. • For the London City ACP, it is possible that some departure routes to the west, northwest or north could create conflicts with Luton or Heathrow arrival and departure route designs.
9	**Between the Stansted and London City ACPs.**	**Likely**	It is likely that airspace design conflicts or enablers will arise between the Stansted and London City ACPs in the overlapping segment 4a in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. • For the Stansted ACP, arrival routes from the south and east to Runway 04 are highly likely to be considered within segment 4a. It is possible arrival routes from the south and east on to Runway 22 may be considered for this segment. Departure routes off Runway 22 towards the south and east are also highly likely to utilise this segment. It is possible that segment 4a could be considered for

			arrivals from the south for Runway 22 and departures to the south, west and even the east from 04. • For the London City ACP, it is highly likely that use of segment 4a would be considered for all northerly and north-easterly departures. It is likely that departure routes to the west may be considered too as the alternative route to the south may end up being a non-preferred consideration due to the potential conflicts with Gatwick and Heathrow. It is possible that departure routes to the south and east might be considered within this segment too as continuous climb operations away from the busy areas to the west may make this a good alternative. It is highly likely that arrivals from the north and possible that arrivals from the east and south into London City would also be considered in this segment.
10	**Between the Heathrow and London City ACPs.**	**Very likely**	It is very likely that airspace design conflicts or enablers will arise between the Heathrow and London City ACPs in the overlapping segment 4b in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. • For the Heathrow ACP, all departures from both runways will enter this segment. Although all arrivals will also enter this segment arrivals to the easterly runways will be very low and on final approach. Nonetheless whatever designs are proposed a significant interaction between the 2 airports route structures is inevitable. • For the London City ACP, because the airport is located within the segment, all arrival and departure designs in all directions will have significant interaction issues with traffic from Heathrow in this segment.
11	**Between the Gatwick and London City ACPs.**	**Possible**	It is possible that airspace design conflicts or enablers will arise between the Gatwick and London City ACPs in the overlapping segment 4c in figure 18, creating the requirement for lateral or vertical deconfliction or possibly other solutions. • For the Gatwick ACP, It is possible that easterly and northerly departures from the westerly runways may be considered in segment 4c. It is likely that

	departures to the north and east from the easterly runways will be considered in this segment. It is possible that arrivals (particularly for the easterly runway) could be considered in this segment too. • For the London City ACP it is possible that arrivals and departures to and from the south may be considered in segment 4c.

150. Several additional overlapping segments arise between the sections of airspace within scope for the LTMA ACPs when Biggin Hill, Southend, Manston and RAF Northolt are added to the analysis. Some of these segments are comparatively very small and not suitable for inclusion in the analysis of potential interdependencies at this stage in the Masterplan process. Other segments are covered or superseded by the analysis summarised in Table 21. The following bullet points offers a summary of the additional potential interdependencies created in the LTMA cluster when Biggin Hill, Southend, Manston and RAF Northolt are added.

- **Southend and Stansted** – This area is likely to create some interdependency issues. However, it is well away from the extended centreline and issues should be resolved through lateral deconfliction of the new routes.
- **Southend and Manston** – although this overlap area is large, because both airports are unlikely to generate comparatively high traffic levels and there are good opportunities to utilise other parts of their airspace, it is unlikely that this area would generate interdependency issues. There is a possibility that there may be constraints on routes considered inbound to Manston from the north-west as the overlapping segment is close to the Manston extended centre-line.
- **Southend and London City** – there are likely to be interdependency issues, particularly for arrival routes when Southend are using their easterly runway and London City are using their westerly runway.
- **Northolt and Luton/Heathrow** – The significance of these areas is superseded by issues arising from the analysis of the Luton – Heathrow interactions above.
- **Biggin Hill and Gatwick** – The potential for conflict or enablers to arise is highly likely particularly between Biggin Hill departures to the south and Gatwick arrivals on the westerly runway.
- **Biggin Hill/Northolt/Gatwick –** Although there are some likely interdependency issues between Biggin Hill and Gatwick (see above) the addition of Northolt is unlikely to lead to further design conflicts or enablers.
- **Luton/Stansted/Northolt and Luton/Heathrow/Northolt** – these segments obviously generate considerable potential conflicts and enablers, although at this stage in the Masterplan process detailing all possible scenarios and restrictions is unlikely to offer valuable insights. Further analysis will be conducted during the development of Iteration 3 using the shortlisted airspace design options for each ACP.

- **Southampton and Bournemouth** In this area it is likely there could be interactions between arrivals to Runway 02 and westbound departures to and from Southampton and with Bournemouth departures from RWY08 as well as with Bournemouth arrivals to RWY 26.

3.4. Trade-off decisions (B5)

151. In the context of the Masterplan, a trade-off refers to a choice or decision to resolve a conflict that impacts some factors favourably at the expense of others.

152. At this stage in the Masterplan development process, the information from the constituent ACPs about airspace design options, conflicts and potential solutions is not sufficiently mature to evaluate the trade-off decisions that may arise. Trade-offs will be identified by ACP sponsors during the development of the initial and full options appraisals (Stages 2B and 3A of the CAP1616 process) and in collaboration with ACOG when assessing the combined and net impacts of interdependent options. Iteration 3 of the Masterplan will set out where trade-off decisions have been made between ACP sponsors during the development of their proposals to ensure transparency in the process. As part of the public engagement exercise conducted to support the preparation of Iteration 3, ACOG will ensure stakeholders understand how to provide input to influence trade-off decisions during planned consultations on the constituent ACPs.

153. In future iterations, this section of the Masterplan will demonstrate how trade-off decisions have been made in line with Government policy and the objectives of the AMS. The trade-offs section will also provide details of the analytical framework used by ACP sponsors to inform their decisions. The CAP1616 process refers to the need to consider combined and net impacts and the associated trade-offs they may create but does not offer detailed guidance on how they should be identified and analysed. Further work is required in preparation for Iteration 3 to develop detailed guidance for ACP sponsors and stakeholders on the objectives and analytical framework that is used when trade-offs are made. This guidance may highlight gaps or contradictions in Government policy or the AMS that may need to be addressed to ensure that trade-off decisions are comprehensive, balanced and consistent. The identification of potential gaps or contradictions in Government policy or the AMS will be set out in the 'Policy Implications' section of Iteration 3 (CAA acceptance criterion B6).

154. The information presented in the remainder of this section offers some proposed definitions and case study examples that are intended to illustrate the types of issues that the analytical framework will be required to address, and how effective trade-off decisions between options can be made when considering different solutions to manage conflicts.

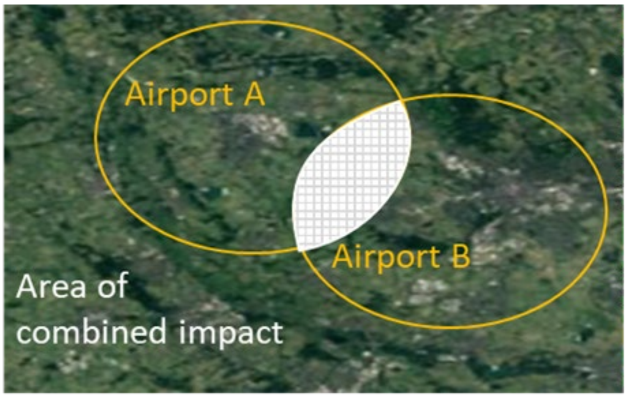
155. It is envisaged that the analytical framework used to inform trade-off decisions will focus on the external impacts generated by the ACPs, primarily related to environmental factors, airspace access and capacity. A separate and parallel process will be required to coordinate the integration of interdependent ACPs from an operational compatibility and safety assurance perspective. Safety is paramount in this process. Assuring the safety of specific changes, and that a series of interdependent changes develops the airspace system in a risk-reducing manner, is an overriding priority for the Masterplan and the AMS.

156. For the purpose of the proposed analytical framework that will be developed as part of Iteration 3:

- A conflict refers specifically to situations where the design of one route has the potential to affect the positioning of another route.
- An impact is the consequence of the position of a route to stakeholders, either positive or negative.
- A combined impact is the impact of two or more different routes as experienced by the same stakeholders at a given location, as illustrated in case study example 1 below.
- The net impact refers to the total impacts of the interdependent ACPs when they are added together, regardless of their bearing on specific stakeholders or locations, as illustrated in case study example 2 below.
- In this sense, the combined impact of two or more routes is always a subset of the overall net impacts of the interdependent ACPs.
- Adverse effects refer specifically to noise impacts that are above the Government's threshold – the lowest observable effect level (LOAEL) - and will therefore lead to measurable consequences.[23] As noise exposure increases above this level, so will the likelihood of experiencing an adverse effect.

157. While effect and impact could be interchangeable in common parlance, 'effects' in the airspace change process generally refer to the measurable consequences of a change, in particular, the 'adverse effects'. The term impact is therefore used for the general consequences of a change, whereas effects are reserved for those noise consequences that are measurable in the Government's Transport Analysis Guidance (TAG) for modelling and appraisal.[24]

Case study example 1: Simple cumulative impact of overflights illustration

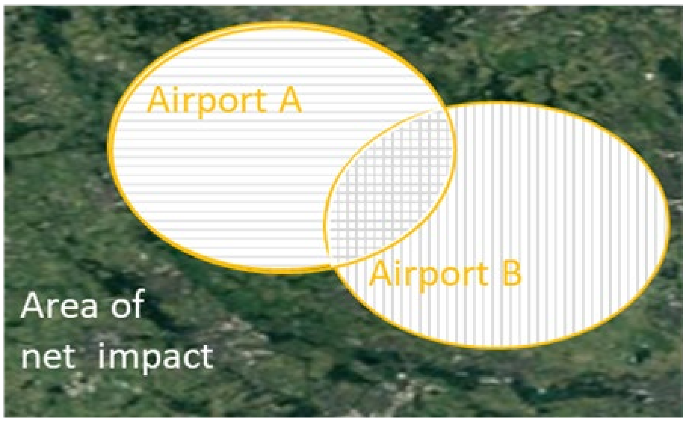


[23] For the purposes of assessing and comparing the noise impacts of airspace changes, the LOAEL is defined at 51dBA $LAEq_{16hours}$ for the day and 45dBA $LAeq_{8hours\ for\ the\ night}$ in the Air Navigation Guidance 2017. [link]

[24] Transport analysis guidance, Department for Transport, last updated 13/10/2021. [link]

- If the overflight from one airport over a given location is 10 flights per day, and
- The same location has an additional 10 flights per day from another airport, then
- The cumulative impact for that location would be 20 overflights per day

Case study example 2: Simple collective impacts illustration



Net impacts refer to the total impacts of two or more interdependent ACPs when combined, This includes:

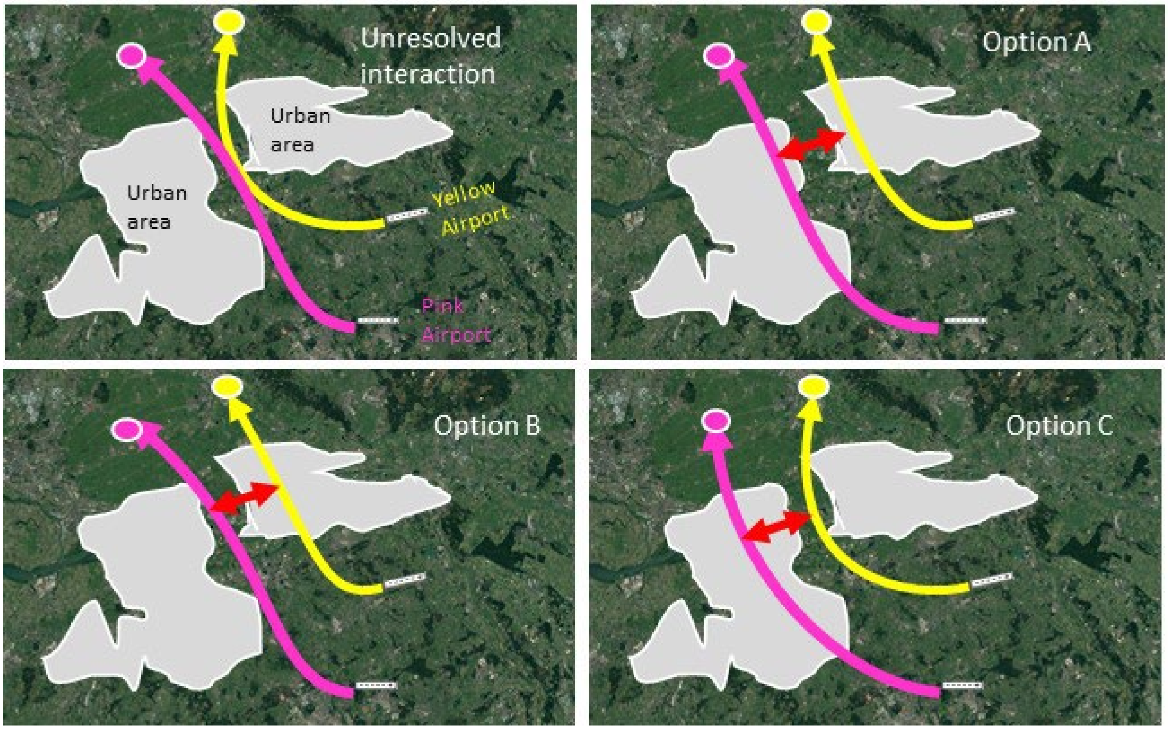
- All noise impacts which are the result of a single airports operation (including adverse effects)
- All combined noise impacts (including combined adverse effects)
- All other external impacts such as aircraft emissions and airspace access

158. Trade-off decisions are needed when there is a choice between airspace design options 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. In the context of the Masterplan, trade-off decisions will usually be driven by the choices made about airspace design options from interdependent ACPs that interact. For example, an emissions benefit for Airport A may be traded-off against a noise benefit for Airport B as a means of resolving an interaction with the least collective impact. In this case study, it is the emissions benefit for Airport A that is forgone. If a sponsor adopts an option in this way, that is suboptimal for the ACP in isolation but provides an overall collective benefit, then this should be referenced and accounted for in Iteration 3 of the Masterplan and considered as part of the consultation and ACP decision stages of CAP1616. Similarly, ACPs that receive an advantage from such trade-off decisions must also register the resulting impacts created for other ACPs as part of their inclusion in the Masterplan.

Case study example 3: Trade-offs to minimise the total adverse effects of aircraft noise

159. The overriding objective regarding the environmental impact of aviation at lower altitudes is to minimise total LOAEL as measured in TAG. Other noise metrics have an important role in portraying impacts and facilitating consultation but do not have significance in terms of TAG analysis. These are therefore considered as secondary metrics in the CAP1616 process.

160. Interdependent ACP sponsors may be inclined towards options that apportion impacts equally between the two proposals. However, this may not generate the optimal outcome from a policy or system-wide perspective. Policy objectives regarding environmental impacts are assumed to seek that the overall collective impacts are minimised at the system level – rather than specifying how this impact is apportioned across constituent ACPs. In practice, trade-off decisions to minimise the total adverse effects of noise may disadvantage one ACP more than another as illustrated in case study 3.



	Option A	Option B	Option C
Population overflown by Pink	4000	500	7000
Population overflown by Yellow	4000	4500	200
Total	8000	**5000**	7200

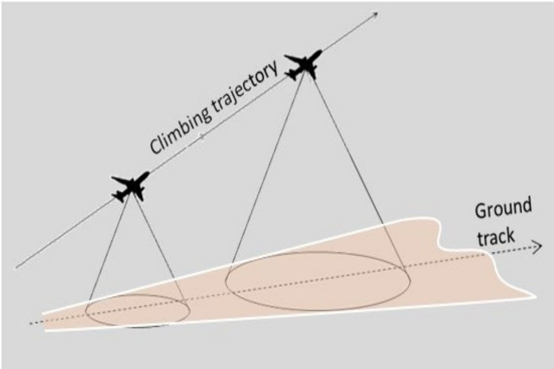
- Collaboration between the yellow airport and the pink airport shows that the pink and yellow routes are both seeking to utilise the same gap in the urban area to minimise overflight
- The pink and yellow routes are assumed to serve a similar number of flights with similar aircraft types.
- Resolving the interaction involves providing the route separation as shown by the red arrow.
- If the objective is to reduce overall impact in terms of population overflown, then Option B provides the best collective benefit despite this being worse for yellow airports individual ACP.
- The collective optimal trade-off in this case study means that the yellow airport ACP would have to accept a greater number of people overflown – however the resultant route is in fact shorter, presenting an emissions benefit to the yellow airport ACP.

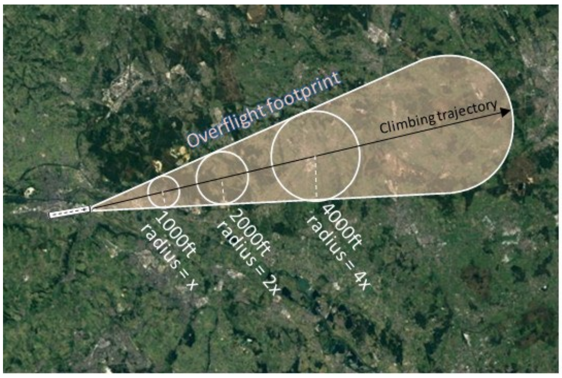
Case study example 4: Trade-offs decisions with economic impacts

161. The outcome of trade-off decisions illustrated in case study 3 may tend to favour busier airports that overfly large populated areas with more flights.
    - Consider for this case study, a region of terminal airspace over a heavily populated area serving a number of large, medium and small airports.
    - There may be relatively few corridors through the area that avoid overflight of major populations, and the objective appraisal is likely to suggest policy will be best met if these corridors are used by the most heavily used routes for the medium and large airports.
    - The analysis conducted to support trade-off decisions may suggest that smaller airports are effectively squeezed out and forced on to long routes around the congested or populated areas because the large impact on relatively few flights cannot justify compromised environmental performance on the more heavily used routes.
    - This could make some routes non-viable as a result of additional costs and emissions and/or flight time which can affect the number of takeoffs and landings possible in a day.
162. Safeguards may therefore be required in the analytical framework that informs trade-off decisions to ensure that smaller airports and their ACPs are not unduly disadvantaged.

Case study example 5: Trade-offs decisions informed by overflight metrics

163. Overflight contours and the associated population counts are a relatively simple measure of the potential local impact of an airspace design option. They define the area of airspace in which people on the ground are likely to observe overflight – this enables a population count of those assumed to be flown over by a route. The population count is based on a cone beneath the aircraft. The width of the overflight cone is directly proportional to the height of the aircraft as illustrated below.





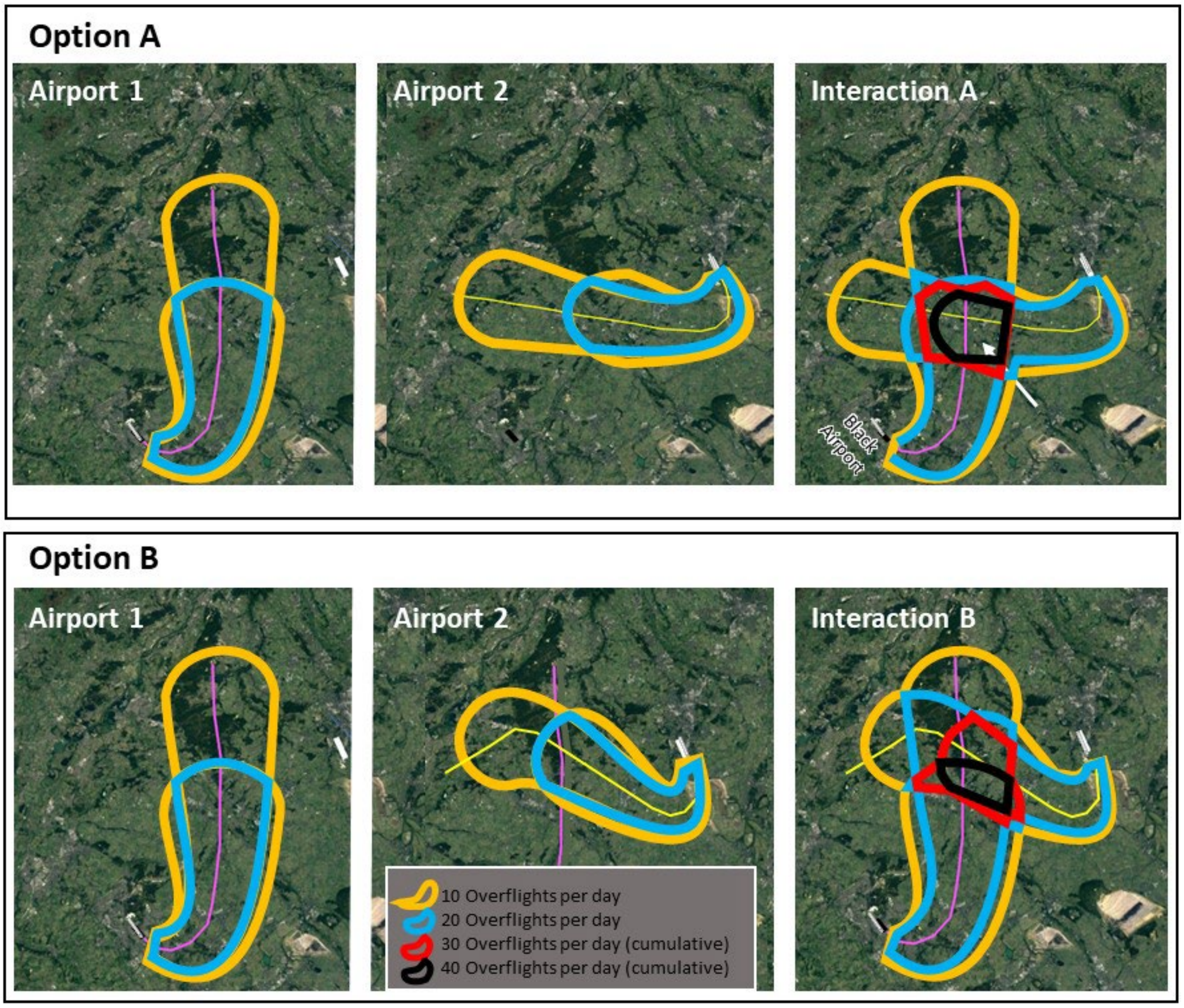
164. Overflight footprints for different aircraft on the same route will be affected by their differing climb rates. Overflight contours for individual route options will differ in terms of length and width as a result of climb/descent rate differences. Overflight contours are built by overlaying the overflight footprints for individual aircraft using the same route and counting the number of overflights above each location. More insight about the impacts of overflight can be generated by measuring overflight events - where an event is one person being flown over by one aircraft. The calculation is therefore simply the total number of people affected by the total number of overflights over a given period. The desired outcome being fewer overflight events.

165. Measuring the average number of overflight events per person within a given contour is achieved by dividing the total number of events by the total population. This is effectively a

measure of noise concentration or dispersion. For two contours with the same number of overflight events, the lower the average number overflight events per person the more the events are spread over a larger area indicating dispersal.

166. Case study 5 illustrates how overflight counts and the measures of events and average events per person may be used as part of an analytical framework to inform trade-off decisions.

- Consider two airports that share an airspace design conflict where their respective routes interact. Two options have been developed to resolve the conflict – Option A and Option B.
- In both options there are areas where the overflight contours associated with each route option overlap, producing a cumulative impacts of 10, 20, 30 and 40 overflights per day (the areas bordered yellow, blue, red and black).
- The table below shows how this example translates into population counts, overflight events and average events per person.
- In this example Option B generates 5000 fewer overflight events in total, which may provide a rationale for a trade-off decision in favour of Option B.
  - However, given that the overflight event totals are similar in both options, if one or both of the airports included noise dispersion as a design principle, the lower average overflight events per person in Option A may provide a counter rationale for a trade-off decision in favour of Option A.


Option A
Airport 1
Airport 2
Interaction A
Black Airport
Option B
Airport 1
Airport 2
Interaction B
10 Overflights per day
20 Overflights per day
30 Overflights per day (cumulative)
40 Overflights per day (cumulative)

	Option A			Option B		
	Count	Event	Average	Count	Event	Average
Collective overflight count 10 Per Day	7500	10*7500 = 75000		3500	10*3500= 35000	
Collective overflight count 20 Per Day	4500	20*4500 = 90000		5500	20*5500= 110000	
Collective overflight count 30 Per Day	500	30*500 = 15000		1000	30*100= 30000	
Collective overflight count 40 Per Day	1500	40*1500= 60000		1500	40*1500= 60000	
Total	14000	240000	**240000 / 14000 = 17.1**	11500	**235000**	235000 / 11500 = 20.4

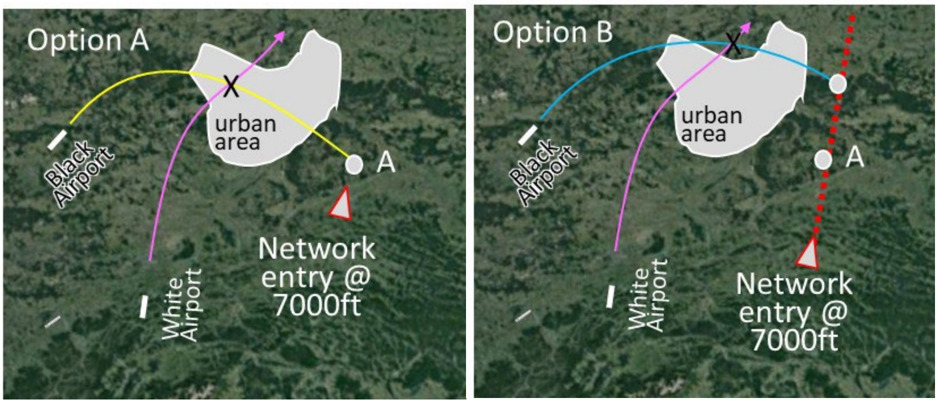
167. This case study is useful, but highlights the complexity of optimising interdependent overflight measures that do not distinguish between aircraft at different heights. Therefore there is no distinction between the impacts of overflying a person at 1000ft or 7000ft - both register simply as '1' added to the population count. Furthermore, the calculation results in greater numbers being affected by flights at higher altitudes than lower altitudes. This means that, taken on its own, the overflight metric could lead to greater emphasis being placed on flight path positioning at higher altitudes (because that is where the footprints are larger and significant population counts are being registered). This is counter to the policy drivers which place an emphasis on mitigating noise impacts from aircraft at lower altitudes - in short, this is a problem because the overflight cone gets bigger as the actual noise footprint gets smaller. The analytical framework will need to develop a method to weight the overflight counts at each height to take account of the fact that impacts from lower overflights are greater.

Case study example 6: Trade-offs decisions informed by overflight metrics

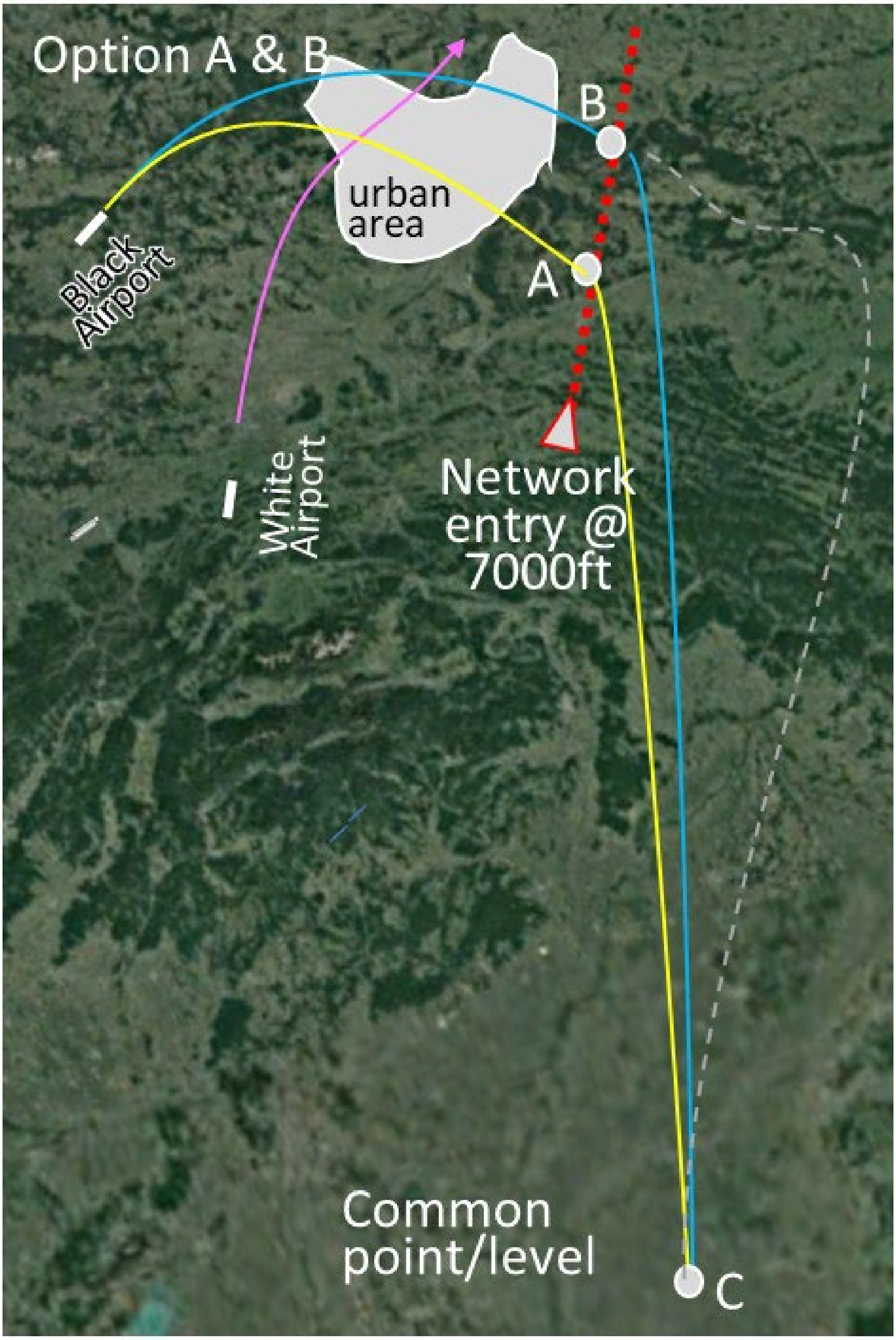
168. Government policy prioritises noise between 4000ft and 7000ft, subject to aircraft emissions not being disproportionately affected. Mitigations to resolve interactions with a focus on noise and overflight can affect the carbon efficiency of one or both ACPs. It will be important for the

analytical framework to take into account network interactions, even though the scope of the airport-led ACPs ends at 7000ft, as illustrated in case study 6.

169. In Option A on the left, the pink and yellow airport route options create a cumulative overflight impact at point X as a result of them both overflying the same part of the urban area. A potential solution is Option B on the right - so that that the crossing point is beyond the urban area. Both the yellow (Option A) and blue route (Option B) have continuous climb and so the emission generated from the runway to 7000ft are assumed to be virtually identical. Considering only the portions of the routes to 7000ft, and assuming that the collective overflight count is the same, Option B appears to be optimal as the emissions are the same, but it avoids the cumulative overflight impact to the urban area.



170. The diagram below shows how the choice of option B to reduce a cumulative impact would inevitably cause an increase in emissions in the network – this is because although the profiles to 7000ft are the effectively the same, Option B leads to a longer network segment as it delivers aircraft into the network further from their destination. As the airports choice of Option A or Option B has a consequence to emissions at a network level, this should be captured in the comparison of the collective impacts of Option A versus B.


Option A & B
urban area
B
A
Black Airport
White Airport
Network entry @ 7000ft
Common point/level
C

171. The airspace changes above 7000ft are the responsibility of NERL and therefore additional design requirements in this airspace that lead to a non-direct tracks (e.g. the grey route) or level-offs above 7000ft are entirely the responsibly of NERL. This principle of capturing the network impact of low level design options is described here in the context of cumulative/collective impacts, however the principle applies equally to an airports choice between its own routes where the different options to 7000ft deliver airport into the network nearer or further from the network exit point.

3.5. Stakeholder Engagement Strategy (B7)

3.5.1. Overview of the Stakeholder Engagement Strategy

172. This section sets out the stakeholder engagement strategy for the overall Masterplan and the programme of engagement that supported the development of Iteration 2. It also considers how the sponsors of the constituent ACPs should work together to coordinate consultation and engagement activities that have the potential to affect the same stakeholder groups. In this context engagement is a catch-all term for the activities conducted by ACOG to build relationships with stakeholders, whether in writing, through meetings or via other channels.

173. The engagement strategy cover's ACOG's engagement with all stakeholders external to the Programme, including communities, environmental interest groups, all airspace user groups, local government and aviation trade associations.

174. The strategy is aligned to the engagement methodology set out in CAP1616, covering the audience, approach, materials and length associated with the activities. Similar to the CAP1616 process, Masterplan engagement begins with representative stakeholders and moves to a broader audience as the impacts of the system-wide changes are better understood. The engagement associated with the development of Iteration 3 is dependent on the timelines and information generated by the constituent ACPs, following the acceptance of Iteration 2. For this reason, this strategy will outline our intended approach to engagement for Iteration 3 at a high level. This will evolve as more information from the constituent ACPs becomes available.

175. For the iterative approach to Masterplan development to function correctly it is crucial that the accompanying engagement is conducted in an open, fair, transparent and effective way. The planning and delivery of our stakeholder engagement activities are guided by these overriding principles; that all Masterplan engagement is:

- **Open:** Stakeholders are assured that the Masterplan development process is not predetermined; their feedback is valued and can influence the final proposal.
- **Fair:** Stakeholders have advanced notice of the engagement so they can plan their contribution and have adequate time and information to form meaningful inputs.
- **Transparent:** Stakeholders are presented with information to help them understand the impact of the system-wide changes on them. All information will be clear and accessible. Although the concepts included in the Masterplan may be complex the language used to communicate them during engagement will be clear.
- **Effective:** Stakeholders will be provided with a complete and accurate set of information that does not require technical knowledge to understand and respond to. The engagement information will focus on the factors that are decisive and of substantial importance to the development of the next Iteration of the Masterplan and not drift into related topics.

176. It is the responsibility of ACOG to own the requirement to conduct meaningful engagement in support of the Masterplan, informing all affected stakeholders about the progress of the current iteration and conducting effective engagement activities at regular intervals throughout the process. It is the co-sponsors role to hold ACOG to account against the requirement to conduct meaningful engagement with stakeholders, in line with the engagement principles set out above, by reviewing evidence of the two-way conversations that have influenced the development of the Masterplan prior to accepting each successive iteration.

177. Throughout the Masterplan development process, ACOG aims to provide stakeholders with a reasonable understanding of the current situation, clear information about what is being proposed at a system-wide level and assurance that their inputs will be conscientiously taken into account. In this capacity, there are five specific objectives for the engagement activities that support Iteration 2 and Iteration 3 of the Masterplan, that:

- The methods used to develop the Masterplan are well understood and respected by stakeholders.
- Stakeholders are able to provide inputs that are relevant and timely to the development of the current iteration.
- ACOG builds a full inventory of stakeholder requirements for the system-wide airspace changes and categorises them effectively for the constituent ACP sponsors to incorporate as appropriate.
- ACOG and the ACP sponsors understand how the different views provided by stakeholders may come into conflict;
- Stakeholders' awareness of the existing airspace system and the system-wide changes proposed in the Masterplan is improved so that the CAP1616 public consultations for the constituent ACPs are as effective as possible.

178. The engagement conducted by ACOG to inform the content of Iteration 2 was comparatively high-level and qualitative in nature because the Programme and most of the constituent ACPs are still in the early stages of development. ACOG will periodically review and update the Masterplan engagement strategy, working in collaboration with the AMS co-sponsors, as the Programme progresses and more information about the constituent ACPs becomes available. The most up to date version of the engagement strategy is available to stakeholders on the Masterplan section of the ACOG website.[25]

3.5.2. Stakeholder Engagement Process for Iteration 2

179. This section sets out the process of engagement activities that accompanied the development of Iteration 2 and explains how the feedback received from this engagement has influenced the development of the Masterplan. In recognition of the strategic and largely qualitative nature of Iteration 2, the co-sponsors have set out their expectations for ACOG to engage with the

[25] ACOG Masterplan Resource Center. [link]

representative stakeholders outlined in the AMS governance structure. The CAA has identified these organisations because they are either conduits to, or representatives of, a wider stakeholder group that is potentially impacted by the system-wide airspace changes. Table 22 summarises the AMS stakeholder representatives that were engaged during the development of Iteration 2, organised into three groups:

- Community or Environmental Stakeholder Representatives
- Representatives of other Airspace User Groups
- Commercial Air Transport Stakeholder Representatives

Table 22: AMS stakeholder representatives engaged during the development of Iteration 2

Community or Environmental Stakeholder Representatives	Representatives of other Airspace User Groups	Commercial Air Transport Stakeholder Representatives
• Airspace and Noise Engagement Group (ANEG) • Aviation Environment Federation (AEF) • Airports Consultative Committees (UK ACC) • Community Discussion Forum (CDF) • Strategic Aviation Special Interest Group (SASIG)	• Airspace 4 All • ARPAS-UK • General and Business Aviation Strategic Forum • Ministry of Defence (MoD) • National Air Traffic Management Advisory Committee (NATMAC) • UK Space Agency	• Airlines UK • The Airport Operators Association (AOA) • International Air Transport Association (IATA) • Industry Communications for the Airspace Modernisation Strategy (ICAMS) • Sustainable Aviation

180. ACOG delivered the high-level engagement required for Iteration 2 through a series of participatory sessions, aimed to facilitate two-way discussion and seek feedback on the development of the Masterplan. An initial session was offered to stakeholders to update them on the remobilisation of the airspace change programme and provide them with background on the Masterplan. An informal follow up session was then offered to all attendees to seek further feedback on what had been presented in session one and provide the opportunity to; present back any supplementary information that had been requested, answer any further questions, and capture any additional feedback.

181. A total of four initial sessions were delivered during June and July 2021 to 50 stakeholder representatives, with 17 stakeholders taking the opportunity to attend a follow up bi-lateral session in August or September. The participatory sessions were also attended by the co-sponsors as observers. The objectives of the initial participatory sessions were to:

- Ensure a common level of awareness of the Programme.
- Set out how the Masterplan is being developed and why.

- Highlight the opportunities for stakeholders to influence its development.
- Ensure clarity in the next steps of the Masterplan development.

182. All sessions were delivered as online video conferences, which was seen as an appropriate channel for the organisations involved considering the Covid 19 restrictions and recommendations. A presentation was used in the initial briefing sessions to deliver an update and to facilitate discussion and feedback across the groups. The presentations covered:

- An overview of airspace modernisation and its drivers.
- How airspace modernisation will happen – including a discussion point on the strategies that might be used to resolve any conflicts.
- Roles and responsibilities (ACOG, sponsors, co-sponsors).
- Next steps for the development of Iteration 2 of the Masterplan and future engagement opportunities.

183. The presentation and outputs from the participatory sessions were emailed to all stakeholders for information regardless of attendance. Following the briefing sessions, the notes from the meeting and the slide deck were shared with stakeholders.

184. In September a follow-up email was sent to those stakeholders that had not responded to the earlier invitation with the offer of a further meeting (in recognition that August can typically be a difficult month to schedule engagement activities).

185. Key themes arising from both the initial participatory sessions and follow up bilaterals are outlined in a table in Appendix B. The appendix also sets out how ACOG has considered and taken on board the feedback provided by stakeholders regarding the development of Iteration 2, as well as any that will be considered and carried forward in the development of Iteration 3.

186. Transparency is a fundamental principle that ACOG follows when delivering engagement activities. We have developed a ‘Masterplan Resource Centre’ on our website (www.acog.aero). This section of the website includes an up to date engagement programme timeline and the published outcomes from the engagement that has been delivered, including how the feedback received from stakeholders during the development of the Masterplan has been considered. The following documents are available from the Masterplan Resource Centre:

- Presentations used to deliver Iteration 2 engagement participatory sessions
- A post engagement summary report
- A Frequently Asked Question (FAQ) document developed using common themes arising from the sessions
- A Masterplan stakeholder engagement strategy, which will be regularly updated as it develops
- A table showing planned and delivered engagement activities and any associated outputs

187. Following the submission of Iteration 2 to the CAA, ACOG will provide an update to all stakeholders contacted as part of Iteration 2 to update them on the outcome of the engagement and signpost them to our Masterplan Resource Centre for further updates.

3.5.3. Engagement with sponsors of the constituent ACPs during Iteration 2

188. ACOG engages with sponsors of the constituent ACPs regularly. Throughout the development of Iteration 2, we have briefed the participating airports and NERL on the engagement activities and their outcomes so that they in turn can keep their stakeholders informed. In addition, during the development of Iteration 2 of the Masterplan ACOG participated in the following forums to deliver regular updates and briefing:

- The UK Airspace Change Programme Board.
- Technical coordination groups (one for each regional cluster) - To identify technical and design issues and discuss potential resolutions.
- Programme Coordination groups (one for each regional cluster) – To drive delivery of an agreed plan and ensure programme related risks and issues are identified and resolved.
- ACOG Communications Group – To provide updates on ACOG's stakeholder engagement programme.
- Specific Masterplan participatory sessions relating to Iteration 2 development were delivered to: LTMA on 15 June, North on 16 June, West 16 June.
- ACOG Operator Coordination Group – To facilitate a two-way sharing of information between ACOG, ACP sponsors and airline operators on the progress of the airspace change Masterplan.

3.5.4. Engagement approach for Iteration 3

189. The approach to engagement required to support Iteration 3 of the Masterplan must cater for all affected audiences, as different stakeholders may be affected in different ways, and to different extents. Where possible, ACOG will consider the engagement preferences of stakeholders, working with the ACP sponsors to draw on their experience and utilise their established communications channels. A detailed audience map will be developed for Iteration 3 using information from the constituent ACPs, including:

- ANSPs, including the NATS team that is tasked with redesigning the UK's medium level airspace network above 7000ft and the European ANSPs that border our airspace.
- Airports that are modernising and upgrading their arrival and departure routes below 7000ft and must ensure that they are aligned with neighbouring airports and connect efficiently with the network above.
- Commercial air transport, general aviation and military users that operate in the airspace and may need to adopt new technologies and procedures as part of the airspace change programme.

- New airspace user groups like remotely piloted aircraft systems (RPAS) and commercial space flights that are expected to demand greater access to the airspace in the future and will need to integrate with conventional users safely and efficiently.
- Passengers, consumers, and companies that rely on air transport for leisure and business and convert aviation products and services into a valuable driver for economic growth and global connectivity.
- Interest groups, local communities and their elected representatives that are concerned about the external impacts of airspace modernisation, especially aircraft noise, emissions, and the effects on local air quality.

190. ACOG will also continue to engage with representative stakeholders on the AMS governance structure on how trade-offs are presented in airspace change proposals (ACPs) consultations.

191. The engagement activities required to support the development of Iteration 3 are made up of:

- A public call for information
- Supplementary engagement exercises for each regional cluster

192. The scope of these activities is explained at a high level in the sections below.

Public Call for Information on Iteration 3 of the Masterplan

193. The aim of the public call for information to support the development of iteration 3 is to provide all stakeholders with the opportunity to input on the approach to managing conflicts and interdependencies between the constituent ACPs, and identify any potential gaps or improvements in the Masterplan, for example, whether all the airspace changes needed to deliver the airspace modernisation that the co-sponsors have commissioned are adequately captured.

194. The public call for information will be based on documentation detailing the forthcoming development of the Masterplan, with a series of associated questions seeking feedback. This feedback would be relevant to the development of all versions of Iteration 3, setting out:

- An overall description of the system-wide design based on the information available.
- Where decisions have been made so far between the sponsors of interdependent ACPs during the development of their respective options.
- How specific airspace design trade-offs will be presented by airspace change sponsors as part of their coordinated consultations through the CAP 1616 process.
- How the sponsors of interdependent ACPs will consult on their proposals in a coordinated manner, so that stakeholders are presented with a holistic view of the overall airspace design and a full description of the cumulative impacts of the individual proposals.

195. The documentation accompanying the feedback questionnaire will use conceptual case studies showing:

- How potential solutions and trade-offs might be used for resolving conflicts.
- How potential solutions and trade-offs will be presented by airspace change sponsors as part of their individual or joint consultations through the CAP 1616 process.
- More information about the cumulative impacts of different design choices and the methods used to calculate them.

196. We will seek feedback from stakeholders on the case studies to shape the way cumulative impacts and trade-off decisions are presented in interdependent proposals and how this is coordinated and undertaken in each version of Iteration 3. In addition, the call for information will ask for stakeholder's views on:

- Whether there are any potential gaps in the Masterplan
- If there are any potential productive additions to be added
- Whether airspace changes have been grouped into clusters appropriately,
- Any other relevant feedback.

197. A fully inclusive, integrated multi-channel approach would be taken to run this exercise, which would use both online and offline methods. All activity will be conducted in a transparent way. The Masterplan Resource Centre on the ACOG website will be used to publish both planned and completed activities, along with the outputs of the engagement.

Supplementary Engagement Exercises for each regional cluster

198. Along with the broad public call for information, further targeted engagement opportunities will be delivered regionally with each associated cluster. The timings of these activities will be based on the deployment timelines of each of the airspace changes within the clusters. ACOG will seek insight from sponsors on the relevant representative stakeholders involved in the engagement on their individual proposals and how best to engage and reach these audiences within their locality.

199. Feedback received from this regional engagement will be considered to make any suggested improvements to each version of Iteration 3 as they develop. This supplementary regional approach will allow on-going opportunities for stakeholders to influence the development of the Masterplan at a cluster-by-cluster level. It will also enable ACOG to signpost stakeholders to the most up to date information about:

- The relevant individual CAP 1616 ACP consultations before they launch
- How the airport-led ACPs at lower altitudes and the network-level proposals led by NERL are linked together using the most recent information

- How stakeholders can influence decisions on proposed trade-offs that may affect them during the CAP1616 consultations.

Engagement materials for Iteration 3

200. The materials used to engage on Iteration 3 must cater for all audiences, as different stakeholders may be affected in different ways, and to different extents. ACOG will consider different engagement preferences of stakeholders, working with individual sponsors to not only identify relevant local stakeholders but to seek advice and insight on the best channels and methods to use to reach them.

201. The materials which will need to be developed for Iteration 3 engagement are likely to be, but not limited to:

- An online platform to support the submission of feedback from the public engagement exercise
- A brochure supporting the feedback questionnaire (online and print)
- Feedback questionnaire - print
- Tailored slide packs to deliver presentations relevant to stakeholder groups (e.g. different levels of technical detail for aviation stakeholders)
- Relevant meeting minutes
- Stakeholder feedback report
- Updated FAQ document
- Latest version of the Masterplan engagement strategy
- Materials used deliver regional engagement by cluster (to be developed with insight from the airport sponsors)
- An asset library for sponsors to use to coordinate their interdependent CAP 1616 consultations to ensure consistency across content, such as:
    - Boilerplates to describe the role of ACOG and the Masterplan, the AMS, the Programme, the LAMP2 network ACPs, etc.
    - Glossary to describe common terminology across the Programme such as interdependency, conflict, trade-off, cumulative impacts etc.
    - Description of how cumulative impacts are calculated
    - A format to present cumulative impacts in an accessible way
    - A format to present trade-off decisions
    - Graphics and infographics
    - Digital assets

- A template to use in CAP1616 consultation strategies to describe the coordinated elements in a consistent way

202. The materials developed to support coordinated consultations will need to be created following the public call for information so that they can include feedback gathered from this exercise. They will be continually refined through supplementary regional engagement. As part of ACOG’s engagement on Iteration 3, we plan to set up a community advisory panel – made up of representatives from local communities. This will allow us to test the accessibility and clarity of materials, messaging and assets and make improvements based on feedback. It will also allow us to use the insight from these communities to ensure that our engagement approach is fit for purpose and is as effective as it can be.

Performance indicators for Iteration 3 engagement

203. We will regularly assess the performance of our engagement activity using the following indicators:

- Participation in engagement from a broad range of stakeholder groups
- Number of responses to the public call for information
- Unique visitors to the Masterplan Resource Centre
- Percentage of overall feedback that influences the Masterplan
- Percentage of earned media exposure

204. The outcomes of these indicators will allow us to review and adapt our approach to ensure we are getting the most out of our engagement opportunities, allowing us to add additional, or discontinue low performing, activities.

205. Table 23 summarises the information that stakeholders will be asked to provide feedback on during the Masterplan public engagement exercise, the supplementary regional engagement activities and the ACP public consultations required as part of the CAP1616 process.

Will seek feedback on:	ACOG public call for information	ACOG supplementary engagement exercises	Constituent ACP CAP 1616 consultations
1. the overall description of the system-wide design (based on the information available from the constituent ACPs).	**YES**	**YES**	**NO**
2. any potential gaps in or productive additions to the masterplan.	**YES**	**YES**	**NO**
3. how specific airspace design trade-offs will be presented by airspace change sponsors as part of their coordinated consultations through the CAP 1616 process.	**YES**	**NO**	**NO**
4. the way the masterplan proposes conceptual solutions to potential conflicts between interdependent ACPs.	**YES**	**YES**	**NO**
5. the decisions that have been made between sponsors of interdependent ACPs to create their respective options (based on the information available).	**YES**	**YES**	**YES**
6. The information about the cumulative impacts of different design choices and the methods used to calculate them.	**YES**	**YES**	**YES**
7. how the sponsors of interdependent ACPs will consult on their proposals in a coordinated manner, so that stakeholders are presented with a holistic view of the overall airspace design and a full description of the cumulative impacts of the individual proposals.	**YES**	**YES**	**NO**

8.	Proposed fight path options.	**NO**	**NO**	**YES**
9.	The actual cumulative impacts of proposed flight path options.	**NO**	**NO**	**YES**
10.	Actual proposed trade off decisions associated with flight path options that have yet to be made.	**NO**	**NO**	**YES**

Table 23: Summary of how stakeholders will be able to provide feedback

3.6. Iterative development of the Masterplan (B8)

3.6.1. Development of the Masterplan Iteration 3 in clusters

206. Each iteration of the Masterplan must include a plan for the content of the subsequent iteration, which will also be considered as part of the CAA's acceptance decision. The co-sponsors may also offer feedback during their assessment of Iteration 2 about further work or areas where more detail may be required, which the plan for Iteration must take into account.

207. Iteration 2 of the Masterplan identifies the areas of interdependency between the constituent ACPs, examines the nature of the airspace design conflicts or enablers that may arise in each area and considers the potential solutions available to resolve them. Iteration 3 will focus on the cumulative impacts of the airspace design options proposed by the interdependent ACPs and how trade-offs between the various benefits and impacts should be evaluated and consulted upon. An accepted version of Iteration 3 showing the system-wide airspace change, and the cumulative impacts of the constituent ACPs, is required before the proposals can pass through the Stage 3 Gateway and launch public consultations on their preferred designs.

208. The expectation is that each cluster can progress along a separate and independent timeline. The clusters with fewer ACPs and less complex interdependencies will progress more quickly. For example, the interdependencies between the ACPs in the WTA cluster are relatively simple to manage. The complexity of the airspace design conflicts or enablers between Bristol, Cardiff and Exeter is comparatively low. The WTA timeline to conduct a full options appraisal, including an assessment of the cumulative impacts of the three ACPs, and launch a coordinated public consultation on the proposed changes is much shorter than the larger more complex clusters. The timelines associated with the STMA and MTMA clusters, although longer than the WTA cluster, will be significantly shorter than the LTMA cluster – where the ACPs create a range of highly complex interdependencies and design conflicts.

209. It is envisaged that Iteration 3 of the Masterplan will be developed and presented to the CAA for acceptance in several versions that address the inherent misalignment in timelines across the clusters. Iteration 3.1 of the Masterplan will include updates on the progress of all

component ACPs but will only present information about the Full Options Appraisal and cumulative impacts relevant to the WTA ACPs for acceptance. In accordance with the acceptance criteria, this will allow for the WTA ACPs to progress through the Stage 3 Gateway and commence public consultation in advance of the rest of the Programme. We expect Iteration 3.1 of the Masterplan to be submitted to the co-sponsors for assessment during 2022.

210. Iteration 3.2 will include further programme wide updates and more information about the progress of the entire constituent ACPs but will only present Full Options Appraisal and cumulative impact information for acceptance that is relevant to the STMA and MTMA clusters. We expect Iteration 3.2 of the Masterplan to be submitted to the co-sponsors for assessment during 2023. The Full Options Appraisal and cumulative impact information associated with the LTMA cluster ACPs will be presented for acceptance in Iterations 3.3. and 3.4 of the Masterplan that will be submitted to the co-sponsors for assessment from Q3-2023 onwards.

3.6.2. Masterplan Iteration 3 Public Engagement Exercise

211. This section considers the approach to the public engagement exercise that is a requirement for ACOG to carry out as part of developing Iteration 3 of the Masterplan. The public engagement exercise is expected to cover the overall description of the system wide design, and the methods that will be applied to coordinate consultations that may affect stakeholders who are impacted by the development of two or more interdependent ACPs in the Masterplan.

212. The aim of the public engagement exercise is to provide stakeholders with the opportunity to provide views on the identification of conflicts and interdependencies, and any potential gaps or improvements in the Masterplan, for example, whether we have identified all the airspace changes needed to deliver the airspace modernisation that the Co-sponsors have commissioned.

213. The public engagement exercise ACOG proposes to deliver for the development of Iteration 3 will be in the form of a public call for information. This will be based on accessible materials that explain the system-wide change proposal, with a series of associated questions seeking feedback that would apply to the development of all versions of Iteration 3.

214. By way of a case study, example material accompanying the feedback questionnaire will draw on the detail from the first cluster of ACPs to reach Stage 3 of the CAP1616 process and that will be publicly consulting on their plans in 2022: Bristol, Cardiff and Exeter. The case study will set out details of the full options appraisal and consultation materials demonstrating how:

- Potential solutions and trade-offs might be used for resolving conflicts
- Potential solutions and trade-offs will be presented by airspace change sponsors as part of their individual or joint consultations through the CAP 1616 process
- Cumulative impacts are calculated and presented

215. Although the requirement of the public engagement exercise is to seek feedback on the way in which airspace change design trade-offs are described in interdependent ACPs and the

potential solutions conceptually, we believe using information based on real ACPs will make it more credible and meaningful for stakeholders.

216. Once the analysis of impacts and trade-offs has been undertaken based on the full options appraisals of these three airports, and the example consultation material of the interdependent proposals have been presented in a coordinated way, we would seek feedback from stakeholders on the case study to shape the way this work is undertaken going forward in each version of Iteration 3 in the Programme.

217. As well as seeking feedback on the presentation of information within the case study, the call for information will also ask for stakeholder's views on whether there are any potential gaps in the Masterplan, or if there are any potential changes should be added, and whether airspace changes have been grouped into clusters appropriately, as well as any other relevant feedback.

218. A fully inclusive, integrated multi-channel approach would be taken to run this exercise, which would use both online and offline methods. All activity will be conducted in a transparent way. The Masterplan Resource Centre on ACOG's website will be used to publish both planned and completed activity, along with the outputs of the engagement (such as a stakeholder feedback report, feedback analysis etc.).

219. Along with the broad public call for information exercise, further targeted engagement opportunities will also be delivered regionally with each associated cluster. The timings of this activity will be based around the deployment timelines of each of the airspace changes within the clusters.

220. In defining this regional engagement, ACOG will base it on the airports' list of representative stakeholders involved in the engagement on their individual proposals and will be guided by sponsors on how best to engage and reach these audiences within their locality. Feedback received from this representative regional engagement will be considered to make any suggested improvements to each version of Iteration 3 as they develop.

221. This supplementary regional engagement will allow on-going opportunities for stakeholders to influence the Programme. It will also enable ACOG to signpost stakeholders to the most up to date information about:

- The later relevant individual CAP 1616 airspace change proposal consultations before they launch
- Now proposals are linked together using the most recent information
- And how stakeholders can influence decisions on proposed trade-offs that may affect them.

222. Sponsors will be unable to progress through the Stage 3 gateway of the CAP 1616 process until the system-wide airspace design of the proposed options, and the cumulative impacts of those options, are represented in an accepted version of Iteration 3.

3.7. Assessment of the impact on other users (B9)

3.7.1. Overview of the assessment of the impact on other airspace users

223. The Masterplan is being produced in response to the current piecemeal, incremental approach to airspace development that over time has given rise to a sub-optimal system. Before the master planning process, changes to the airspace system were not subject to any coherent approach intended to optimise the utility of the finite volume of UK airspace as a scarce resource.

224. The CAP1616 process that the ACP sponsors are following is clear about the requirement to engage all airspace users in the development and assessment of design options from an early stage. A full assessment of the impact that the design options may have on the operations of other airspace users is a key part of the process. Each sponsor conducts this assessment in isolation of the other interdependent ACPs that may propose a further modification to the same volume of airspace. Decisions about the direct impacts of a change on other airspace users and the second-order effects that may arise when changes are integrated with other proposals is constrained by the lack of a coherent analysis. It is this coherent analysis that the Masterplan ultimately aims to provide through a system-wide assessment of the impacts of the constituent ACPs on the operations of other airspace users.

225. In this context the term 'other airspace users' refers to all classes of aircraft other than those conducting scheduled commercial air transport operations. This definition covers a wide range of conventional and emerging operators, pursuing a mix of different interests in a variety of aircraft types, that can be organised into the following groups:

- Fixed-wing powered general and business aviation operators
- Rotary general and business aviation operators
- Gliders
- Other non-powered general aviation operators such as hang gliders and balloons
- Large model aircraft operators
- Military
- Unmanned Aerial Systems (UAS), Electric Vertical Take-off and Landing (eVTOL) and Advanced Air Mobility (AAM) operators.

226. The assessment of impacts on other airspace users should guide how the design options developed by the constituent ACPs, and the system-wide changes that they contribute to, are shaped by the potential to generate benefits and mitigate risks for these groups. In due course, this should include identifying issues with the existing airspace system and influencing the options developed by the constituent ACPs to upgrade it.

227. Ultimately the assessment produced in this section of the Masterplan must demonstrate how the system-wide changes proposed by the constituent ACPs represents an overall efficient allocation of airspace. For Iteration 2, the assessment is limited to a general, high-level and largely qualitative consideration of the impacts and the definition of the framework through which the analysis will be expanded and refined during the development of Iteration 3. The outputs of the assessment conducted for Iteration 2 highlights areas where further detailed work will be required during the preparation of Iteration 3 to examine the impact of design options, interdependencies and potential trade-off decisions on the operations of other airspace users.

228. As the Masterplan develops the assessment framework should include the coordination of engagement with other airspace users, the use of data to measure impacts, the approach to reducing the net volumes of controlled airspace and the deployment of concepts to encourage greater access and integration.

229. Further development of the assessment framework in preparation for Iteration 3 should be closely aligned with the CAA's 2021 review of the AMS, recognising that some of the key issues facing other airspace users today exist in part because of the lack of progress towards modernising the UK's airspace structures to release lower altitude bands. By accepting the Masterplan into the AMS, the CAA must apply its airspace change decisions in accordance with the Masterplan and therefore in the best interests of the overall aviation sector, and not just the sponsors or primary beneficiaries of a change. Over time, the Masterplan must demonstrate how the impacts and opportunities of the constituent ACPs and the system-wide changes they will produce, will be shared across all airspace users.

3.7.2. Engagement with other airspace users

230. Operations outside controlled airspace are a portion of the existing airspace system that generates comparatively little data (although this is changing with the spread of electronic conspicuity technology, see section 3.7.5.). As a result, decisions about the impacts of changes that affect the system are best served through extensive engagement with airspace users. Sustained and meaningful engagement is required with other airspace users to ensure that successive iterations of the Masterplan are developed with the appropriate balance. Section 3.7 provides details of the engagement with other airspace users conducted to support the development of Iteration 2 and summarises the key outputs that have influenced the content of the Masterplan and how it will progress in Iteration 3. The engagement with other airspace users must be maintained during the development of Iteration 3 to ensure the Masterplan is developed collaboratively and generates a targeted and proportionate set of outcomes.

231. The high-level assessment conducted to support Iteration 2 is also informed by the engagement conducted by ACP sponsors to agree on design principles during stage 1 of the CAP1616 process. The design principles provide a qualitative framework that must be used by the sponsors to develop and assess design options for their respective ACPs. Table 23 provides a list of the design principles that consider the impacts on other airspace users, which have been

agreed upon by the sponsors of the constituent ACPs that have already completed stage 1 of the process.

Table 24: Constituent ACP design principles that consider the impact on other airspace users

#	Design principle (DP) considering other airspace users	Reference
1	Seek to minimise the amount of controlled airspace required, and our future route designs should ensure an efficient and systemised operation at Stansted, minimising interactions with other airports and maintaining priority access for emergency services.	DP2, Stansted Airport
2	Design the appropriate volume of controlled airspace to support commercial air transport, enable safe, efficient access for other types of operation and release controlled airspace that is not required.	DP3, Glasgow Airport
3	Our route designs should minimise the impacts on other airspace users by limiting controlled airspace.	DP5, Manchester Airport
4	The airspace change should promote optimal network performance in collaboration with other airspace users.	DP8, London City Airport
5	Should minimise the impact on other airspace users through; Keeping CAS requirements to a minimum; Simple airspace boundaries; Allowing flexible use of airspace, where possible.	DP8, Luton Airport
6	Should minimise the impact on other airspace users - consider designs and procedures that facilitate and accommodate access to airspace for non-commercial users, including general aviation (e.g. recreational aviation or private transport), Ministry of Defence and other aviation communities.	DP8, Bristol Airport
7	The airspace change will endeavour to be compatible with the requirements of the MoD.	DP6, Cardiff Airport
8	The impacts on GA and other civilian airspace users – due to the ACP – will be minimised.	DP7, Cardiff Airport
9	Any new airspace should not create funnelling or chokepoints for other airspace users.	DP3, Exeter Airport
10	Any new airspace should allow equitable access to all airspace users.	DP7, Exeter Airport
11	Design the appropriate volume of controlled airspace to safely support commercial air transport and release controlled airspace which is not required.	DP7, Aberdeen Airport

12	Controlled airspace options should ensure there is safe and efficient access for other types of operations and should explore measures, including classification and flexible use of airspace, where possible and appropriate, to improve access and decrease airspace segregation.	DP8, Aberdeen Airport
13	Our controlled airspace should be open to all authorised users; however, priority will be given to airport air traffic over other airspace users, except for emergency aircraft.	DP6, East Midlands Airport
14	If the design of the new procedures requires a smaller volume of airspace, airspace design or classification should be altered for the benefit of other airspace users.	DP10, Liverpool Airport
15	The ACP should minimise the impact on other airspace users.	DP3, RAF Northolt
16	The airspace design should afford the appropriate volume of controlled airspace to contain and support commercial air transport for both runways, enable safe, efficient access for other types of operation and release controlled airspace.	DP8, Southend Airport
17	Airspace design options should minimise the impact on other airspace users in the local area.	DP5, Manston Airport
18	Maximise operational efficiency for commercial air transport and general aviation users affected by the airspace change.	DP10, Southampton Airport
19	Avoid increasing the overall volume of controlled airspace and where deemed necessary, mitigate the impact by including measures that improve access to GA and do not increase airspace segregation.	DP13, Southampton Airport

3.7.3. Gathering data and measuring the impact on other airspace users

232. The lack of accurate, up to date and sufficiently comprehensive data about other airspace users operating predominantly outside controlled airspace has the potential to limit the Programme's ability to identify issues and track meaningful improvements through the Masterplan process. ACOG is working with the CAA and wider sector to understand what data is required to inform Iteration 3 and how it can be gathered, including:

- The net volume of controlled airspace and how it is forecast to change over time.
- The number, locations and nature of GA operations in specific volumes of airspace.
- Users requirements for suitably sized and sited volumes of airspace to conduct their operations and how well (or otherwise) the current airspace structures meet those requirements.

- The evolution of the aircraft fleet that predominantly operates outside controlled airspace, including the growth in new aircraft types.
- The proportion of the fleet that is equipped with an interoperable EC device.
- The number of flying sites that service operations outside controlled airspace across the UK, including their key characteristics in terms of infrastructure, activity and geographical location.

233. Table 24 provides a summary of the size and nature of the operations of the airspace user groups listed in section 3.9.1. The summary is intended as a basis from which to build a more comprehensive dataset to inform the development of this assessment for Iteration 3. The table demonstrates that the size and nature of the operations conducted by the different airspace user groups varies greatly, leading to different and sometimes potentially conflicting requirements for airspace.

Table 25: Size, nature and forecast growth of the operations of other airspace user groups

User group	Size and nature of the operation
Fixed-wing powered general and business operators.	Typically conventional light aircraft participating in sports, leisure and business activities. • 4012 UK registered fixed-wing power GA aircraft in 2021. • Total UK fleet has reduced by 12% from 4565 in 2011. • Up to c.1500 foreign registered fixed wing aircraft also operate in UK airspace. • 26,000 private pilot licence holders in the UK. In addition, some of the 19,000 professional licenced UK pilots are also engaged in general aviation activity.
Rotary general and business aviation operators.	Large commercial helicopter operations, small helicopters (both business and GA) and gyroplanes. 70% of the fleet is comprised of small rotorcraft predominantly in uncontrolled airspace. 8-10% of the fleet are conducting Offshore Operators. • 1208 UK registered rotary wing aircraft in 2021. • UK fleet has reduced by 12% from 1364 in 2011.
Gliders.	Self-launch motor gliders and sailplanes. • 2231 UK registered glider aircraft in 2021. • 6000 registered glider pilots in the UK. • The total UK glider fleet has remained stable over the past decade.

	The seasonal nature of gliding activities and strong dependence on meteorological conditions means a large proportion of the overall fleet may be active at the same time during peaks.
Other non-powered general aviation operators.	Hang-glider, paraglider, balloons, sky diving and parachute activities. • The British Hang-gliding and Paragliding Association estimates its membership at 7000 pilots and that a further 20% of pilots are non-members. • The British Balloon & Airship Club has over 1000 members. • The annual number of cross-country paragliding flights increased by 11% from 135k in 2011 to 151k in 2021. • British Skydiving has a membership of around 6,400 full members. • There are 146 notified hang-gliding sites, 98 paragliding sites and 36 parachute drop zones distributed across the UK.
Large model aircraft.	• 40,000 model aircraft association members flying model aircraft of all types and sizes, from several grammes to 150kg throughout the UK. • There are c.800 model flying clubs across the UK. • The 20 largest clubs operate flights up to 1500ft.
Military airspace users.	• Military airspace users include a wide range of aviation activities representing parts of the gliding community; some recreational flying clubs; flying training schools; Battlespace Management Force Headquarters; area radar; Joint Helicopter Command (support and attack helicopters); the RAF transport fleet and fast jets. Navy Command (Maritime attack and support helicopters); the RAF transport fleet, maritime patrol aircraft, fast jets, light aircraft, gliders; United States Visiting Forces transport fleet, medium lift support aircraft and fast jets. All Commands operate RPAS/UAS, ranging from large (Watchkeeper/Protector) to small (Puma). • The MoD is expecting to begin conducting UAS operations in class G airspace by 2024.
Unmanned aerial systems. **Urban air mobility.** **eVTOL.**	In recent years (from c. 2013 onwards) there has been a significant increase in UAS operations in UK airspace for both commercial and recreational purposes. Over 500,000 recreational drones were sold in the UK during 2014. By 2018 sales had risen to over 1.5 million per year. Permissions granted by the UK CAA for the commercial operation of UAS grew by 40% between 2019 and 2020. While the future is unpredictable, especially following the pandemic, it is envisaged that emerging technologies will continue to drive the introduction of new aviation products and services delivered by UAS and in due course AAM. PWC estimate that by 2030 over 76,000 UAS will be operated in the UK by businesses and the Public sector.

	In addition, improvements in lightweight materials and battery performance are driving the development of a new wave of electric vertical take-off and landing (eVTOL) aircraft (often referred to as air taxis) that are expected to use some volumes of UK Class G airspace extensively as the AAM market emerges (from c. 2023 onwards). The first eVTOL Advanced Air Mobility vehicles are expected to enter commercial operation in 2024.
General aviation aerodromes and unlicensed flying sites.	The General Aviation Awareness Council (GAAC) maintains a non-exhaustive list of the main airfields and airports in the UK. Based on the GAAC inventory, there are approximately 120 GA aerodromes supporting operations that may interact with the ACPs included in the Masterplan. In addition, the GAAC has identified between 350 and 500 unlicensed flying sites across the UK.

Figures 27 to 30 replicate the charts in section 3.2 that illustrate the overlapping areas where airspace design conflicts might arise between the Masterplan ACPs and overlays the adjacent airports and GA airfields taken from the GAAC lists. The charts demonstrate the large number of other airports and airfields that operate within the existing airspace system, which the Masterplan ACPs must consider when developing airspace design options.

Figure 27: Other airports and airfields in the LTMA region

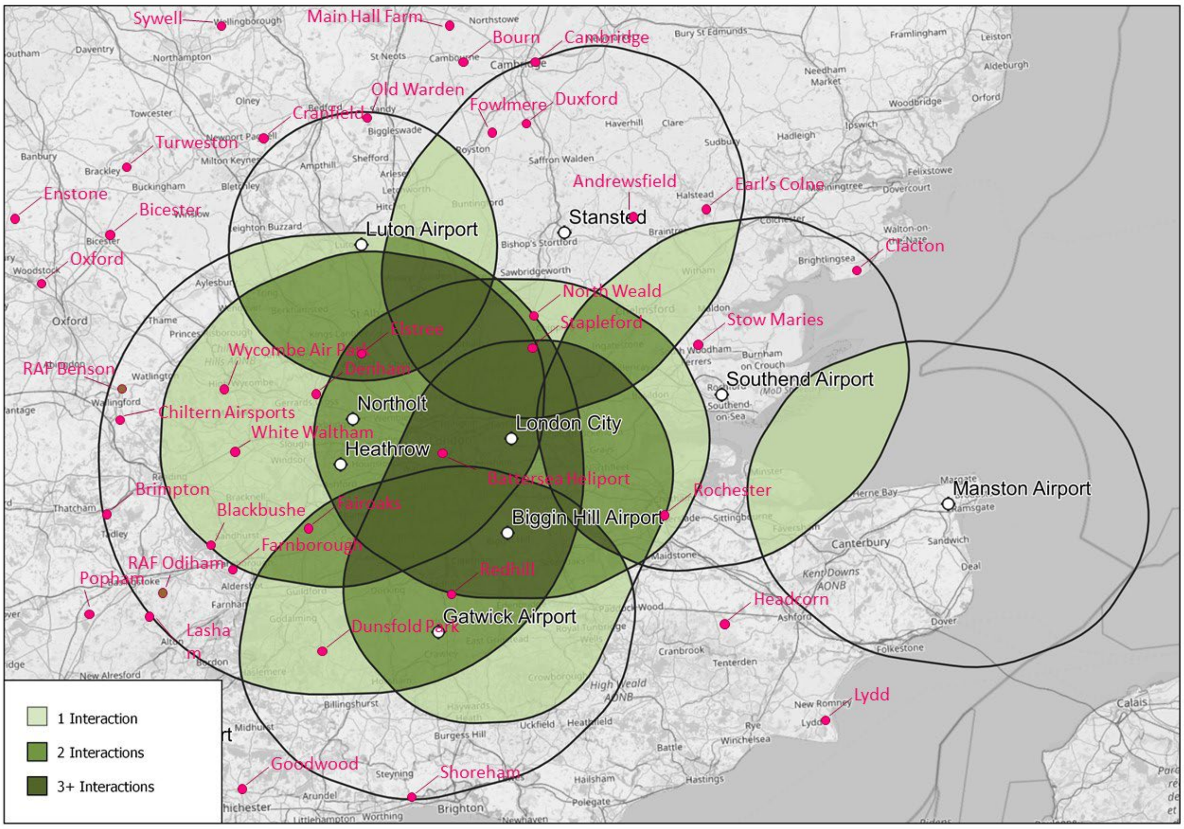


Figure 28: Other airports and airfields in the MTMA region

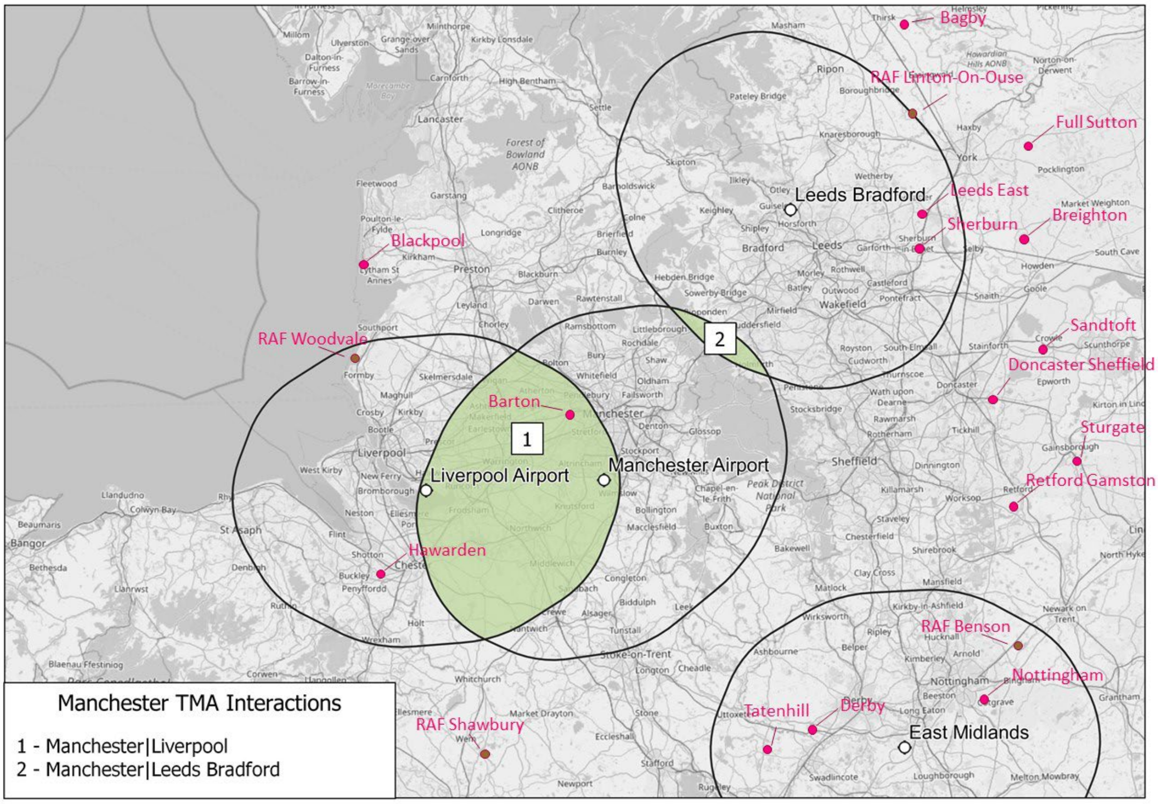


Figure 29: Other airports and airfields in the WTA region

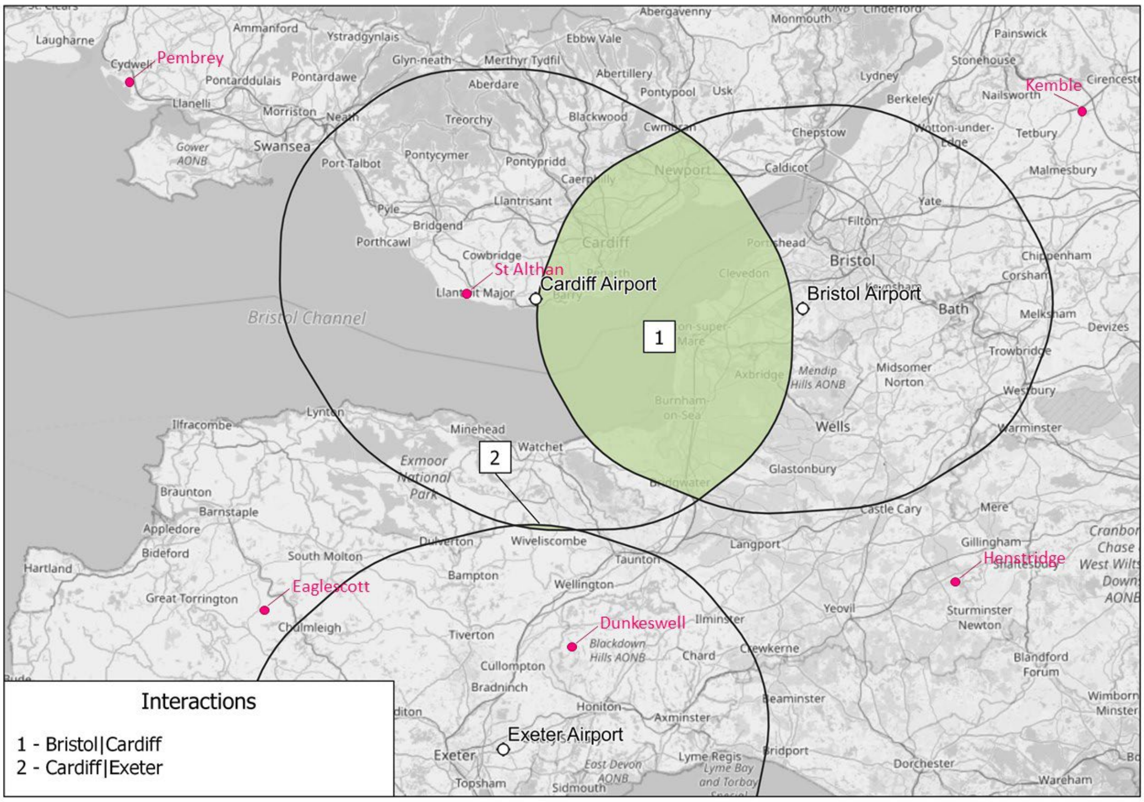
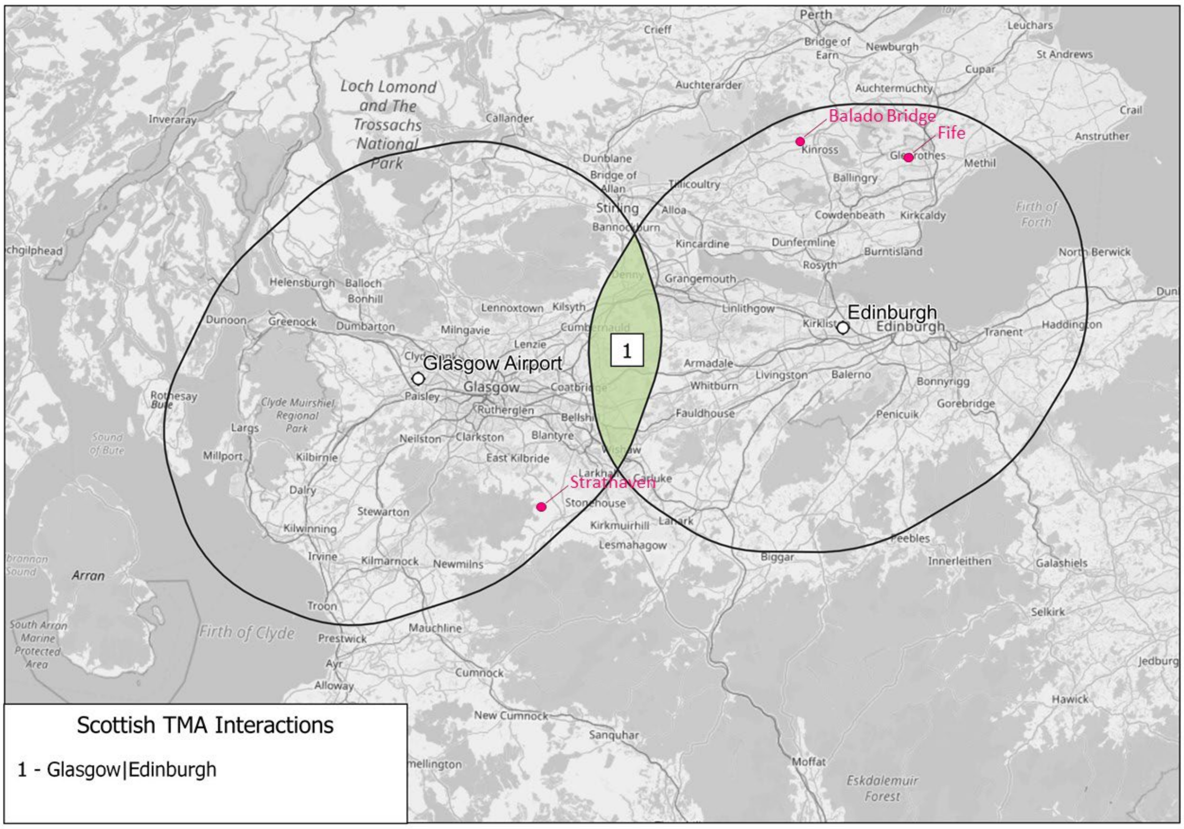


Figure 30: Other airports and airfields in the STMA region



3.7.4. Reducing the net volume of controlled airspace

234. Section 1.1. describes how the demand for commercial air transport has grown significantly in the past three decades. Over time ACPs have resulted in some airports taking responsibility for comparatively large volumes of controlled airspace to support the expected increase in traffic levels required to service the growth in demand.

235. The trend towards expansion in the net volume of controlled airspace has generated three high-profile negative impacts for other airspace users operating predominantly outside controlled airspace:

- It reduces the net volume of uncontrolled airspace available for other users to access and operate in a manner that satisfies their demand.
- It increases the risk that uncoordinated deployments of controlled airspace create bottlenecks or choke points in Class G, leading to a degradation in safety performance.
- It increases the potential risk of airspace infringements and consequently the risk of mid-air collisions.

236. Although technically other airspace users can enter controlled airspace with the correct permissions, practically many users are effectively excluded because either their aircraft is not

suitably equipped or controllers do not have the capacity to provide a crossing service at the times and locations required. Over time without a coherent national approach to the allocation of the UK's airspace as a scarce resource, users outside controlled airspace risk becoming further squeezed into smaller accessible areas with direct consequences for the sustainability and growth of GA operations and aerodromes outside controlled airspace.

237. Section 1.1.8. describes how the constituent ACPs will lead to the widespread introduction of PBN arrival and departure routes at lower altitudes. The airspace design criteria associated with PBN creates the opportunity to reduce the separation distance between routes and minimise the containment areas of controlled airspace that are required to protect commercial air transport operations. The widespread adoption of PBN routes in the busy terminal airspace offers the potential to release controlled airspace at lower altitudes, increase access for other airspace users and achieve an overall more efficient allocation of airspace at a system-wide level.

238. Some airspace users frequently highlight that several regional airports maintain volumes of controlled airspace that are many times larger than those required for some of the country's busiest airports, which indicates to them the potential for portions to be released back to uncontrolled airspace as part of the relevant ACPs. The mechanism by which unused or under-utilised controlled airspace is considered for release is the remit of the CAA Airspace Classification Team. The CAA has the necessary powers and expertise to make changes to the established airspace design where justified.

239. In 2019-20 the CAA launched a consultation to ask stakeholders to identify volumes of controlled airspace in which a classification change could be made to better reflect the needs of all airspace users on an equitable basis. Around 1100 responses were received from this consultation. The Airspace Classification Review team identified 17 airports across the UK which all have a Masterplan ACP, between stages 1 and 2 of the CAP1616 process, which had attracted responses in the consultation. These airports are: Aberdeen, Biggin Hill, Bournemouth, Bristol, Cardiff, East Midlands, Edinburgh, Gatwick, Glasgow, Heathrow, Leeds Bradford, London City, Luton, Manchester, Southampton, Southend and Stansted.

240. The responses have been distributed to the relevant airports by the CAA. Across the 17 airports a total of 308 comments were made across 115 volumes of airspace. The CAA will expect to see evidence that the change sponsors have considered and responded to this insight at the appropriate stage of the CAP1616 process, in the same way that they would consider and respond to any other stakeholder engagement feedback on airspace design options and will look for evidence of this within the ACP's final submission.

241. Having decided in March 2021 to refresh its approach to the airspace classification review task and adopt a regional approach, the Airspace Classification Team published a report in August on the Cotswold Region with an accompanying survey seeking local views on the use of this airspace and any associated issues. The team also sought to identify whether stakeholders had

views, besides reclassification of airspace, as to potential solutions to these issues.[26] After the survey closed at the end of September, the team has been conducting detailed analysis on the survey findings using air traffic surveillance data. The results will be discussed with appropriate airspace control authority before producing an initial plan, with a view to consult on this towards the end of the year, and to use the findings of this consultation to develop a final plan of volumes which will be taken forward to the amend phase in the Spring of 2022.

3.7.5. Enabling greater airspace access and integration

242. The content of table 24 illustrates how the UK's airspace is a finite resource that is in growing demand. Commercial air transport was the main source of new demand during the last three decades, leading to new volumes of controlled airspace, sometimes at the expense of operations outside. Traffic levels are forecast to continue growing steadily out to 2040, following recovery from the pandemic. Most general and business aviation operations are forecast to remain stable or continue growing slightly over the next decade. UAS and AAM operators are a significant source of new demand. Requests from UAS operators for temporary danger areas to segregate their testing and commercial activities from other users in uncontrolled airspace have increased by over 200% per year since 2018. This trend has demonstrated that the conventional approach to segregating airspace structures that separate the operations of different user groups is increasingly limited by the impacts on access and efficiency. Continued segregation of airspace user groups based on the nature of their operation is considered unsustainable. New airspace structures, technology and operational concepts are required to integrate all users safely and efficiently.

243. The use of electronic conspicuity technology in UK airspace supports a common goal laid out in the AMS: to strengthen the 'see and avoid' principle for aircraft operating under Visual Flight Rules (VFR) with the ability to 'detect and be detected', so that all users in a given volume of airspace can 'see, be seen and avoid'. In this context, electronic conspicuity (EC) is an umbrella term for technologies that are used to help pilots and air traffic services to improve their situational awareness. EC technologies include the airborne devices and ground-based systems that enable information about an aircraft's position, trajectory and speed to be transmitted and received.

244. There is an expectation across all airspace user groups that progressively more formal requirements to carry appropriate EC devices in specific volumes of airspace are necessary and pending. In conjunction with the widespread adoption of interoperable EC technologies, the Masterplan ACPs are expected to enable greater sharing and integration of UK airspace structures, especially at lower altitudes, with the objectives that:

- All users are able to readily access volumes of airspace that are suitably sized and sited to support the nature of their operations.

[26] Airspace Classification Review, Cotswold Report, CAA, 2021. [link]

- The UK is able to take advantage of technologies that support the safe and efficient provision and integration of new aviation products and services offered by UAS, AAM and eVTOL operators.
- The likelihood of mid-air collisions (MAC) is reduced in volumes of airspace where there is considered to be a serious risk that MAC poses a threat to people engaged in flying or to people on the ground.

245. The roadmap for the evolution of EC technologies and their use in the modernisation of UK airspace, including the concepts required to maximise access and integration should be further refined in close collaboration with all airspace user groups during the development of Iteration 3.

3.7.6. Military airspace users requirements for segregated airspace

246. It should be noted that a wide range of defence aerodromes and airspace utilised by defence in support of Government tasking, are located adjacent to, or in the vicinity of, major and minor UK airports that have been included in this Masterplan. As defence evolves, inventories are updated and UK regulatory requirements are finessed, there will be a need to ensure that operating bases are permitted to continue in a safe, efficient and regulatory compliant manner. A joint and fully integrated approach will be critical to cohering the evolution of defence requirements with the UK's Masterplan.

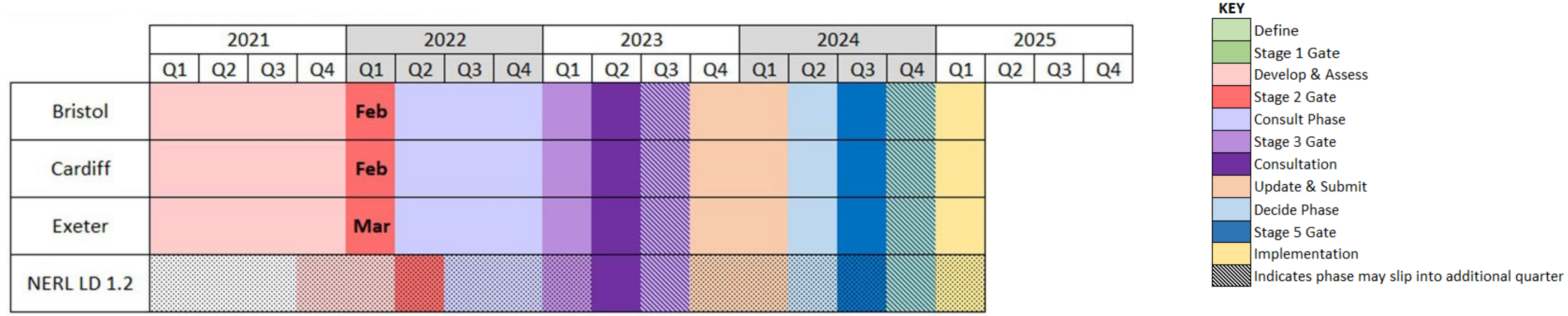
247. With the introduction of 5th generation aircraft, an increase in aircraft and air system numbers, the development and use of new technologies to support defence outputs, test and evaluation, training and cooperative exercise airspace must be available to MoD. Airspace available should provide aircrew, controllers, operators and air system operators the ability to perform the entirety of the task required of them. Tasking ranges from simulating realistic ingress/egress distances and weapons employment for all mission sets, while defending against enemy tactics in a contested environment, all the way to allowing for a bounded assessment of new weapon(s) system(s) or emergent Electronic Warfare (EW) capabilities. Much of the current Special Use Airspace (SUA) was developed to support now defunct tactics, equipment and retired aircraft and is not optimal for current mission sets or emerging requirements/technological advances. In recognising that extant SUA may not be appropriate for defence's evolving requirements, the Defence Airspace Suitability Review (DASR) has been initiated. The DASR will inform the Defence Airspace Strategic Plan (DASP) out to 2035 and beyond. The DASR and DASP will be available to complement the UK's Masterplan in future iterations.

248. The Advanced Flexible Use of Airspace (AFUA) concept that allows the booking and release of temporary segregated airspace increases the flexibility of the existing and future system to meet MoD's evolving requirements, while minimising the impacts on commercial air transport. Notwithstanding these flexible structures, there will always be a requirement for some airspace reservations of a static nature. Fixed Airspace Reservations will exist as permanent airspace structures that follow 'need to operate' principles, such that utilisation is minimised to the extent

required to do the job. Wherever possible, the dimensions of these structures will be reduced as much as possible and only segregated for the minimum period possible under agreed protocols following FUA principles.

Appendix A: Indicative programme plan by regional cluster

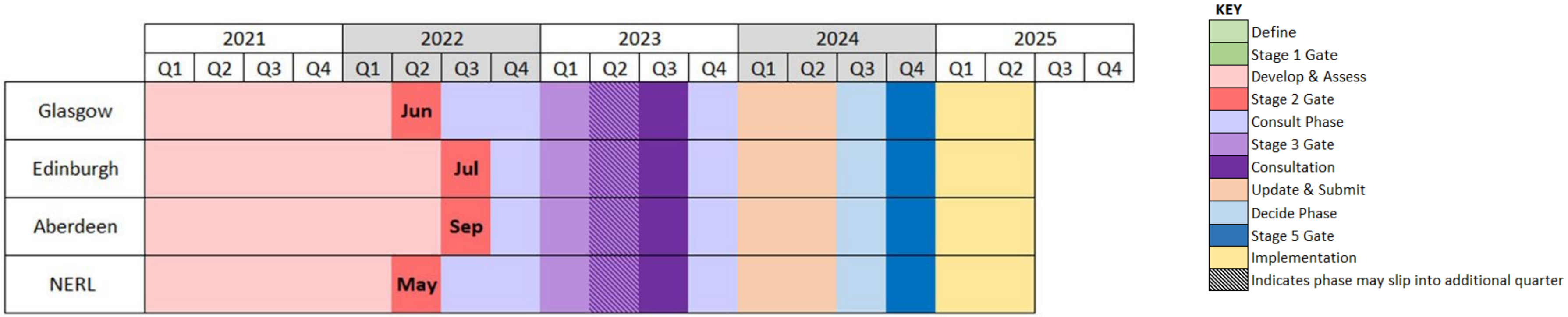
West TMA Programme Plan



Planning caveats included for Iteration 2 of the Masterplan

Unless stated, Stage gates are provisional estimates only and are to be agreed in consultation with the CAA and sponsors once further planning has been completed	Consultation windows are for illustrative purposes only and will be confirmed once supporting strategies, planning and documentation are sufficiently mature	NERL LD1.2 ACP currently under review - CAP1616 windows are indicative only

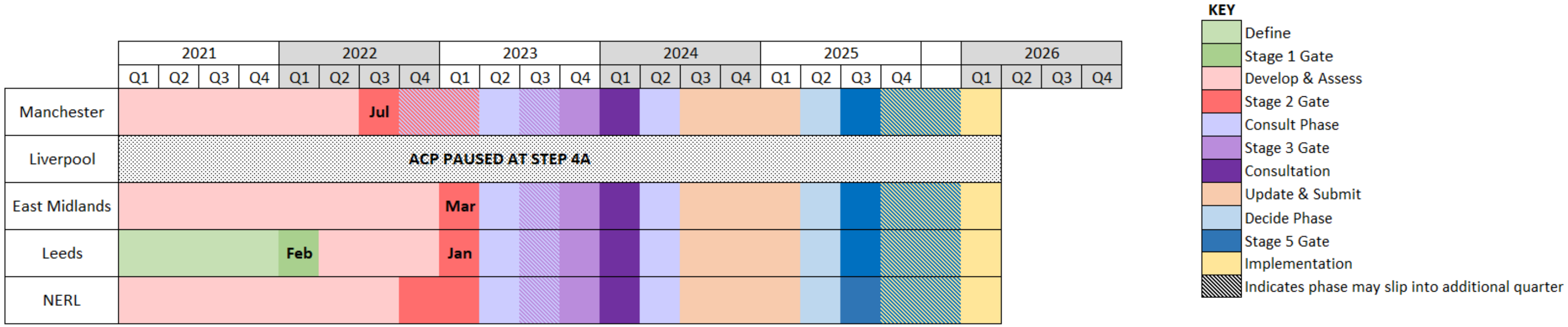
Scottish TMA Programme Plan



Planning caveats included for Iteration 2 of the Masterplan

Unless stated, Stage gates are provisional estimates only and are to be agreed in consultation with the CAA and sponsors once further planning has been completed	Consultation windows are for illustrative purposes only and will be confirmed once supporting strategies, planning and documentation are sufficiently mature

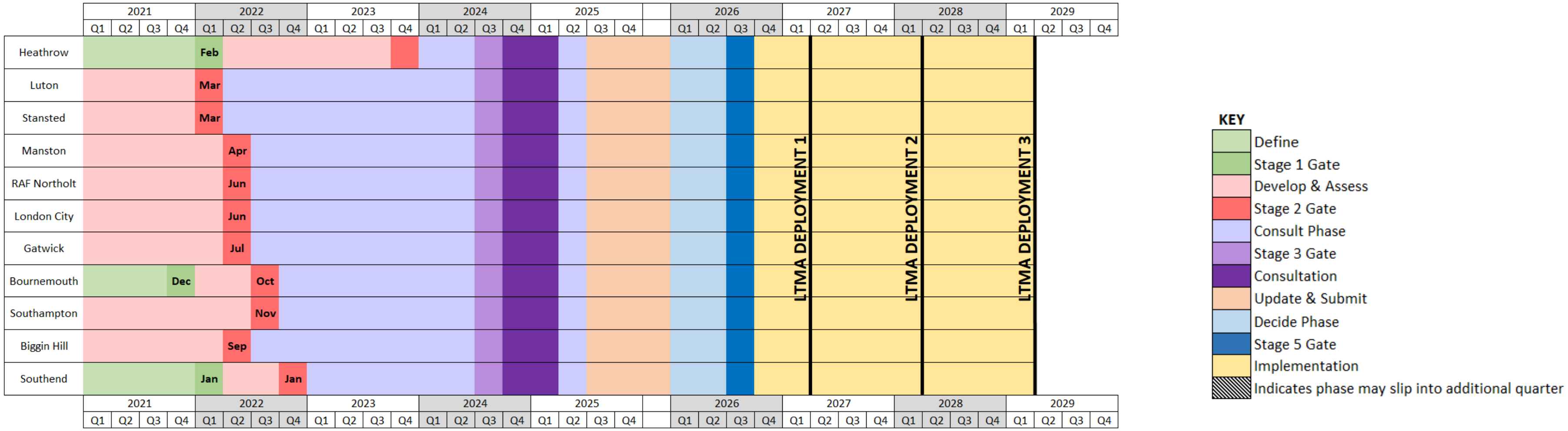
Manchester TMA Programme Plan



Planning caveats included for Iteration 2 of the Masterplan

Unless stated, Stage gates are provisional estimates only and are to be agreed in consultation with the CAA and sponsors once further planning has been completed	Consultation windows are for illustrative purposes only and will be confirmed once supporting strategies, planning and documentation are sufficiently mature	Aim is for a deployment in Q1 of 2026	Liverpool ACP currently paused at Stage 4 awaiting restart decision

London TMA Programme Plan



Planning caveats included for Iteration 2 of the Masterplan

Unless stated, Stage gates are provisional estimates only and are to be agreed in consultation with the CAA and sponsors once further planning has been completed	Consultation windows are for illustrative purposes only and will be confirmed once supporting strategies, planning and documentation are sufficiently mature	LTMA deployments will fall in Q1 of each year from 2026 onwards	Sponsors have not yet been grouped into deployment clusters within the LTMA. These clusters will be confirmed once deployment plans are sufficiently mature

Appendix B: Record of stakeholder feedback and its influence

Summary of feedback (You said)	Feedback theme	Has the feedback been considered? Yes (Y) Not applicable (NA)	Outcome (We did)
Clarification and reassurance that the Masterplan will relate to the AMS as it is currently being reviewed by the CAA.	AMS/CAP1616 Review	Y	▪ The Masterplan will be developed through an iterative approach. ▪ This will allow ACOG to consider any changes in Policy during the development of each successive iteration. ▪ The proposed approach to developing Iteration 3 will be captured in Iteration 2 together with the engagement programme required to continue to capture and consider feedback from stakeholders. ▪ ACOG is engaging with the CAA to incorporate feedback from the AMS stakeholder review that is relevant to the development of the Masterplan.
There is a risk about the transition arrangements for existing ACPs in the Programme if both the AMS and CAP1616 is under review.	AMS/CAP1616 Review	N/A	▪ This feedback has been passed to both the CAA's airspace modernisation and airspace regulation teams for further consideration. ▪ ACOG regularly meets with the CAA's airspace modernisation team to consider the potential impacts of changes in policy and process on the Masterplan. ▪ The CAA will keep ACOG up to date with its progress and highlight any impacts that they expect may to arise for ACPs in the Programme. ▪ It is the CAA's responsibility to develop any transition arrangements required for in-train ACPs when changes to policies and processes are made.
Defence resources use swathes of airspace and these need to be	Impact on other airspace users	Y	▪ ACOG will continue to engage with DAATM through the development of successive iterations of the Masterplan

considered in the Masterplan so that they can continue their activities with minimal disruption.			to capture and consider the interdependencies associated with military operations, airspace use and ACPs.
Would it sense to define the Programme from a top down (State led) rather than a bottom up (commercial led) approach?	Policy	N/A	▪ The UK has a competitive airports market. Each airport operator is responsible for maintaining the routes that serve their arrival and departures between the ground and 7000ft. ▪ The regulatory airspace change process advocates a bottom-up approach with individual sponsors owning the proposal and incorporating stakeholder considerations as it develops. ▪ A commercial approach can make the co-ordination of the Programme at a system wide level more challenging, which supports the need for a Masterplan. ▪ A centralised, State led approach to the development of a system-wide airspace upgrade would require fundamental changes to the current policies and process that underpin airspace change. This feedback has been passed to both the CAA's airspace modernisation and airspace regulation departments.
The GA impact assessment should not only consider Class G airspace.	Impact on other airspace users	Y	▪ Agreed. We have taken this feedback onboard. ACOG recognises that the assessment should cover the impact on all airspace users in all classes of airspace.
How is the CAA's Airspace Classification Review being considered?	Airspace classification	Y	▪ Iteration 3 of the Masterplan will show how the relevant outputs from the airspace classification review are being tracked by the constituent ACP sponsors during the development and assessment of their airspace design options. ▪ ACOG is working with closely with ACP sponsors and the airspace classification review team to identify further opportunities to release controlled airspace as part of the Programme.

How are RPAS operations being considered?	Impact on other airspace users	Y	▪ Section 3.7 provides a general qualitative assessment of the impact on other airspace users including RPAS operations (captured under UAS). This assessment will be refined, working in collaboration with UAS stakeholder representatives during the development of Iteration 3.
The noise impacts of airspace changes were raised and how these would be dealt with in the Masterplan.	Noise impacts	Y	▪ Stakeholders are directed to familiarise themselves with the first of the Government's key environmental objectives set out in the Air Navigation Guidance (2017) which states that airspace changes are to: **1. Limit and, where possible, reduce the number of people in the UK significantly affected by adverse impacts from aircraft noise.** This objective is broken down in the Altitude Based Priorities section of the ANG to; limit and where possible reduce noise below 4000ft; and minimise noise providing there is no significant CO_2 cost between 4000ft. and 7000ft.) ▪ The Masterplan and the component ACPs must demonstrate how this objective will be achieved as part of their proposals to the CAA's satisfaction (not ACOG's), otherwise, they will not be approved/accepted.
Future engagement opportunities.	Engagement	Y	▪ ACOG will continue to engage with the AMS stakeholders representatives throughout the development of all iterations of the Masterplan. ▪ An extensive stakeholder engagement programme will accompany the development of Iteration 3. ▪ A Masterplan Resource Centre has been developed as part of ACOG's website detailing all the delivered and future engagement activities, and a library for all relevant documentation.
It needs to be clear in engagement materials that additional capacity is a requirement to	Engagement	Y	▪ ACOG will make it clear in Iteration 2 of the Masterplan and in all engagement activities and associated materials that capacity is a key driver for change.

accommodate growing demand for aviation.			
How will trade-offs be decided when resolving the interdependencies between the airports' designs? These trade-off decisions can create different potential impacts and the concern was raised that these decisions would be made in the absence of any community input.	Trade-off decisions/Engagement	Y	▪ ACOG will influence how the engagement between the sponsors on trade-off decisions is delivered and ensure that the analysis is undertaken thoroughly to an agreed methodology. This must be done in a transparent way and the methodology needs to be clearly explained to stakeholders in an accessible way. This information will also make up part of their consultation materials on their individual CAP1616 proposals. ▪ ACOG will have an influence over how trade-offs are examined and how stakeholders are able to influence the decisions. ACOG will therefore set up a Community Advisory Panel made up of community stakeholder representatives to regularly engage with on the development of Iteration 3.
Will Heathrow be creating flight path options for a 2 and 3 runway airport? And will that uncertainty affect the Masterplan?	Optimisation	Y	The Heathrow Airport ACP included in the Masterplan focuses on the existing two runway operation. See section 2.1.8. for more information
Will the release of controlled airspace lead to an increase in operations by General Aviation and other airspace users? There is concern that this could have negative noise impacts on local communities, who may be hoping for a reduction in noise.	Airspace classification/ Noise impacts	N/A	▪ ACOG has passed this feedback to the CAA's airspace classification and airspace regulation teams.
There was concern that with this approach, some airports may be waiting for others 'catch up' in process terms and may not realise the benefits of	Policy	Y	▪ As part of Iteration 2 ACOG has proposed a 'clustered' approach to the development of Iteration 3, which will allow some clusters of proposals, once approved, to be deployed ahead of other parts of the programme. This will mean that the benefits for these

their ACPs for longer than originally expected.			clusters will be realised without waiting for the last part of the programme to be concluded.
How will airports who are not in the Programme be involved?	Engagement	Y	▪ Iteration 3 of the Masterplan will be developed in consideration of feedback received from stakeholders through a public engagement exercise. This will include seeking feedback from other airports and sponsors that are not currently part of the Programme. ▪ Sponsors of the individual airspace changes will supplement this activity through their own public consultation exercise on CAP 1616 process.
Can you slow sponsors down if they're progressing with their airspace change proposals too quickly?	Timelines	Y	▪ The Masterplan will play an important role in the sequencing of airspace changes. ACPs will be held at the relevant Stage of CAP 1616 process based on advice in the Masterplan. This will ensure options development and consultation is delivered in a coordinated, joined up manner ▪ The CAA will require a version of the Masterplan to facilitate their decision making at the relevant gateways in CAP 1616 process e.g., they will refer to the version of Iteration 3 that corresponds to the cluster of airspace changes targeting a Stage 3 Gateway when undertaking their assessments
What about impact on RPAS operations below 4000ft?	Impact on other airspace users	Y	▪ This will be a consideration taken forward in the development of Iteration 3. ▪ This feedback has been passed to the CAA for consideration in the work they are undertaking around developing a strategy for the lower levels of airspace, both within Class G and access to controlled airspace
Concern over controlled airspace take because of the Programme	Airspace classification	Y	▪ See section 3.7.4.
How will you balance environment and capacity?	Optimisation	Y	▪ See section 3.4.

What consideration was being given to residents living around airports that will be impacted by the changes, particularly health impacts?	Noise impacts		▪ This is a consideration for airport ACPs ▪ This feedback has been passed to the CAA's airspace regulation department for consideration in their CAP 1616 review ▪ Cumulative impacts will be considered and calculated through the Masterplan process
What is being done around night flights?	Noise impacts	N/A	▪ This is a policy issue; however it is possible that some more advanced concepts could be deployed at night through airport ACPs to reduce the total adverse effects.
Can ACOG set out gaps in policy?	Policy	Y	▪ Where we can evidence a policy gap in the process, we will raise it with the DfT to make them aware of it ▪ ACOG will consider how they can incorporate this point into Iteration 3 engagement
Have you considered the impacts if a sponsor leaves due to the impact of the Covid-19 pandemic?	?	Y	▪ Exit and entry criteria are considered in Iteration 2 and will also be captured be in future iterations
How will airports be consulting with stakeholders affected by more than one ACP and will they be required to consult at a similar time?	Engagement	Y	▪ This will be a consideration of Iteration 3 ▪ The individual sponsors' consultations must be able to explain the cumulative impacts of their proposals and the methods used to calculate them in an accessible way for stakeholders. The outcome of ACOGs public call for information will provide sponsors with a way in which to do this, based on feedback from stakeholders. ▪ ACOG will also continue to engage with representative stakeholders on the AMS governance structure on how trade-offs are presented in ACP consultations ▪ Sponsors of interdependent changes will be required to consult at a similar time and will aim to align their CAP 1616 Stage 3 Gateways to allow the CAA to holistically assess their consultation strategies and materials

The clarity of information provided by airports and ACOG will be crucial in any ACP given the technical nature of the issues that need to be communicated. The impacts and benefits need to be clearly communicated to stakeholders.	Engagement	Y	▪ CAP 1616 requires sponsors to create materials that do not require technical knowledge to understand and respond to it and this will be assessed by the relevant regulatory specialists throughout the process ▪ ACOG adheres to the good practice engagement guidance within CAP1616 and will adopt the principles promoted in the process when creating engagement materials for the public engagement associated with Iteration 3. ▪ The individual sponsors' consultations must be able to explain the cumulative impacts of their proposals and the methods used to calculate them in an accessible way for stakeholders. The outcome of ACOGs public call for information will provide sponsors with a way in which to do this, based on feedback from stakeholders.
Will the CAA's review of CAP1616 affect the Masterplan?	CAP 1616 review	N/A	▪ The CAA's review of the CAP1616 process is expected to consider the treatment of interdependent ACPs in greater detail, which is expected to support the Masterplan. ▪ It is the CAA's responsibility to develop any transition arrangements required for in-train ACPS. ▪ This feedback has been passed to the CAA's Airspace Regulation department.
Will ACOG take a view on mitigation proposals that are put forward by stakeholders?		Y	▪ The outcome of the individual airport's CAP1616 consultations will likely mean modifications to a proposed design. This may include mitigating proposals put forward by stakeholders for the ACP sponsors to consider ▪ Iteration 4 of the Masterplan will contain the final airspace designs, which will be the outcome of their formal CAP1616 consultation process.
A point was raised that technology is outdated, the industry is still using	Technology	Y	▪ See section 1.1.7

VHF radio, primary radars and ground based beacons. The Masterplan needs to look at how technology can be modernised along with airspace.			
ACOG said that GA impact assessment would be consistent with classification review – what does that mean?	Airspace Classification	Y	▪ ACOG is required to ensure that sponsors take into account feedback that CAA has collected from the classification review, and if not, why not? ▪ ACOG will stay connected with CAA's classification review department about their regional assessments and outputs from that will be considered in the Masterplan ▪ The Masterplan will show how the relevant outputs from the airspace classification review are being tracked by the constituent ACPs during the development of Iteration 3.
Is there a lag between sponsors modernising airspace and having the appropriate national policy for example on things like separation standards? Does ACOG have a role to push CAA to put these policies in place? Otherwise benefits of airspace changes will be limited and changes will be made ahead of these sorts of issues being resolved.	Policy		▪ The existing suite of airspace design criteria, including separation standards, is evolving as new technology is introduced to the fleet. ▪ Some sponsors/airspace designers have requested an 'airspace design toolkit' that would combine airspace separation standards, guidance on PBN procedures and likely impacts in terms of flight efficiency and noise. ▪ ACOG will continue to engage with the CAA on this point.
The CAA needs to be clear when airports are apportioning airspace change between resilience or capacity.			▪ See section 3.4.

Appendix C: Masterplan Risk Assessment at Iteration 2

1. Appendix C provides ACOG's strategic assessment of the risks facing the Masterplan at the point that Iteration 2 is submitted to the co-sponsors for assessment (December 2021). The strategic risk assessment concentrates on threats to the successful delivery of the Programme associated with four themes; 1) Financial, 2) Scope 3) Environment and 4) Consultation and Engagement. A narrative description of the size and nature of the risks and planned actions to mitigate them are set out below.

Financial

2. The effect of the Covid-19 pandemic on the financial viability of the aviation industry as a whole may preclude airports in the Programme being in a position to continue with their ACPs beyond FY21/22. Despite the remobilisation of the Programme following the provision of DfT grant funding, the airport ACP sponsors continue to operate under significant financial constraints that may limit their ability to invest in airspace developments in the near term. Airports are largely dependent on income received principally from airline user charges and also on-airport merchandise sales to travelling customers. Both of these income streams have plummeted since the onset of the Covid-19 pandemic and it is not anticipated that a return to near normal situation will be achieved by 2023 at the earliest.
3. Airport sponsors that cannot access the necessary investment could fall behind and the timeline for delivery of the constituent ACPs in each regional cluster might become significantly misaligned. Due to the ACP interdependencies that exist and the coordination required through the Masterplan, this could lead to significant non-linear delays to benefits realisation. A key mitigation to this risk relies on the third tranche of government grant funding for FY2022/23 to maintain momentum towards Iteration 3 and bring the Programme coherently to the end of the stage 2 CAP1616 process. That this funding might not materialise is a risk in itself. The potential need for additional future funding creates a second financial risk. Both risks have the potential to destabilise the programme by iteration 3 of the Masterplan. ACOG is working with the CAA and Department of Transport to examine the potential for future government support to the Programme.

Scope

4. Uncertainty surrounding the scope and timeframe of plans to introduce additional runway infrastructure in the south-east of England may make it difficult for the airports and NERL to determine the required scope of their ACPs and the nature of the dependencies between them. For example, Heathrow Airport has started a new ACP based on a two-runway configuration, but there is uncertainty regarding how much flexibility should be designed into the airspace system longer-term to enable a possible three-runway operation at a point in the future. Gatwick has plans to utilise additional existing infrastructure to increase runway capacity. The challenge will be to try and determine how much flexibility can be built-in to airspace design to 'future proof'

possible expansion plans, acknowledging that regulatory policy is explicit that future ACP options will not be permitted to disadvantage existing ACPs created under this Masterplan.

5. Strategic changes to the policy and regulatory framework that guides (and mandates) the development of airspace change proposal have the potential to hinder progress in developing the constituent ACPs and the policy objectives they should meet. For example, it is likely that the current review of the AMS and related guidance could result in a significant increase in scope to accommodate commercial UAS, AAM and eVTOL operators into the current controlled airspace structures. The Government is also expected to publish a Transport Decarbonisation Plan, an updated Aviation 2050 strategy and a framework for the sustainable recovery of the aviation sector; all of these have the potential to affect to a greater or lesser degree, the next iteration of the Masterplan.

Environment

6. Environmental performance may become a dominant feature in airspace design requirements resulting from policy or regulatory changes as outlined above. These in turn risk environmental impact conflicts in the complex terminal airspace that could lead to ineffective or inconsistent trade-offs between capacity, access and environmental factors. This could result in suboptimal airspace design outcomes. The emerging ACOG environment strategy is designed to mitigate this risk and provide the opportunity to optimise and future proof environmental performance, maximising opportunities to limit and where possible reduce the adverse impacts of aircraft noise and make a substantial contribution to reducing aviation's carbon footprint in real terms.

7. The Strategic Environment Assessment (SEA) (required as part of the Masterplan acceptance process) and its application and integration with the CAP1616 environmental impact assessment requirements present a timing and scope risk. Dealing with environmental assessment factors on a regional cluster basis (i.e. in line with the geographically co-located ACPs grouped in their clusters) would mitigate this risk for Iteration 3. This would entail taking an incremental approach, using the CAP1616 environment impact assessments per ACP and finalising the cumulative effects and trade-offs within a cluster. Once finalised, the cluster data within each region could be combined into a set of final outputs to produce a strategic assessment of the whole Programme on a national basis. The SEA would need to be timed to inform the Masterplan such that any changes necessitated by the assessment could be made coherently.

Consultation and engagement

8. Critical to success is the constituent ACP sponsors' public consultations with local communities and other stakeholders and the preceding ACOG-led public engagement exercise on Iteration 3 that describes the combined effects of the multiple interdependent proposals. There is a risk that the scope of multiple ACP consultations and engagement activities may be too expansive (and expensive) and complex for the sponsors and ACOG to manage in a consistent and coherent manner. This could cause delays to the Programme and defer the overall airspace optimisation process. In the lead up to Iteration 3, part of the ACOG communications strategy sets out a series of public information interventions as well as an on-going drum beat of airspace information via

its website and multiple other media channels. These are designed to provide an incremental narrative that will position Iteration 3 for an informed debate by all stakeholders as the public engagement exercise commences.

Appendix D: Assumptions Log at Iteration 2

1. Table 25 identifies the key set of assumptions that underpin the Masterplan at Iteration 2.

Table 26: Key assumptions underpinning the Masterplan at Iteration 2

#	Description of assumption made:
1	All airport ACP sponsors will design new arrival and departure procedures up to 7000ft and NERL will design the airspace structures and route network above 7000ft.
2	CAP1616 is sufficiently flexible to accommodate multiple, interdependent ACPs.
3	The constituent ACPs in the programme are developed in line with the existing policy and regulatory framework.
4	The constituent ACPs will be implemented in four 'clusters' due to the relative size and complexity in each region.
5	ACPs within a cluster should be deployed concurrently as a single, integrated activity due to the interdependencies that exist.
6	A coordinated approach between constituent ACPs will remain throughout the programme in order to optimise the overall Airspace System in each cluster and mitigate the negative impacts.
7	There may be some network interdependencies between regional clusters.
8	All airport ACPs within a cluster share interdependencies with the network above.
9	Pre-Covid-19 traffic levels will return by 2025 and continue to grow leading to the UK airspace system being capacity constrained.
10	Each constituent ACP will be implemented in a defined deployment window based on the existing AIRAC process.
11	Constituent ACPs will have to be implemented during specific AIRAC cycles which will be determined by the size, complexity and interdependencies of the respective proposals.
12	It is assumed that the ATC training requirement and the size of the Heathrow ACP means that the full change will not be implemented in one deployment.
13	Core LTMA deployments that include Heathrow must be divided into a minimum of three windows separated by 12-month intervals and cannot begin before 2027.
14	The CAA Airspace Regulation department has sufficient resources to handle the multiple, interdependent regulatory assessments required.
15	For the ACP interdependency analysis, the scope of each airport-led ACP is determined by the definition of separate arrival and departure areas for each runway end from the ground to 7000ft and may not take account of particular design requirements at this stage.

16	For the ACP interdependency analysis, the definition of the arrival and departure areas is not constrained by any existing airspace restrictions.
17	For the ACP interdependency analysis, departure airspace sections start at the runway threshold (at 0ft above mean sea level).
18	For the ACP interdependency analysis, the arrival and departure airspace sections are based on a continuous descent / climb rate for each airport.
19	The constituent ACPs should work together to coordinate consultation and engagement activities that have the potential to affect the same stakeholder groups.
20	ATC vectoring will still be required following the implementation of airspace modernisation to deliver runway throughput.
21	The use of 'holds' will still be required following the implementation of airspace modernisation in order to optimise runway throughput and for contingency purposes.
22	The current UK airspace system and associated ATC operation may be a constraint on the redesign.
23	Other airspace change proposals may be introduced into the Masterplan later in the development process to provide additional benefit.
24	The programme plan will change (unless stated, data is provisional and to be agreed in collaboration with the CAA and sponsors once further planning has been completed).
25	The consultation windows are for illustrative purposes only and will be confirmed once supporting strategies, planning and documentation are sufficiently mature.

Appendix E: Commitment of the ACP sponsors

1. The original commissioning letter from the co-sponsors to NERL of 2 November 2018 requires the Masterplan to identify the party responsible for taking each individual airspace change forward and the degree of commitment offered by each individual party.

2. The provision of DfT grant funding has enabled the remobilisation of the Programme which paused in March 2020 due to the effects of the Covid-19 pandemic. The large majority of organisations sponsoring Masterplan ACPs have remobilised their teams and restarted their proposals in line with CAA regulatory guidance. In addition, Heathrow airport and Leeds Bradford airport have both started a new ACP with a new Statement of Work. All sponsors in the programme have a CAP1616 stage gateway booked and are working towards submission of documentation ahead of regulatory assessment.

3. The one exception is Liverpool airport, because due to the misalignment of timelines before the Covid-19 pandemic, the Liverpool ACP is currently paused at step 4A. Liverpool is working with ACOG and AMS co-sponsors to determine how best to integrate its proposal into the wider programme given the low-level and network interdependencies that exist with Manchester airport and NERL respectively.

4. All Masterplan ACP sponsors have been engaging with programme-wide activities including senior-level representation at the UK airspace change programme board, the top level of the programme governance structure, which is chaired by ACOG. At a working level, sponsors are engaged with ACOG-led activities primarily designed to ensure the coordination of proposals and to mitigate programme-wide risks due to the complexity and scale of integration and implementation activities. At this stage of the Programme there is no evidence to suggest a lack of commitment from any participant. The situation will be monitored as ACP sponsors move through the first two stages of the CAP1616 process and continue to integrate their plans and design options to optimise the system wide design. A further update on sponsor commitment will be provided in Iteration 3 of the Masterplan.

5. Table 26 provides an outline of the work completed to date following programme remobilisation in Q2 2021 and demonstrates the commitment to the Masterplan at this time.

Table 27: Status update demonstrating commitment of the ACP sponsors to the Masterplan

Sponsor / ACP ID	Current Status	Mobilisation	Progress since programme remobilisation
Bristol Airport ACP-2018-55	In progress, Step 2A	ACP restart approved by CAA – 12th May '21	Developing and assessing options with Stage 2 gateway assessment planned for February 2022. Working with WTA sponsors on plans to ensure alignment of project work where dependencies exist.

Cardiff Airport ACP-2019-41	In progress, Step 2A	ACP restart approved by CAA – 16th June '21	Developing and assessing options with Stage 2 gateway assessment planned for February 2022. Working with WTA sponsors on plans to ensure alignment of project work where dependencies exist.
Exeter Airport ACP-2018-47	In progress, Step 2A	ACP restart approved by CAA – 9th September '21	Developing and assessing options with Stage 2 gateway assessment planned for March 2022. Working with WTA sponsors on plans to ensure alignment of project work where dependencies exist.
Edinburgh Airport ACP-2019-32	In progress, Step 2A	ACP restart approved by CAA – 19th May '21	Passed Stage 1 gateway in July 2021 and are now working on developing options with a Stage 2 gateway assessment planned for July 2022. Working with STMA sponsors on plans to ensure alignment of project work where dependencies exist.
Glasgow Airport ACP-2019-46	In progress, Step 2A	ACP restart approved by CAA – 19th May '21	Developing and assessing options with Stage 2 gateway assessment planned for June 2022. Working with STMA sponsors on plans to ensure alignment of project work where dependencies exist.
Aberdeen Airport ACP-2019-82	In progress, Step 2A	ACP restart approved by CAA – 6th August '21	Developing and assessing options with Stage 2 gateway assessment planned for September 2022. Working with STMA sponsors on plans to ensure alignment of project work where dependencies exist.
Manchester Airport ACP-2019-23	In progress, Step 2A	ACP restart approved by CAA – 23rd June '21	Developing and assessing options with Stage 2 gateway assessment planned for July 2022.
East Midlands Airport ACP-2019-44	In progress, Step 2A	ACP restart approved by CAA – 23rd June '21	Work planned to restart in January 2022 with Stage 2 gateway assessment currently planned for March 2023.
Leeds / Bradford Airport ACP-2021-66	In progress, Step 1B	New ACP	Statement of Need submitted in September 2022 and assessment meeting held with the CAA in October. Define (Stage 1) gateway planned for February 2022.

Liverpool Airport ACP-2015-09	Paused, Step 4A	N/A	Currently working with ACOG and AMS co-sponsors to determine how best to integrate their proposal into the wider programme given the low-level and network interdependencies that exist with Manchester airport and NERL respectively.
London Heathrow Airport ACP-2021-56	In progress, Step 1B	New ACP	Statement of Need submitted in August 2022 and assessment meeting held with the CAA in September. Define (Stage 1) gateway planned for February 2022.
London Luton Airport ACP-2018-70	In progress, Step 2A	ACP restart approved by CAA – 9th June '21	Developing and assessing options with Stage 2 gateway assessment planned for March 2022. Collaborating with ACOG and other LTMA sponsors on combined programme plan including implementation options.
London City Airport ACP-2018-89	In progress, Step 2A	ACP restart approved by CAA – 21st May '21	Developing and assessing options with Stage 2 gateway assessment planned for June 2022. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
London Southend Airport ACP-2018-90	In progress, Step 1B	ACP restart approved by CAA – 4th August '21	Stage 1 gateway assessment planned for January 2022. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
London Gatwick Airport ACP-2018-60	In progress, Step 2A	ACP restart approved by CAA – 21st May '21	Developing and assessing options with Stage 2 gateway assessment planned for July 2022. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
London Stansted Airport ACP-2019-01	In progress, Step 2A	N/A – ACP remained active through programme pause	Developing and assessing options with Stage 2 gateway assessment planned for March 2022. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
London Biggin Hill Airport ACP-2018-69	In progress, Step 2A	ACP restart approved by CAA – 21st May '21	Developing and assessing options with Stage 2 gateway assessment planned for September 2022. Collaborating with ACOG and other LTMA

			sponsors on the combined programme plan including implementation options.
Southampton Airport ACP-2019-03	In progress, Step 2A	ACP restart approved by CAA – 30th June '21	Developing and assessing options with Stage 2 gateway assessment planned for January 2023. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
RAF Northolt ACP-2018-66	In progress, Step 2A	ACP restart approved by CAA – 24th June '21	Developing and assessing options with Stage 2 gateway assessment planned for June 2022. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
RiverOak Strategic Partners (Manston Airport) ACP-2018-75	In progress, Step 2A	N/A – ACP remained active through programme pause	Stage 2 gateway assessment planned for April 2022 following previous failed gateway. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.
Bournemouth Airport ACP-2019-43	In progress, Step 1B	ACP restart approved by CAA – 30th June '21	Stage 1 gateway assessment planned for December 2021. Collaborating with ACOG and other LTMA sponsors on the combined programme plan including implementation options.