Future Airspace Strategy Implementation South (FASI-S)

Bristol Airport

Gateway documentation:
Stage 2 Develop and Assess

Step 2A (i) Options Development

Sign-Off

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Issue 2.0	17/06/2022	Updated following CAA feedback to include engagement with AoNBs and further information on design option engagement.

Contents

Introduction

This document forms part of the document requirements under the CAA's CAP1616 Airspace Change Process: *Stage 2 Develop and Assess, Step 2A (i) Design Options.*
The purpose of this document is to outline Bristol Airport's comprehensive design options that address the Statement of Need which can be found on the portal (link). It will also describe the engagement Bristol Airport undertook with stakeholders and how the feedback from these activities fed into the design options.

This document should be read in conjunction with documents:
Stage 2 Develop and Assess, Step 2A (ii) Design Principles Evaluation

Stage 2 Develop and Assess, Step 2B Options Appraisal (phase I – Initial)

Statement of Need

Bristol Airport submitted a Statement of Need to the CAA in October 2018 which initiated this Airspace Change Proposal (ACP). The Statement of Need sets out the change sponsor's (Bristol Airport) reason for change such as what airspace issue or opportunity it is seeking to address.

Bristol Airport's Statement of Need outlined the context behind airspace modernisation for Bristol Airport specifically but also across the whole UK. The following issues are provided, which Bristol Airport seeks to address:

- *Minimise flight paths above populated areas, where possible, up to 7,000ft in order to reduce noise impacts.*
- *To reduce emissions through minimisation of additional track miles associated with where aircraft fly today.*
- *To alter where Bristol Airports main air traffic Hold is.*
- *To seek flexibility on the borders of controlled airspace (CAS) with other airports within the vicinity of Bristol Airport to allow for the continual use of RNAV technology as a default method of navigation.*

The Statement of Need also outlines that this proposal must ensure coordination with the wider Future Airspace Strategy Implementation for the South (FASI-S) and align with the CAA's Airspace Modernisation Strategy (CAP1711).

Design Principles

Bristol Airport constructed a set of draft Design Principles – seeking to fulfil their Statement of Need - and engaged a representative group of aviation industry and community stakeholders on this draft list. Stakeholders were invited to formal workshops to discuss the Design Principles and provide their feedback on the draft set provided by Bristol Airport.

This feedback was analysed and used to update a final set of Design Principles. Bristol Airport submitted the final Design Principles – alongside evidence of engagement - to the CAA in December

2019, which were subsequently approved in January 2020. Detail on the engagement activities, feedback received and how this influenced – or did not – the final set of Design Principles can be found in the Stage 1B Design Principles document which can be accessed on the portal (link).

Design Work Inputs

During the Stage 2 options development work the Statement of Need and Design Principles, described above, were used to inform, and steer the design options. Alongside these, the following sources were also used as input for the long list of design options:

1) Bristol Airport requirements on London Airspace Modernisation Project (LAMP)

These are the requirements Bristol Airport put on the network LAMP project, which will systemise and update routes which feed traffic into and out of Bristol. They include requisites such as the network providing a delay absorption method (such as a traditional holding facility) which is not overhead the airport and caters for the future predicted traffic growth.

2) Operational issues identified from the Air Traffic Control (ATC) Safety Survey (2018)

Concerns raised in the safety survey included:

- The current holding location causes operational difficulties including loss of traffic identification in the radar overhead and label garbling.
- The holding capacity is stretched during peak periods.
- Airspace to the south of Bristol Airport hinders lateral separation on downwind legs, no ability for parallel tracks.
- Airspace to the northeast of Bristol Airport was set at levels when Colerne, Filton and Lyneham Aerodromes were open. The relatively high base levels are not complementary to continuous decent profiles and tactical vectoring.
- Relatively late presentation of traffic from the west of Bristol Airport hinders proactive traffic planning. Downwind and base legs for Runway 09 are problematic and not favourable for effective vectoring.
- Runway capacity - 2-minute departure separation does not accommodate growth aspirations.
- Current Area Navigation (RNAV) Standard Arrival Routes (STAR) are insufficient to meet growth and environmental aspirations.
- Current routes for arrivals and departures do not lend themselves towards a systemised approach of air traffic management and require high levels of ATC and pilot input.

3) Results from Analytics future capacity study commissioned by Bristol Airport (2018)

The following recommendations were made to Bristol Airport:

- Additional CAS may be required for a future increase in traffic movements, particularly to the south of the airport.
- Revised Standard Instrument Departures (SID) and STARs should be designed to reduce tactical intervention and workload of both pilots and ATC.
- Relocation of the Hold away from its current location (in the overhead).
- 7NM Arrival/Departure/Arrival (ADA) separations.
- Traffic allocated to 'north' and 'south' 1 min split SIDs (to increase from the 30/hr departure limit which currently exists).

Design Options Development

Initial Design Options Long-List

Following the approval of the Stage 1B Design Principles in January 2020, Bristol Airport began work on a long list of design options. Initially subject matter experts from Bristol Airport air traffic control and operations alongside representatives from Cardiff Airport and NATS En Route Ltd (NERL) took part in design workshops to generate broad design ideas.

This group of representatives was able to provide technical input used to understand the parameters for feasible design options. The workshops resulted in broad design option illustrations for arrival, departure and Holding options for Bristol Airport alongside a description for each. This initial long list was then engaged on with stakeholders as described below.

Options Development Engagement

The long list of design options presented in this document were developed through two-way engagement with the same stakeholders who were involved in Stage 1B, as described above. A full list of stakeholders can be found in Appendix C and a summary of all engagement activities can be found in Appendix D.

We are aware of neighbouring and interdependent airspace changes being proposed under the Masterplan programme. Bristol Airport has included relevant change sponsors – including Exeter Airport and NERL – as key stakeholders to its design work. Bristol Airport sits alongside these change sponsors within the regional West Terminal Airspace (WTA) Deployment of upcoming UK airspace change. We recognise that is imperative that we work alongside these change sponsors (alongside our other stakeholders) to ensure that airspace changes are developed through engagement and where possible, mutually beneficial. This has not only allowed different change sponsors to provide feedback on design options but also to identify potential shared issues or benefits.

Design workshops with representative aviation stakeholders started in February 2020. The workshops were structured identically whereby participants were provided with a presentation on Bristol Airport's requirement for an airspace change and its involvement in the UK-wide airspace modernisation programme of work. This included background information on other relevant airspace change which Bristol Airport's ACP could impact and vice versa e.g., potential for shared benefits or overlapping design options.

The majority of time at each workshop was spent discussing our initial list design options with attendees encouraged to submit ideas and identify any pros/ cons on those already discussed. For example, the positioning of some route options were updated to reflect areas of known military activity or where improved GA access was a desire. We encouraged attendees to consider potential impacts, both positive and negative, which was all captured. As covered in the engagement minutes, noted below, stakeholders were overall content with the original long list of design options and provided pros and cons from their perspective.

Stakeholders were also provided with Bristol Airport's Design Principles and asked to consider these throughout the design discussions. The feedback received has also been able to inform the Step 2Aii Design Principle Evaluation and Step 2B Initial Options Appraisal.

We summarised the feedback and used it to further refine the design options. The notes of these workshops have all been provided to the CAA as evidence in support of this Stage 2 submission.

Impact of Covid

In March 2020, Bristol Airport paused its ACP due to the impact of the Covid-19 pandemic. The pandemic had a direct impact on resources and priorities at the airport and therefore the ACP was put on hold.

In March 2021, the Department for Transport (DfT) and CAA announced that the government would provide financial support for the FASI-S programme and its associated change sponsors, including Bristol Airport. This was provided due to the financial impact of the pandemic, alongside the government's commitment to support airspace modernisation and decarbonisation. This funding would allow Bristol Airport to continue through Stage 2 of their ACP.

Following the government funding announcement, Bristol Airport submitted a form to the CAA providing evidence and justification for restart of a paused ACP, in April 2021. This summarised Bristol Airport's commitment to continue with its ACP and confirmed that there was no change to the scope of the change, including the original Statement of Need.

In June 2021 Bristol Airport contacted all their stakeholders via email to inform them that the ACP had been restarted. The email included information on the wider UK airspace modernisation strategy which Bristol Airport's ACP is in support of. Bristol Airport also provided information on the next steps of their Stage 2 Develop and Assess work. This includes further engagement with stakeholders, whereby Bristol Airport will provide an update on the design work prior to formal submission to the CAA.

Continued Design Options Development

Following formally restarting its ACP, Bristol Airport continued work on the Stage 2 design options from June 2020. This included collating feedback from the previous design workshops and working on the supporting documentation (*Design Principles Evaluation and Initial Options Appraisal*).

In November 2021, Bristol held two online presentations to which all stakeholders, who were identified during Stage 1, were invited. These included local stakeholders – such as councillors and community representatives – alongside aviation stakeholders who may be impacted by Bristol Airport's airspace change. The meetings were held online in line with covid restrictions at the time alongside being cognisant of a potential reluctance for participants to travel and attend in person. As summarised in Appendix B below, attendees were provided with an update on Bristol Airport's Stage 2 design work and invited to ask questions throughout the presentations thus fulfilling the two-way engagement requirement.

There were a few occasions when stakeholders had been omitted or the wrong contact information had been used when the engagement email was sent out. In these instances, Bristol Airport offered additional engagement sessions where the same information described above was presented, feedback invited and captured, and this was used to further inform the Design Principles Evaluation and Initial Options Appraisal. As summarised in Appendix B, additional engagement sessions were held with the MoD, BGA and environmental board organisations (Areas of outstanding Natural Beauty).

To summarise, design options were developed iteratively with the initial long list of design options first developed by Bristol Airport and a few key stakeholders. Subsequent design workshops were held with stakeholders to enable their views to be captured and further develop the design options, which has resulted in changes to the original list. Stakeholder feedback was also used to evaluate the design options against the Design Principles and as evidence for the Initial Options Appraisal.

Future Airspace Strategy Implementation – South (FASI-S) and Masterplan Participation

FASI-S

FASI-S is the combined programme of airspace changes to the legacy air traffic route structures in the southern part of the UK. FASI-S is comprised of several change sponsors including NERL, the UK's en route Air Navigation Service Provider (ANSP). NERL is responsible for airspace change to the en route network above 7,000ft such as creating additional capacity to support growth and reducing airspace inefficiencies. FASI-S also includes low-level airport changes led by change sponsors including Bristol, Cardiff, and Exeter Airports. These are focussed on low-level designs including the better management of noise impact and reduction of environmental impacts.

These change sponsors are currently leading their own ACPs which often focus on similar geographical areas of airspace. It is therefore imperative that we work together to develop airspace design options and manage engagement with stakeholders in a joined-up approach. As summarised in the engagement evidence, Bristol Airport has been working closely with the aforementioned change sponsors, alongside numerous other stakeholders. This has ensured that designs are progressed with other potential airspace changes in mind; allowing potential conflicts and enablers to be identified.

Masterplan

Bristol Airport has involved the Airspace Change Organising Group (ACOG) throughout its Stage 2 work to ensure it is aligned with the wider UK airspace modernisation programme (FASI-S) which this ACP is part of. This is demonstrated through our two-way engagement evidence. Bristol Airport is fully supportive and aligned with ACOG's initial Masterplan which provides a high-level programme plan for airspace change in the south of England.

Bristol Airport has also supported the recently approved Iteration 2 of the Masterplan. This specifically focuses on interdependencies between independent ACPs where design conflicts or enablers could arise. As covered in our engagement evidence, Bristol has worked alongside and engaged Cardiff, Exeter and NERL throughout its Stage 2 design work. This has enabled potential conflicts to be identified early on, such as awareness of where Cardiff Airport may want to introduce a Hold, and appropriate design decisions to be made. This is documented within our Design Principles Evaluation, which has been uploaded to the portal alongside this document (link).

Bristol Airport appreciate the support from ACOG and are confident that this Stage 2 submission is fully aligned with both iterations (Stage 1 and Stage 2) of the Masterplan. Within this document and the accompanying other Stage 2 documentation, we present a comprehensive list of viable design options which will continue to be coordinated with other regional airspace changes, notably the WTA airspace changes. We look forward to continuing to work alongside ACOG and the change sponsors of ongoing ACPs.

Bristol Airport Current Airspace and Operations (do nothing option)

Overview

The following section describes the current operation at Bristol Airport which can be considered a "do nothing" option if no airspace change were to take place.

Prior to the covid-19 pandemic, Bristol Airport was experiencing its highest demand for destinations in the south and south-east of continental Europe. This made up about 73% of its commercial traffic. The remaining demand was to the north (20%) and west (7%). Due to the current airways structure, the European traffic arrives and departs on routes aligned to the east or south of Bristol Airport. The relative split depends on specific destination and flight planning and can vary with weather conditions or demand on the ATC network. This demand profile is not expected to materially change as traffic levels continue to recover.

Predominantly medium-sized aircraft fly to and from Bristol Airport (e.g., Airbus A320 and Boeing 737 variants), most of which tend to have good climb performance. The fleet mix will most likely stay similar to today although the number of B788 (heavy) aircraft is likely to increase slightly in the future.

There are a reasonable number of General Aviation (GA) users split between light piston-engine aircraft that usually fly under Visual Flight Rules (VFR) in the local area (including circuits) and a charter company that operates and handles business jets. A locally based helicopter operator conducts powerline surveys in the southwest.

Bristol Airport has two runways: Runway 09 and Runway 27. The runway in use depends on the current wind direction, with Runway 27 used roughly two thirds of the time and Runway 09 for the remaining third.

As seen in Figure 1 below, there is limited CAS to the south of Bristol Airport due to historic design and occasional excursions outside of CAS are experienced. The 2018 Safety Survey identified that the current Bristol Radar Manoeuvring Area (RMA) is too constrained for effective and efficient vectoring of aircraft to the Instrument Landing System (ILS) and containment of all traffic within CAS (irrespective of wind direction and strength). This is particularly true to the south of the airport and is a rationale of Bristol Airport for an airspace change.

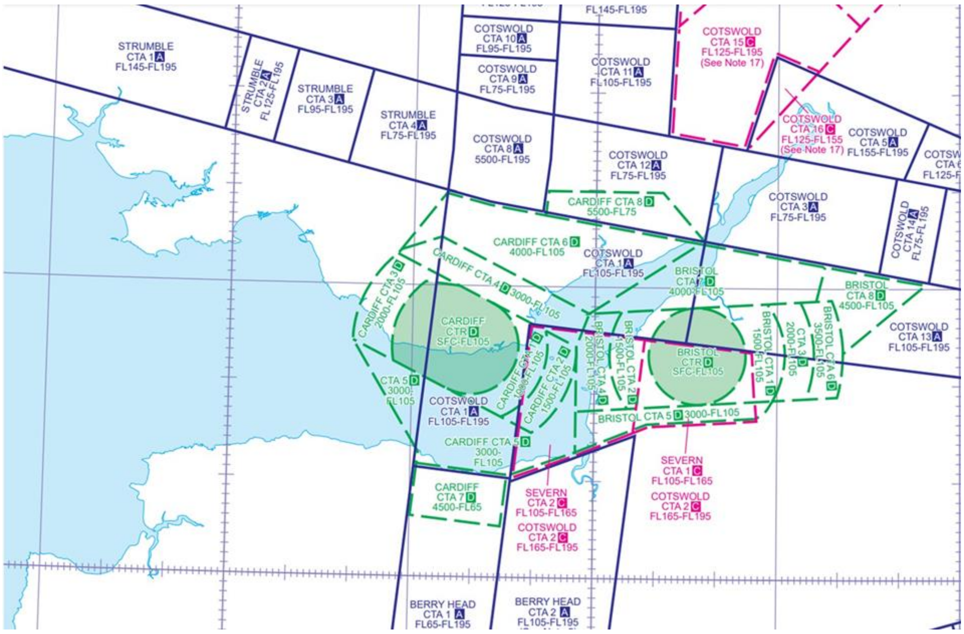

Figure 1: Bristol Airport Current Airspace

Bristol Airport has a holding facility directly over the airport which is not in an optimal location; it adds complexity and workload for approach controllers, including aircraft label garbling on radar screens. Inbound aircraft sometimes need to hold during periods of excess demand or poor weather conditions. The latter creates a reduction in runway visibility therefore resulting in increased spacing between successive landing aircraft and a resulting slower landing rate. The current location of the Hold also affects departing aircraft, preventing continuous climbs, and therefore impacting on noise and emissions. Improving the location of the Hold is another intention of this airspace change. A delay absorption mechanism, such as a Hold(s), will still be required by Bristol Airport in the future.

As seen in radar tracks (Figure 2 below) a large proportion of traffic (~90%) does not follow the defined Standard Instrument Departure (SID) routes; particularly those departing to the East. Controllers tactically intervene such that traffic is presented in an optimal way to airspace sectors above Bristol Airport (London Control) although this also increases their and pilots' workload. As well as re-defining the current SIDs, additional SIDs are being explored to decrease workload by systematically separating traffic from opposite direction aircraft, a feature of the current route design. There is also potential benefit in high-performance SIDs to allow more direct route design, continuous climbs and reduce tactical intervention.

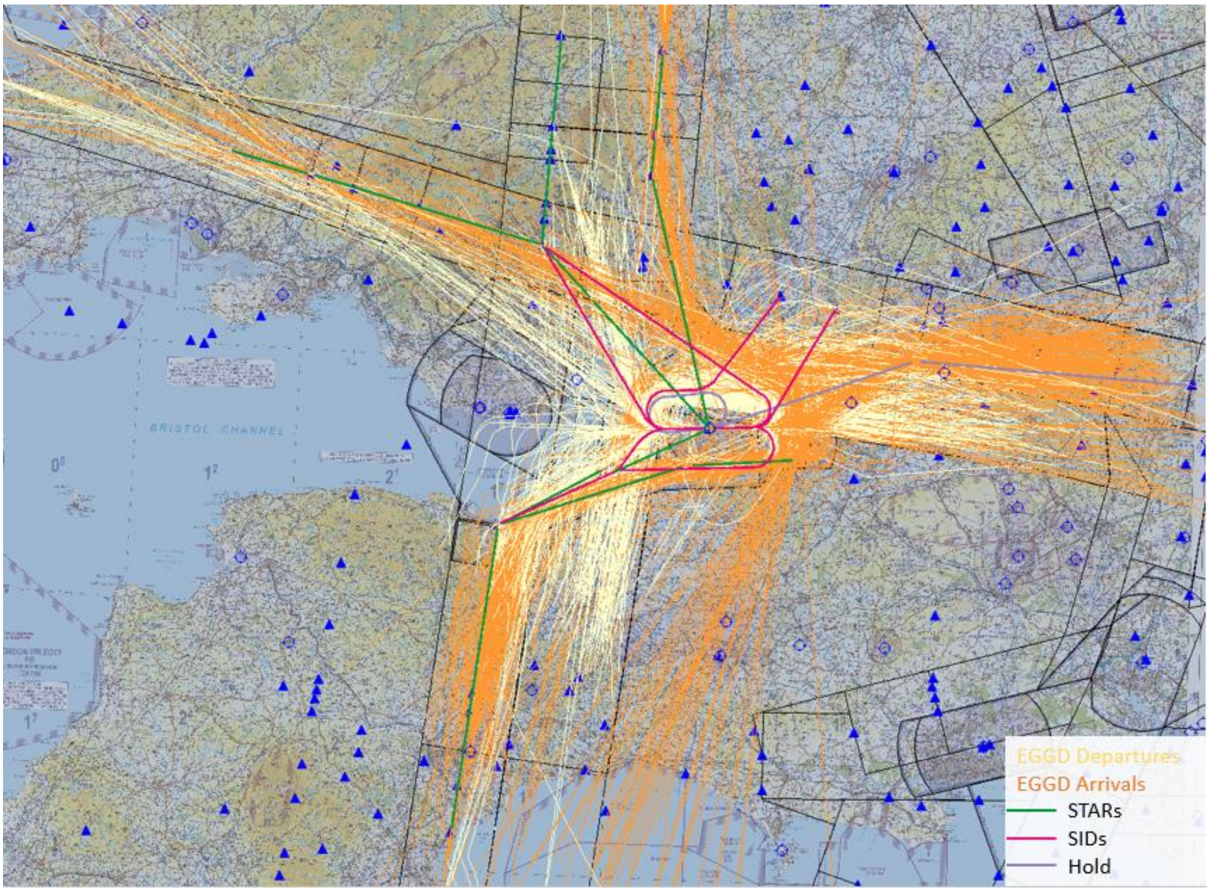

Figure 2: Current Bristol Procedures and Traffic Flows (August 2019)

The 'first rotation' departures (early morning) from Bristol Airport account for the busiest demand period across the day. At this time the loading on sectors over London is also at its peak. To mitigate the demands of this traffic and to allow shorter routings it is intended to establish an early morning 'temporary' route which will depart Bristol in a more south-easterly direction. This would cross airspace normally occupied by military and defence operations during the daytime, however at this time of the day the intention would be for such airspace sharing to have minimal impact.

Local procedures currently require all Bristol departures to climb straight ahead for around 4.5 Nautical Miles (NM) which is just over 5 miles. This results in a minimum time separation between departing aircraft of 2 minutes thus constraining the airport throughput. Forecast modelling has shown that ground delay will increase markedly in the future as and when traffic levels seek to increase. Departure routes are therefore being sought that would allow shorter time intervals between successive departures. A target is to allow intervals down to 1 minute between specific revised SIDs, a separation standard which is used at the majority of commercial UK airports.

We will also be considering the introduction of published climb gradients higher than the minimum standard for obstacle clearance (3.3%), to capitalise on modern aircraft performance and achieve more continuous climbs to higher levels. This will provide environmental benefits alongside efficient integration into the above network. An initial assessment and liaison with local operators indicates this to be achievable for gradients of 5-8%.

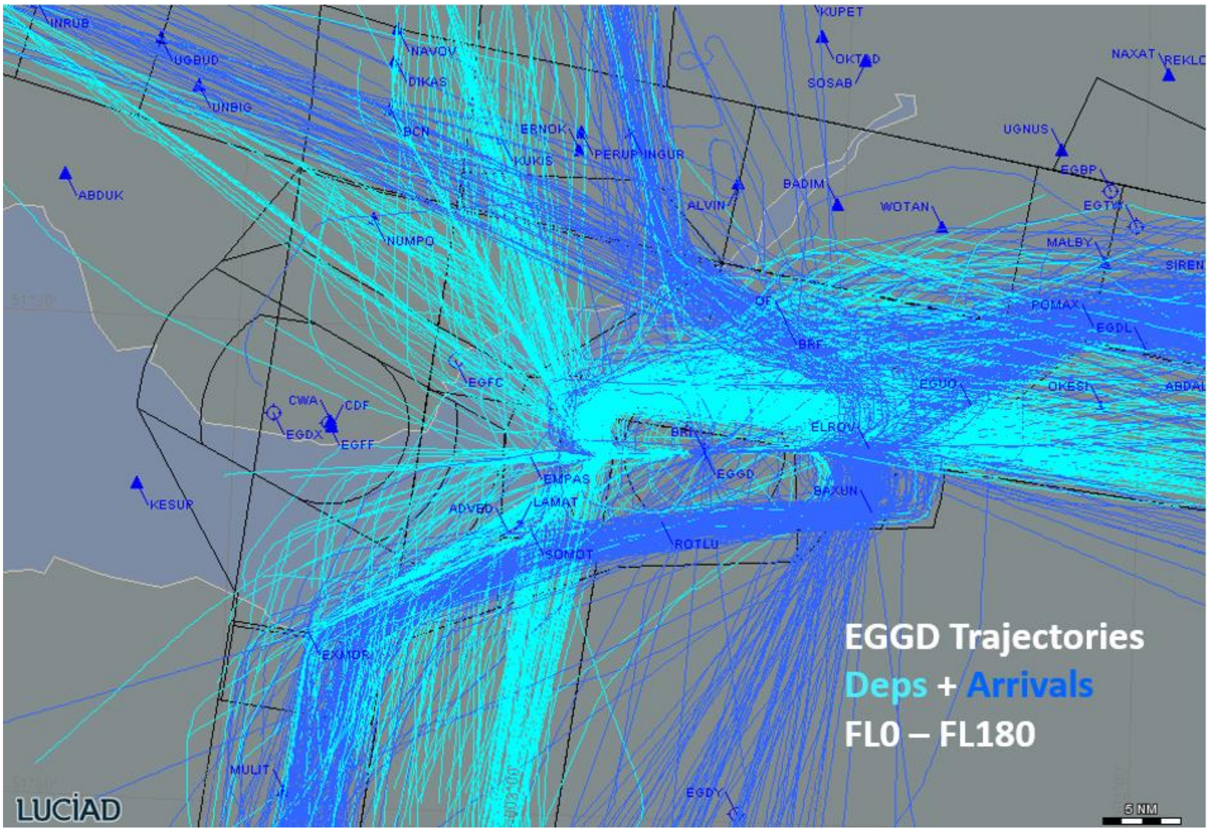

Figure 3: Bristol departures (light blue) and arrivals (dark blue) below 18,000 ft

The above diagram shows all recorded aircraft tracks during one week of operation (August 2019). It illustrates the wide spread of aircraft away from 'nominal' published routings, necessary to ensure safety and maximise traffic throughput. A design goal is to construct routes in a more 'systemised' way to ensure published routes provide maximum efficiency and minimise additional controller intervention. Separation of arrival and departure routes to the greatest extent possible will also enhance environmental performance by allowing more smooth and continuous climbs and descents.

Further information and visualisations on the current arrivals and Holding operations can be found in Appendix D towards the end of this document. This includes information on the current traffic swathes and how controllers tactically manage the arrival flows.

Arrivals

As shown in Figure 4 below, arrivals are presented via Standard Arrival Routes (STARs) from the North, East, South and West. These 4 standard routes are used between 06:00 and 23:00 with amended tracks applicable at night.

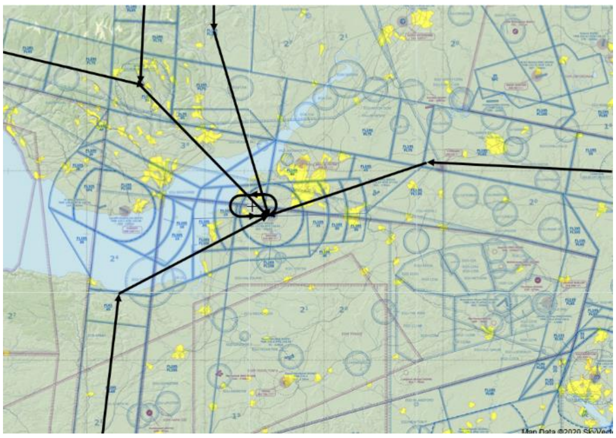

Figure 4: Current Bristol Airport STARs

Whilst these STARs nominally terminate at the BRI (Bristol) Hold overhead the airport, in reality controllers have standing agreements which mean they are delivered tactically via agreed arrival points and routes as indicated by the bright colours in Figure 5 below (Runway 27). There are slight differences in the presentation of traffic above 7,000ft for flights from the north for Runway 09. This tactical delivery minimises delay and helps to ensure the separation of arrival and departure routes.

Below 7,000ft Bristol Airport controllers issue vectors to achieve a safe, orderly, and expeditious sequence of aircraft as they establish on the runway centreline between approximately 7.5 and 14nm from touchdown. The bright colours in Figure 6 indicate that controllers have to use a relatively wide swathe of airspace to establish a sequence. It also clearly indicates that aircraft are frequently very close to the edge of the narrow area of controlled airspace to the south-east of the airport. The CAA regulation for CAS containment requires the nominal track of a procedure to normally not be less than 3nms from the edge of CAS, with a minimum of 2nm if tactical vectoring is used.

Inbound Routes Above 7,000ft

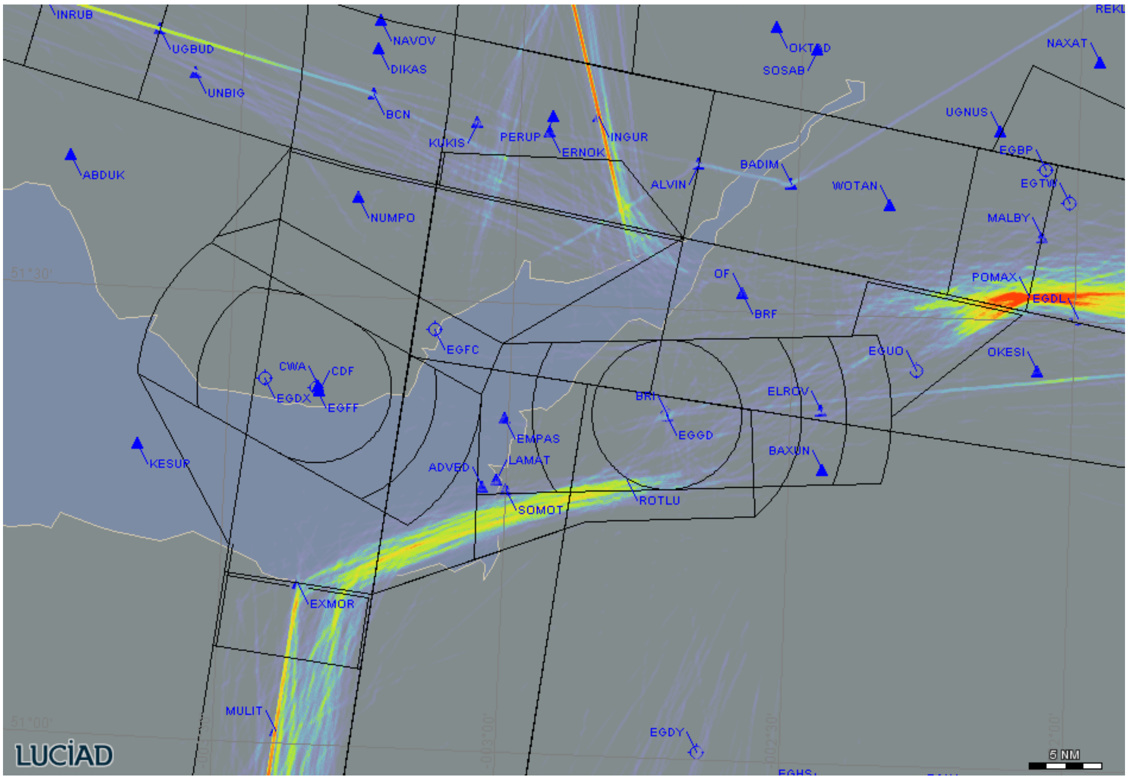

Figure 5: Relative density of current Bristol arrival aircraft above 7,000 ft (1 week)

Inbound Routes 7,000ft and below

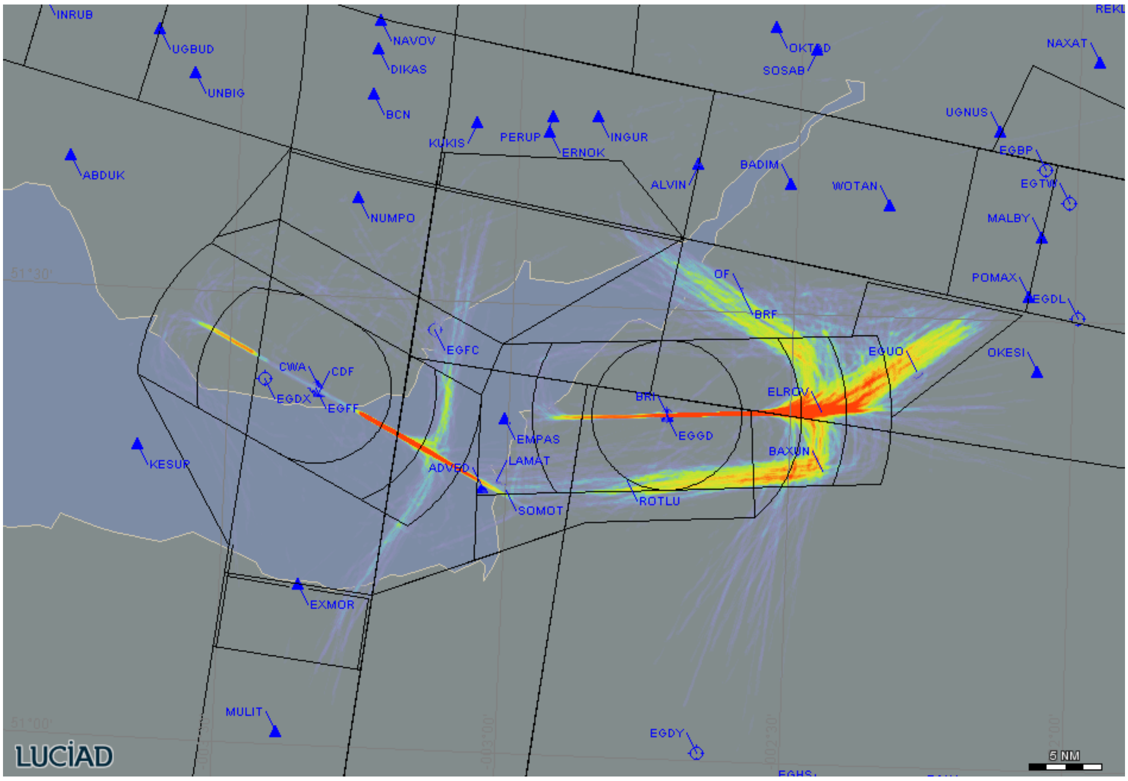

Figure 6: Relative density of current Bristol arrival aircraft below 7,000 ft (1 week of data) (NB the majority of aircraft shown here are using Runway 27. Cardiff traffic also shown)

Departures

Figure 7 below illustrates the relative concentration of departing aircraft up to 18,000ft. For each runway at Bristol there are 3 Standard Instrument Departures (SIDs) that deliver the aircraft into the adjoining en-route airspace structure via a series of standing agreements between ATC agencies. Noise Preferential Routes (NPRs) dictate that controllers should not amend the track of departing jet aircraft below 4,000ft (above mean sea level) unless there is an urgent safety requirement (generally, but not exclusively, weather avoidance). Quieter turboprop types may occasionally have their track amended below 4,000ft to minimise delay to other departing flights. Above this level controllers are free to amend tracks as required, but to the South, West and North this is only normally required to integrate with Cardiff airport traffic as shown by the relatively narrow swathe of colours.

Of note is the precise routing of flights to the east, whereas the 'published' procedure joins the route network much further to the north. This is caused by the regular need for Bristol and Swanwick controllers to issue tactical headings to safely integrate Bristol departing flights with both Bristol arrivals and en-route traffic within the airways network immediately to the north of Bristol Airport. The effect of aircraft climbing straight ahead before turning, resulting in the 2-minute minimum departure interval, is also clear.

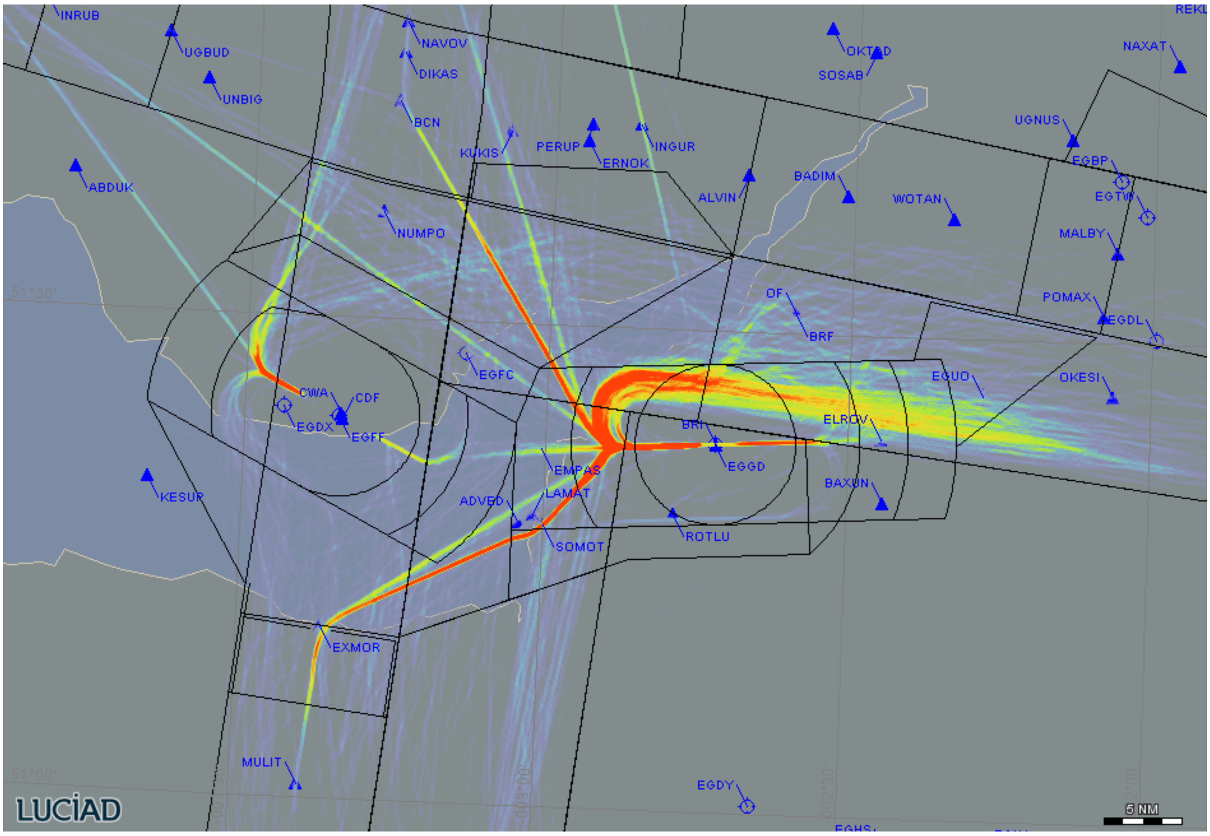

Figure 7: Bristol departures up to 18,000 ft

Current Hold and Delay Absorption Requirement

Bristol Airport requires a method of 'delay absorption' for arriving traffic when the demand exceeds the landing capacity. There are typically 3-4 arrival peaks per day at Bristol Airport. Depending on the amount of traffic, weather conditions and any coincident departure demand, the arrival traffic regularly needs to be 'metered'. Normal practice is to apply radar vectoring to manage a sequence of aircraft prior to the landing runway. However, when short-term demand exceeds the capacity of available airspace to manage this the aircraft must be delayed by holding. The current design comprises a single holding pattern to achieve this, located at the BRI Non-Directional Beacon (NDB). This Hold is currently situated in the overhead, above Bristol Airport, which can at times constrain departures due to its location. As covered above, the current Hold location also adds complexity and workload for approach controllers, including aircraft label garbling on radar screens.

There are significant periods throughout the day when no holding takes place. However, when it is required the fluctuation in the number of aircraft holding (frequently as a result of weather variations) can currently overload the capacity of the existing single Hold. Bristol Airport have undertaken analysis which modelled the future traffic demand, and such overloads were shown to happen more frequently. An increase in the capacity to delay/meter traffic is therefore also a requirement.

The variable and unpredictable weather conditions surrounding Bristol Airport are due largely to geographical location and airfield height. Unpredictable meteorological conditions regularly require the need for airborne delaying procedures with very little notice. Low Visibility Procedures (LVPs) are instigated at the airport because of poor runway visibility or low cloud base. This increases the minimum arrival spacing between successive landing aircraft, thus slowing down the landing rate and requiring a tactical delay absorption procedure i.e., airborne holding. As an additional complication, in LVP conditions individual aircraft may or may not be able to make an approach due to their own minima and constantly varying weather conditions. ATC must therefore be able to react to such unpredictable patterns of demand.

Bristol Airport will therefore require delay absorption capability in a relatively close location to the airport in order to be able to react to variable weather conditions. It must be able to be utilised flexibly and at short notice, and thus minimise disruption and any unnecessary airborne delays - with associated environmental consequences.

Options include traditional airborne Holds, a design supporting Point Merge or relying on the network to meter all inbound traffic to match runway capacity at any time.

There are therefore four holding/ delay absorption requirements:

- A metering system for times of peak demand.
- A tactical delay absorption method for low visibility periods.
- A delay absorption capability near to the airport; and
- Relocate the Hold from the overhead thus removing the current constraint on departures.

Interaction with Cardiff Airport

The proximity of Cardiff Airport impacts potential designs for both the Bristol Airport ACP and the concurrent Cardiff Airport ACP. Although Cardiff Airport has lower traffic levels than Bristol Airport, their ACP is looking to introduce new arrival/departure routes, a delay absorption mechanism, and links to/from the network. Therefore, the Bristol Airport design options needs to consider this. Significant engagement between both airports has taken place throughout their independent ACPs so far and is assisting with optimised design development.

Figure 8 below shows radar data with both Bristol and Cardiff traffic shown (summer 2019). The tracks in yellow/orange show the current spread of traffic in and out of Bristol Airport, clearly illustrating the interaction with Cardiff arrivals and departures and thus the importance of joint planning for new routes and holding facilities.

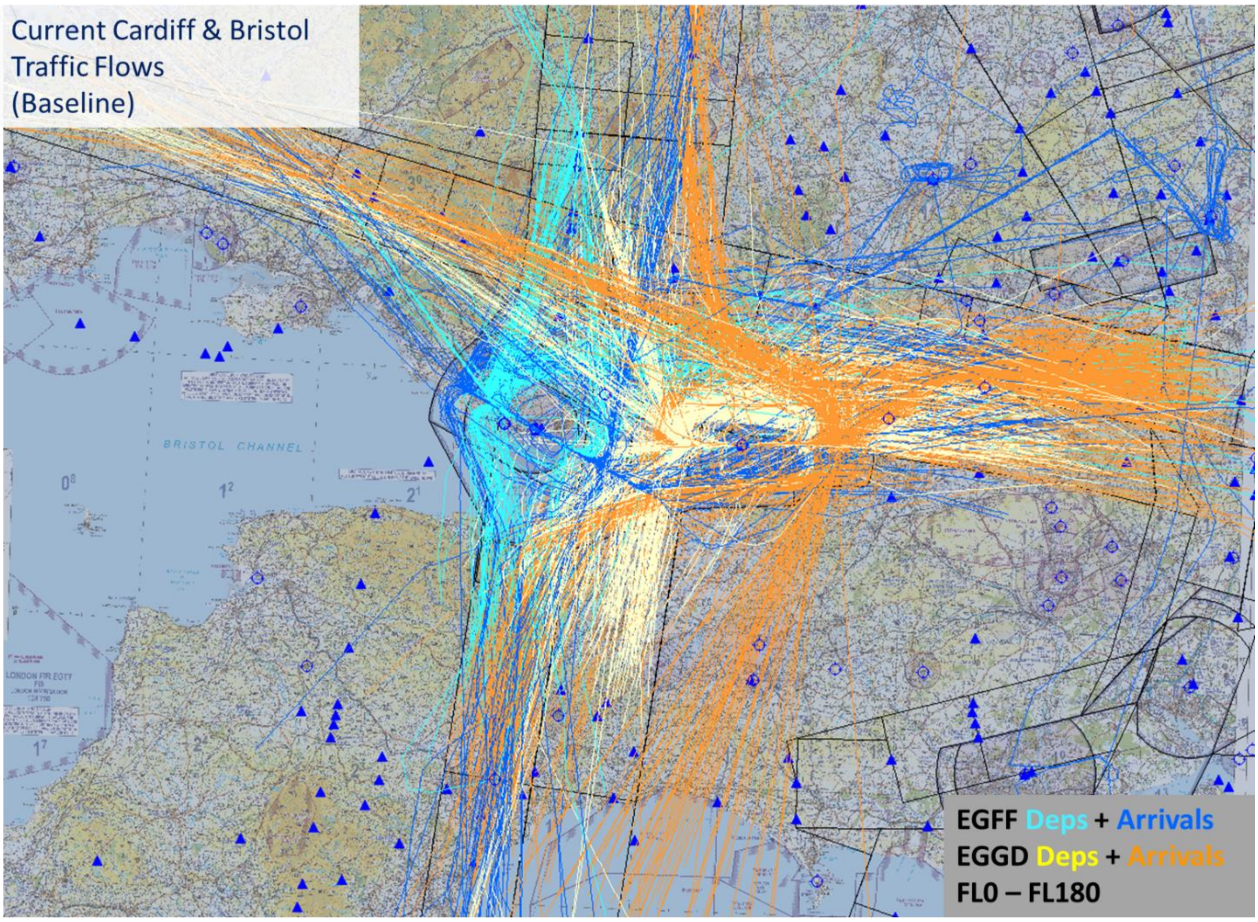

Figure 8: Current (baseline) Traffic flows for Cardiff & Bristol Airports (2019 traffic)

Forecasts

The long-term impacts of Covid-19 on the aviation industry are yet to be fully understood, though a recovery is underway. The pandemic has significantly impacted the aviation industry in the short term and has made accurate forecasts of traffic and recovery very difficult to make. Bristol Airport provided updated forecasts in November 2020 which stated that:

The global Covid-19 pandemic has meant that passenger throughout at Bristol Airport has been temporarily suppressed and passenger numbers are now expected to reach 10 million in 2024, 3 years later than originally projected, and 12 million in 2030, four years later than originally projected.

Design Options: Point Merge

A Point Merge option was discussed at a number of design workshops as a potential alternative and radical method of inbound sequencing. The Point Merge transition procedure is an Area Navigation procedure that allows controllers to sequence inbound aircraft onto the final approach. The system has been developed primarily for airports with continuous busy inbound flows where the priority is on achieving consistent maximum runway efficiency with minimum controller workload.

Rather than using traditional radar vectoring, aircraft fly along published sequencing legs and when it is considered that there is adequate spacing, the controller will instruct the pilot to route direct to the 'Merge Point'. However, as well as sequencing arcs Point Merge still requires traditional holding patterns (at the end of each arrival route) for contingency; to facilitate delay absorption during inbound demand peaks and/or reduced landing rates. Accordingly, a significant volume of CAS will be required to contain the holding patterns and the Point Merge transitions.

Existing Point Merge procedures were examined, specifically Dublin and London City, both of which feature sequencing arcs in excess of 30NM (~35 miles) from the airport. Due to Bristol Airport's short notice start/stop to the operation in adverse weather condition, any delay absorption facility would ideally need to be close to the intermediate/final approach area to be able to react to tactical changes. This location should also be a similar distance from each runway end, in consideration of the differing landing direction.

Potential areas for Point Merge procedures were examined, although these are expected to prove very challenging in terms of airspace design, volume, and usage. To the East or North of Bristol, the airspace is occupied by traffic from several other airports as well as busy London Airport traffic flows. De-confliction from Bristol's own departure routes and the desire to achieve more continuous climbs would also be necessary. To the South of the airport a Point Merge procedure would require additional volumes of CAS to be established. To the West of Bristol, the airspace is less congested and features potential to use an over-sea area. However, a large volume of CAS would have to be established and it would be a long track distance for arrivals from the East. It would also likely interact with traffic to/from Cardiff Airport. The distance from a Point Merge in this location to the predominate landing runway (27) would also be incompatible with the needs of tactical control during periods of fluctuating weather conditions.

The below diagrams (Figure 9 and Figure 10) have been included to demonstrate the large amount of airspace required for a Bristol Airport Point Merge option (Runway 27 arrival option only illustrated). The primary issue is the volume of airspace required, including extensions to current controlled airspace. Runway 09 would be more complex, potentially needing sequencing arcs to both the North and South of final approach due to the proximity of Cardiff airport. Thus, designs for Runway 09 have not been attempted.

Figure 10 has been included as an alternative option which would require slightly less additional airspace due to shorter extensions. However, this would still require an unproportionally large amount of airspace when considering the amount of traffic at Bristol Airport and impact on other airspace users.

Another important factor is the local arrangements Bristol ATC has with local non-commercial airspace users to provide flexible access to certain airspace blocks when traffic loading permits. It is the full intention to continue with and even improve such arrangements, requiring a more flexible approach to traffic routing – particularly inbounds – which a rigid structure upon which Point Merge is based would not allow.

Therefore, following consideration a Point Merge option will not be taken forward. Although it could be considered a radical option for Bristol Airport, it would also be unviable.

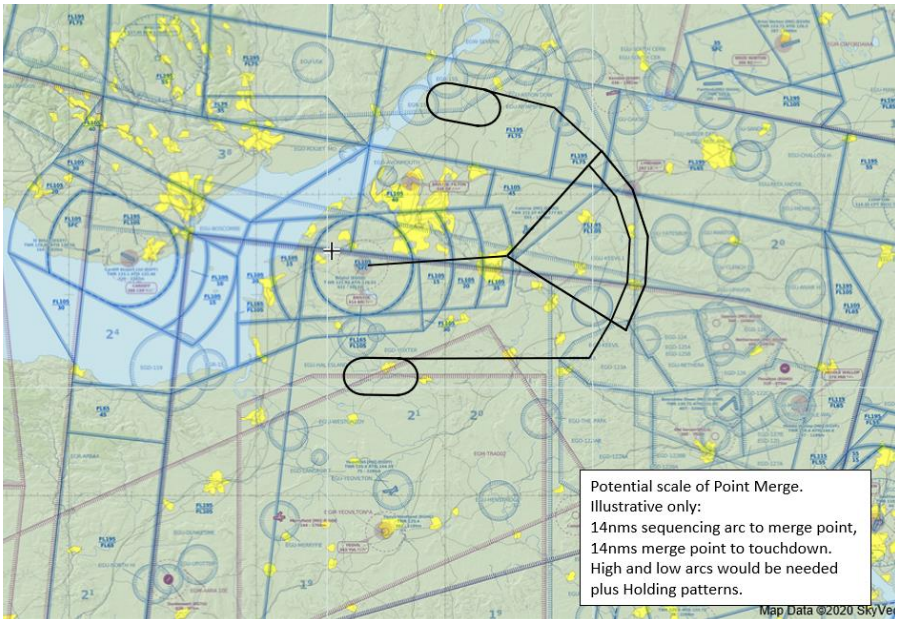

Figure 9: Bristol Airport Point Merge Option

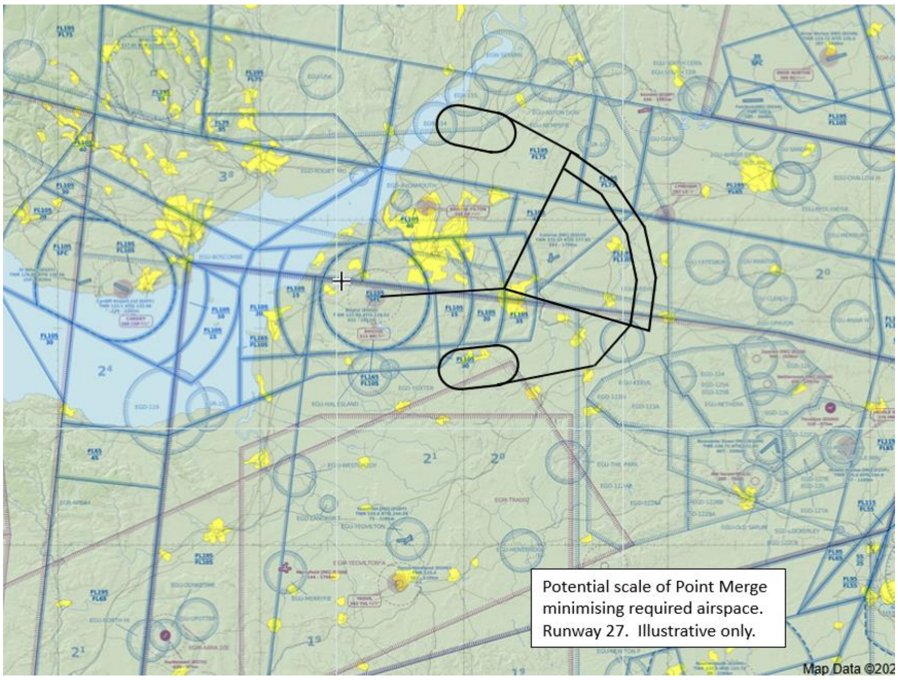

Figure 10: Bristol Airport Point Merge Option (less airspace required)

Design Options: Holds and Transitions

Holds

As covered above, currently aircraft are held over the airport in a racetrack pattern, typically at 7,000ft and above. During the design workshops the current issues of the overhead Hold were discussed, such as the restrictive climb profiles and radar clutter. A summary of an analysis into Bristol's future holding requirements was also provided, which concluded that a single Hold would be insufficient therefore, two separate Hold locations will be required. 80% of Bristol's inbound traffic arrives from the East and South, with approximately an even distribution between the two directions. Thus, analysis shows that one Hold servicing traffic from the East and North and one Hold servicing traffic from the South would provide the best option for tactical delay absorption.

During the design workshops, participants were asked to consider potential Hold positions that could work for Bristol Airport in the future. During the design workshops and based on the discussions held, the Hold options shown in Figure 11 below were developed. In the following section, a description on each Hold option is provided. Please note that the exact location, size, and orientation of the different design options are not precise at this point.

The Holds coloured black in Figure 11 are being progressed beyond Stage 2 whilst those in red are not. This was the outcome of the Stage 2 Design Principle Evaluation which assesses how each design option responds to the Design Principles. The Design Principle Evaluation forms part of this Stage 2 submission and can be accessed on Bristol Airport's page on the CAA portal (link).

In each case the Holds have been positioned to take account of the proposed London Airspace Modernisation Programme (LAMP) Deployment 1.1 (LD1.1) network structure in order to simplify alignment and Standard Arrival Route (STAR) procedure design. The design intention is also to provide procedural separation between the Holds and adjacent SIDs, to the maximum extent possible, in order to facilitate Continuous Climb Operations (CCO). Hold orientation (i.e., left, or right-hand pattern) will be refined during more detailed design analysis to achieve this.

Although three options for the position of the Southern Hold will be progressed, the final solution will partly depend upon, and influence, in and outbound route alignment to connect with the network. Initial coordination with LD1.1 and Cardiff ATC planners has taken place and will continue as more detailed work is conducted in Stage 3 of this ACP.

The indicative Hold options shown are located partly within airspace for which Bristol is not the designated controlling authority. However, development of this level of detail was necessary to illustrate network connectivity and assist with visualisation as the area is complex. The design options as presented have been developed with input from Cardiff and London airspace planners, recognising their responsibilities in this region for the provision of ATS. More detailed work on defining Hold protection airspace, route separation and network connectivity as well as integration with Cardiff and Exeter traffic will be required. Further detail on planned separation is given in the description of individual SIDs below.

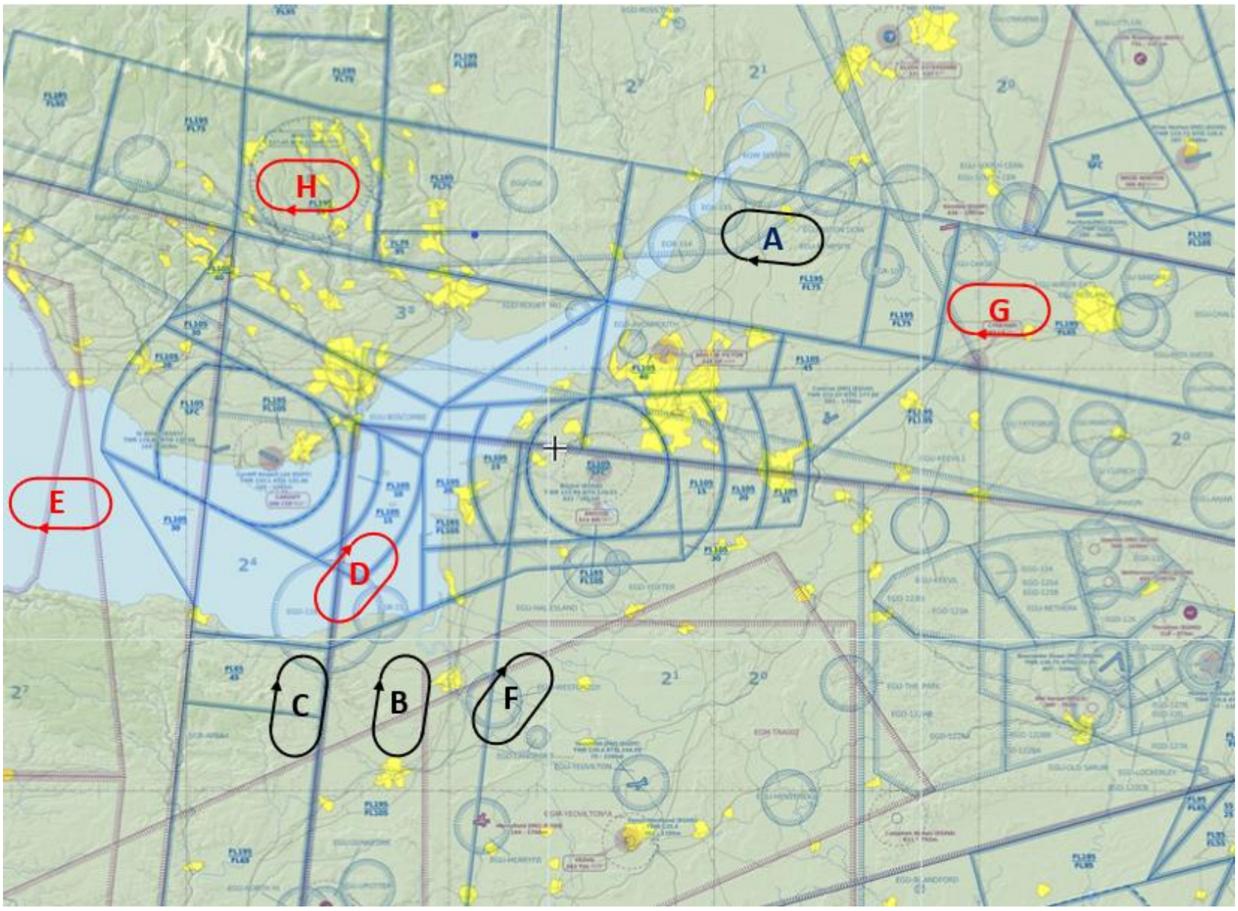

Figure 11: Bristol Airport Hold Options

Hold A (north of Bristol Airport) – to be progressed

Hold A is positioned to the north of Bristol Airport approximately equidistant to both Runway ends, therefore minimising any adverse impact of long transitions and operational timing for efficient sequencing. Hold A was suggested as an alternative to address some of the issues encountered with Hold G (described below). Operational feedback suggested that this would be well positioned for connectivity to the network and for Approach operations at Bristol.

This Hold would have much less impact on other traffic flows – such as Birmingham and Cardiff Airport traffic - and airspace users such as the military when compared to other Hold options. However, the cross-over between the transition for runway 09 and departures to the north-west remains, as currently.

It would be situated within the current Bristol delegated ATS airspace although some CAS would need to be adjusted to the South of the Hold in order to contain transitions for Runway 27 within permitted descent gradients.

A small adjustment to the boundary of the Cotswold Control Area (CTA-3) to the north of the Hold may also be required for containment; this will require further examination.

Taking all factors into consideration, operational judgement concluded that the (approximate) position of this option satisfied requirements to the greatest extent possible and is thus the only option being taken forwards for a northern Hold.

Hold B (to the south-west, alternative to Hold C) – to be progressed

Hold B sits to the south-west of Bristol Airport, geographically a good location for aircraft transiting onto final approach to either runway or also arrivals from the network. Hold B was proposed as an alternative to Hold C to alleviate some of the concerns highlighted below.

It is aligned with the LD1.1 network (route "Y"), although connectivity and CAS requirements will need further development as currently CAS only exists in that position at weekends. Operationally It is likely to have a lesser impact on other traffic flows, such as Cardiff and Exeter outbounds, when compared to Hold C.

Although a Hold in this location would still require additional CAS this would be in a better position for Bristol arrivals than Hold C due to a more reasonable track distance to Runway 27.

Due to the current arrangements for delegation of ATS from London to Cardiff, a Hold in this location will require further development of procedures for controlling authority and tactical air traffic control.

Hold C (to the south-west) – to be progressed

A Hold in this location, to the south-west of Bristol Airport, would benefit from allowing some transitions to be positioned over the water, providing a noise management advantage. It may also be a simpler location for network connectivity, but this is subject to further detailed planning work. Hold C would likely require a small amount of additional CAS for containment, but less than Holds B or F which sit further to the east.

However, this Hold would be positioned in a busy region of airspace used also by outbounds and inbounds from Cardiff and Exeter Airports. Finally, the track distance to Runway 27 is longer than all of the other design options and could be operationally complex in terms of tactical control and efficient sequencing.

Due to the current arrangements for delegation of ATS from London to Cardiff, a Hold in this location will require further development of procedures for controlling authority and tactical air traffic control.

Hold D (to the west, over water) – to be rejected

Hold D was included as an option over the Channel between Bristol and Cardiff, south-west of Weston-Super-Mare. It would benefit from some transitions being over the water and well positioned for network connectivity.

However, due to the location of Hold D it would substantially impact upon Bristol departures and Cardiff traffic. Most significantly though is that there would not be enough distance to safely fit a transition to Runway 09.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this Hold D option has been discounted and will not be taken any further.

Hold E (to the west, over the Channel) – to be rejected

Hold E was positioned far west from Bristol Airport to take advantage of being positioned over water, alongside most transitions to the airport. This would provide clear noise benefits for ground-based stakeholders.

Despite the noise management benefits, it was agreed that a Hold in this location would dramatically increase track miles for arriving aircraft and create too much complexity in arrival sequencing. It would also have a large impact on military operations within this region.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this Hold E option has been discounted and will not be taken any further.

Hold F (to the south) – to be progressed

Hold F would sit directly to the south of Bristol Airport and would be well positioned for the busy traffic flows into Bristol Airport from the South, subject to network connectivity. The Hold is geographically practical for Bristol arrivals providing almost equidistant track distance to each runway ends. It is also well separated from the main in and outbound flows for Cardiff and Exeter as well as Bristol departures, thus simplifying separation of routes and procedures.

However, there would need to be an increase in CAS as this area is currently Class G airspace and as such can be utilised by GA and Operational Air Traffic (OAT). The orientation of this Hold, south-west to north-east, and proximity to the airport have accordingly been designed to reduce the amount of new CAS needed.

Issues associated with controlling authority and tactical air traffic control for a Hold in this location are likely to be much less than for either Holds B or C (above) due to the location relative to Cardiff's area of delegated ATS.

Hold G (to the north-east) – to be rejected

Hold G was a suggested location which could favour diversions in low visibility conditions.

However, this location is known to be within a very dynamic traffic environment with traffic to/from airfields including Brize Norton and the London airports. This could result in network traffic being constrained. It is anticipated that Brize Norton is going to continue to grow and utilise this region of airspace. As such, it may be difficult to obtain Hold levels.

The excessive track distance to Runway 09 was an added complexity in terms of traffic marshalling and efficient sequencing.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this Hold G option has been discounted and will not be taken any further.

Hold H (to the north-west, around Brecon) – to be rejected

Hold H was suggested as a possible sequencing Hold at higher levels, possibly shared by both Bristol and Cardiff Airports. This is positioned where current and possible Bristol arrival flows will be at these higher levels.

However, the excessive track distance to touchdown would be operationally complex. It was suggested that even a Hold for excessive traffic would benefit from being closer to Bristol Airport. There would also be a lot of conflict with both Bristol and Cardiff northern departures.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this Hold H option has been discounted and will not be taken any further.

RNAV Transitions

RNAV Transitions are being designed to connect from each STAR and Hold to final approach. When traffic conditions allow this will enable aircraft to fly an autonomous approach with predictable vertical profile and track.

As described above, Holds A, B, C and F are being progressed through to Stage 3. Figure 12 below has been included to show illustrative locations of transitions from these four Holds. A full summary of this assessment can be found on the portal in Bristol Airport's *Stage 2 – Step 2A (ii) Design Principles Evaluation* document. Other Holds were rejected based on their specific location (see above) therefore indicative transition options were not progressed for these Hold options.

There will be two transitions from each Hold: one to each runway end. At this stage these are indicative alignments, subject to further detailed assessment and wholly dependent on the preferred Hold locations/orientation etc.

A brief description on each transition pair can be found below Figure 12.

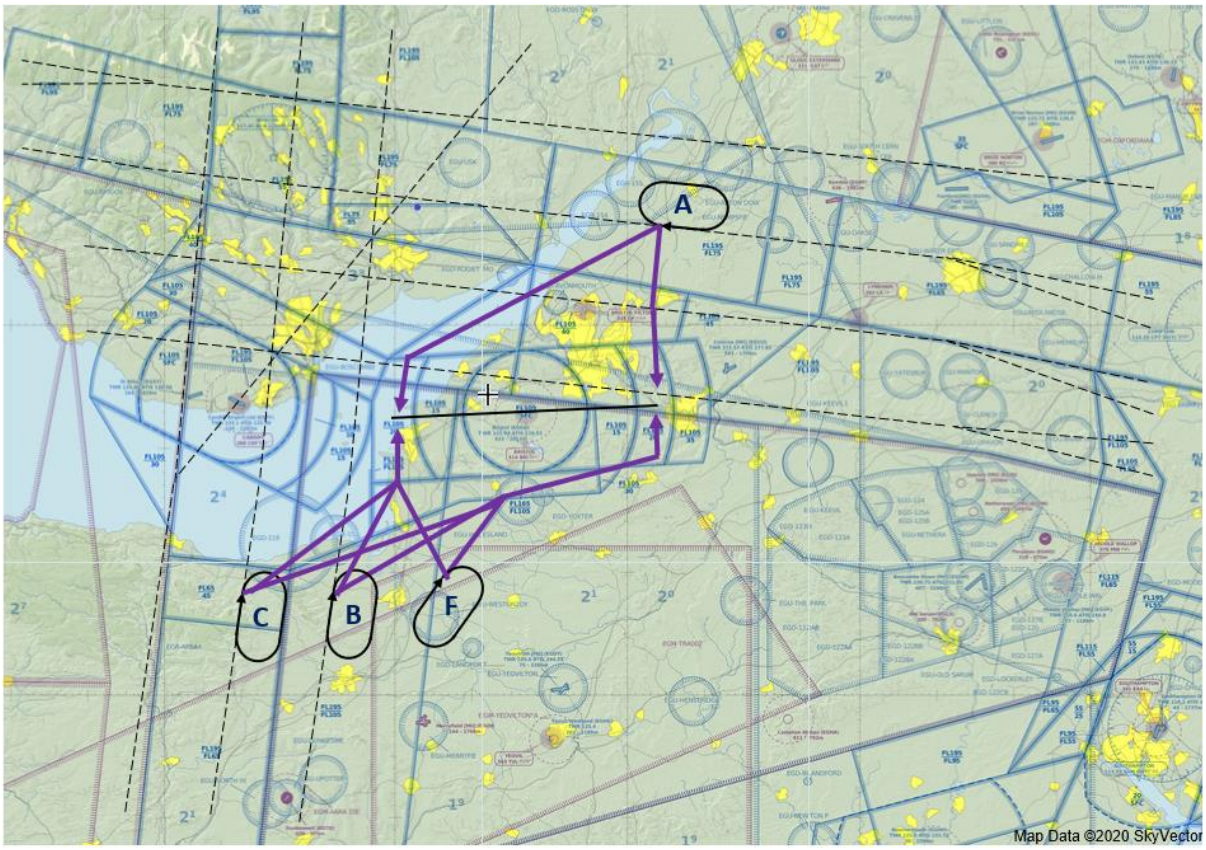

Figure 12: Bristol Airport Progressed Hold Options with Indicative Transitions

Hold A Transitions

Hold A is proposed to be aligned with LD1.1 network route "C", with direct entry from the East and a downwind entry from the West. Accordingly, the transitions will commence at the Holding fix and connect with the Initial Approach Fix (IAF) for each RNAV approach.

Runway 27 – Routing avoids main population centres and assumes the IAF mirrors the position of BAXUN, on the current RNAV STAR procedure from the South.

Runway 09 – Routing is predominately aligned over the Bristol Channel, with the IAF positioned on the edge of the current Bristol/Cardiff buffer zone to ensure the procedure is independent of runway/approach direction at either airport.

Hold B Transitions

Hold B is proposed to be aligned with LD1.1 network route "Y". This route is currently only high-level so further development of structure and connectivity will be required.

Runway 27 – Routing is intended to minimise extension of CAS and any impact on GA or the northern edge of the Yeovilton Area of Intense Aerial Activity (AIAA). The intention is to converge with the current RNAV STAR procedure and share the same IAF (BAXUN). The SIDs are intended to provide procedural separation from the Hold and Transitions.

Runway 09 – Routing will be over the Bristol Channel as far as possible, remain to the East of the Bristol/Cardiff buffer zone and converge with the current RNAV IAF (ADVED). The SIDs will inevitably cross-over the Transition but will allow continuous climb subject to achieved climb gradient and procedural separation from the Hold.

Hold C Transitions

Hold C is proposed to be aligned with LD1.1 network route "X", subject to further development of network connectivity and procedures between Bristol, Cardiff, and London Area Control.

Runway 27 – Routing comments are the same as for Hold B, covered above. Options for SID alignment present different options for procedural separation depending upon crossovers and achieved climb gradient.

Runway 09 – Routing and SID separation comments are the same as for Hold B, above.

Hold F Transitions

Hold F is proposed to be established to the South of the airport requiring new connectivity to the network.

Runway 27 – Routing as above will converge to the current RNAV IAF and will provide straightforward separation from the majority of SIDs. An exception to this being the proposed early morning departures route (shown as SID B27-6 or 6B) where published height restrictions will be utilised to ensure separation (as typically used currently) with tactical climb/descent by ATC instruction.

Runway 09 – Routing comments are the same as Holds B and C above, with convergence to the current RNAV IAF (ADVED).

Design Options: Standard Instrument Departures (SIDs)

Options for Standard Instrument Departure routes (SIDs) were developed during design workshop activities. Workshop participants were provided with an overview of today's departure routes alongside what is actually flown (covered above) and a summary of Bristol Airport's requirements for future SIDs. These included reduced departure intervals with a design goal of 1 minute and avoiding built up areas where possible. A feature of the current SIDs is the restriction of the local Noise Preferential Routes (NPR) which requires a climb straight ahead for a distance of approximately 5nms. As this restriction currently precludes 1 minute departure separations the revised designs will propose earlier turns. This will in turn affect tracks over the ground and downstream height acquisition to achieve CAS containment. Whilst ensuring all SIDs are compatible with the performance of aircraft expected to use the procedures such factors will be studied with more objective analysis to ensure containment and separation.

Other SID features considered included compass departures where the direction is determined by final destination, including the potential for "wrap-around" SIDs to aid local departure separations. The potential for alternative respite SIDs was also discussed which was positively supported by community stakeholders during the Stage 1 Design Principles workshops and specifically noted within the Design Principles.

Alongside the Hold options covered above, attendees of the design workshops were asked to consider different SID options that could work for Bristol Airport and its stakeholders, alongside associated pros/cons for each. The following sections summarise the different departure options. Please note that the exact location, size, and orientation of the different design options are not precise at this point.

In many cases the design intention is to provide lateral procedural separation from adjacent Holds, thus facilitating use of Continuous Climb Operations (CCO). However, we are aware this will need further specific safety assessment in each case as RNAV design standards are as yet not sufficiently defined.

The concept of publishing 'SIDs to Flight Level' is still under development within the aviation industry so is not an assumed result of these designs. However, lateral separation of SIDs from Holds will serve to enable regular tactical application of CCO even if publication is not yet possible.

The SID options shown nominally proceed into airspace for which Bristol is not the designated controlling authority. However, this is intended to show potential network connectivity and assist with visualisation as the area is complex. The design options as presented have been developed with input from Cardiff and London airspace planners, recognising their responsibilities in this region for the provision of ATS. More detailed work on defining route separation and network connectivity as well as integration with Cardiff and Exeter traffic will be required. The following sections have been split out into departure options from the Runway in use (09/27); and also, by those which will be progressed onto Stage 3 and others which will not. Reasons for rejecting different design options were based on stakeholder feedback including over-complexity for controllers, increased routing distance and a poor fit with the network. This was the outcome of the Stage 2 Design Principle Evaluation which assesses how each design option responds to the Design Principles. The Design Principle Evaluation forms part of this Stage 2 submission and can be accessed on Bristol Airport's page on the CAA portal (link).

Design Options: Runway 09 SIDs

Runway 09 SID options being progressed

Figure 13 below shows the departure options from Runway 09 which are being progressed through Stage 2. The Design Principle evaluation can be found on the CAA portal (link) for further information on the assessment.

Note that all SID design options assume the introduction of the London LD1.1 network. The LD1.1 route proposals are shown in all cases as the black dashed lines in the following charts.

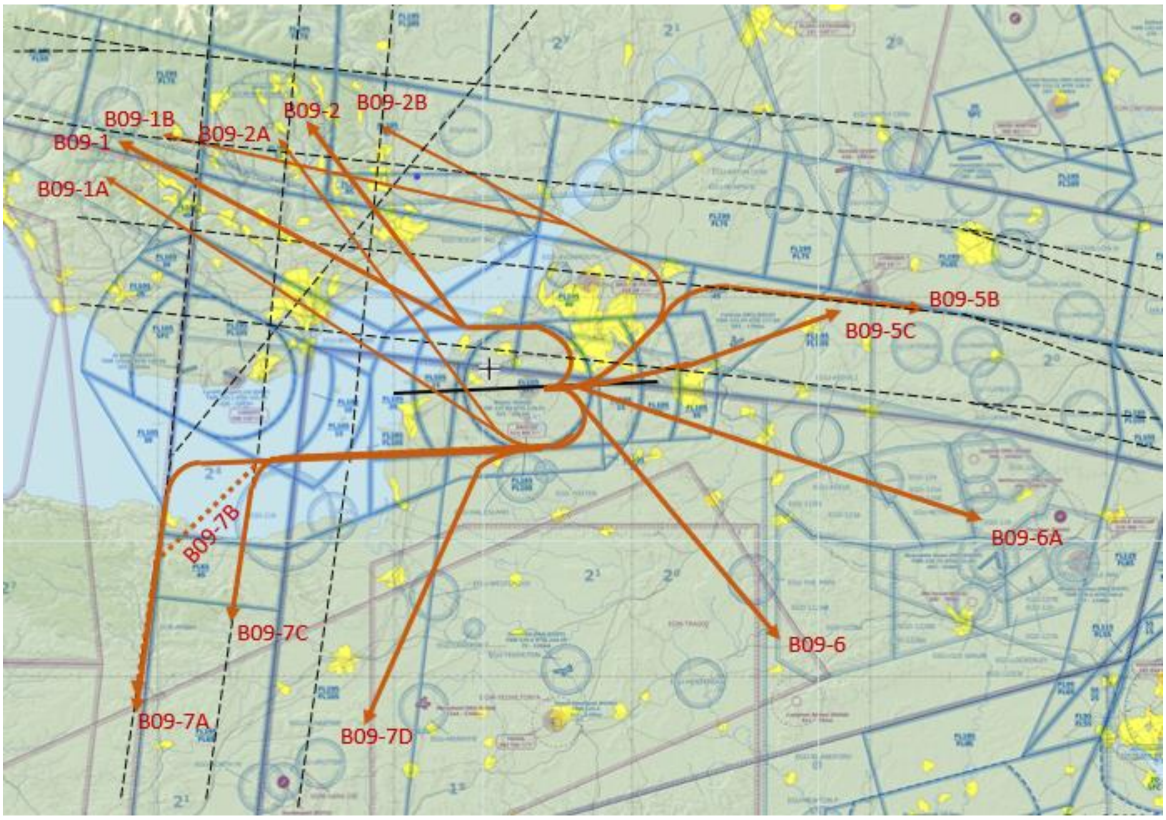

Figure 13: Runway 09 SIDs being progressed

Runway 09 SID B09-1

SID B09-1 is a left turn departure which routes north-west directly towards Strumble. The early left turn could assist in avoiding overflying central Bristol alongside making use of some of the climb being over water – both noise management advantages. From a capacity perspective, this route should support one-minute splits from other SIDs, alongside being suitable for continuous climbs. It is also well positioned for onward network connectivity.

The placement of B09-1 will need de-confliction from Cardiff traffic, as is tactically handled today. It will cross Bristol arrivals on the Transition, hence the addition of a potential kink in the lateral route in order to specify target heights and enable climb above the Transition. It may also require both new low-level and high-level CAS although this will be minimised through further objective design analysis.

Runway 09 SID B09-1A

SID B09-1A is also a direct north-west departure towards Strumble but turns right, unlike B09-1 (covered above). This procedure's right turn would allow it to completely avoid central Bristol, alongside benefiting from more of its climb being over water. It would also be easier to connect with the en-route network.

This SID would need to be carefully deconflicted from Cardiff traffic as above and Bristol inbounds. It is also positioned overhead a gliding site in the Mendips. Finally, dependent on climb rate, there could be a noise impact overhead the Mendip Hills AoNB and potentially Cardiff City.

Runway 09 SID B09-1B

This is an alternate left turn north-west departure which routes east and north of Bristol to avoid directly overflying the city. This procedure would be suitable for low performance aircraft which are unable to achieve the climb requirements of SID B09-1. The initial turn would aid in supporting reduced departure separation from other SIDs.

However, the extended track distance – albeit designed for low performance aircraft – would present an environmental inefficiency from additional fuel burn. The positioning also requires de-confliction from Cardiff traffic and Bristol inbounds from the east.

Runway 09 SID B09-2

SID B09-2 is a left turn north-west departure towards Brecon. This is an efficient route, shorter than the current and provides a noise benefit from some of the climb being over water. It would support continuous climbs, providing an environmental and capacity benefit. The route alignment could also assist in avoiding Bristol City alongside Cardiff and Newport.

It is anticipated that this procedure would support one-minute splits from other SIDs and high-performance departures however, it may not be suitable for lower performance aircraft.

This SID may require both new low-level and high-level CAS and would need to be carefully designed in order to avoid Cardiff traffic and allow separation from Bristol arrivals (as SID B09-1).

Runway 09 SID B09-2A

This is an alternate right turn departure to the north-west, towards Brecon. The right turn completely avoids overflying Bristol City and flies for longer over the water than alternate north-west departures. The initial turn would also support reduced departure separation from other SIDs, a key objective of this airspace change.

However, the right turn also introduces an environmental disbenefit as it is a longer track distance than other SIDs to the north-west. The high-ground topography within this region may mandate minimum performance requirements. Finally, there would again be a potential interaction with Cardiff traffic and Bristol inbounds.

Runway 09 SID B09-2B

SID B09-2B is an alternative left turn north-west departure towards Brecon which is routed to avoid overflying Bristol City. It is more suitable for low performance aircraft and less likely to require speed restrictions than B09-2. The initial turn would also support reduced departure separation from other SIDs.

The two main disadvantages of this SID are the extended track distance (associated environmental impact) and the potential for interactions with inbounds to Runway 09.

Runway 09 SID B09-5B

SID B09-5B was constructed as an improved alternative to B09-5A (covered below) being aligned with the proposed LD1.1 network. It turns left on departure before routing to the east thus providing a longer track distance potentially for low performance aircraft unable to meet the height requirements of SID B09-5C. It is a similar track to that tactically flown today therefore minimising the overall change.

This route would utilise existing CAS and have little or no impact on other airspace users.

The left turn of this route would create an increased track distance when compared to B09-5C (covered below) but could be positioned between Bristol and Bath.

Runway 09 SID B09-5C

SID B09-5C is a direct departure to the east and aligned with the proposed LD1.1 network. It will support continuous climb operations, providing both environmental and capacity benefits. It would not have any major impact on other airspace users or traffic flows. The height requirements for joining the network have been initially assessed, meaning this route would be suitable for the majority of jet traffic operating from Bristol.

It has been routed slightly north of Bath, providing a noise management benefit when compared to B09-5 (see below). It would also make use of existing CAS and has been positioned to connect well with the network.

Runway 09 SID B09-6

SID B09-6 is a departure to the south-east which would specifically be used early morning during first rotation, a known high demand period. It could reduce early morning delays and potentially provide a fuel saving for airlines, when compared to what is flown today. It could also enable continuous climbs, providing an environmental and capacity benefit.

A secondary benefit may be realised by removing/reducing some traffic flows from the London Middle sectors, although integration of the traffic further downstream would still have to be addressed.

However, B09-6 could potentially interact with military operations; and will require new/revised selectable CAS and airspace management procedures to be developed.

These impacts could be managed through the application of *Flexible Use of Airspace* (FUA) which would allow the usage of the route to be limited to certain hours i.e., early morning.

Runway 09 SID B09-6A

SID B09-6A is an alternative design for a south-east departure as above, with a different connectivity to the onward network.

As with B09-6, covered above, this route would be used to meet a known high demand in the morning period. Alongside the above option it could also impact upon the military, require a change to CAS and new airspace management procedures, which could be alleviated through the use of FUA.

Whilst both SID 6 and 6A (this option) would provide efficient access to the en-route network for first rotation departures, their proposed joining point leads to a significant difference in geographical placement and track over the ground. Note: only one route 6 is envisaged, alignment TBD.

SID 7 group – departures to the South

There are a number of different options for SID 7 (A/ B/ C/ D) covered below as they are predicated on the location of a southern Hold and connectivity to the onward network structure, which is complex in this area. A design intention is to create a more consistent and predictable structure within this area, where currently the differing traffic flows as well as (published) regular changes to CAS availability result in a highly tactical environment with multiple different tracks being flown.

Lateral separation from the Holds is also intended to facilitate CCO, where constraints of airspace and track separation allow. Certain proposed Hold locations may also support more than one option for a Southerly SID; these are briefly described below.

More detailed work on defining network connectivity following the proposed LD1.1 implementation as well as integration with Cardiff and Exeter traffic will be required.

Runway 09 SID B09-7A

This SID is one of the options associated with Hold C. It will climb largely over the water and is linked to network route “W”. The intention is to separate this route procedurally from Hold C in order to facilitate regular CCO. Depending on the alignment and climb profile of this route, a small fillet of new permanent CAS may be required. Departures would also need to be de-conflicted from Runway 09 arrivals. Also dependent on alignment, the route may overfly part of Weston-Super-Mare shortly after take-off.

Runway 09 SID B09-7B

This SID is similar to the above and also connects to network route “W”. It is associated with Hold B and allows for a slightly shorter route whilst still enabling lateral separation from the Hold.

Runway 09 SID B09-7C

This SID would be associated with Hold B or F and connects to network route “X”. It is intended to provide lateral separation from either Hold.

Runway 09 SID B09-7D

This SID provides an alternative network connection but still associated with Hold C.

It sits further to the East to provide potential separation from Hold C, although it would converge with the network further downstream and therefore require new permanent CAS (more than B09-7A, B09-7B or B09-7C covered above).

An advantage would be shorter track distance (thus reduced emissions) and is aligned to where the network currently positions outbound traffic when the airspace is available at weekends.

Runway 09 Departures not being progressed

Figure 14 below shows the departure options from Runway 09 which are being progressed through Stage 2. The Design Principles evaluation can be found on the CAA portal (link) for further information on the assessment.

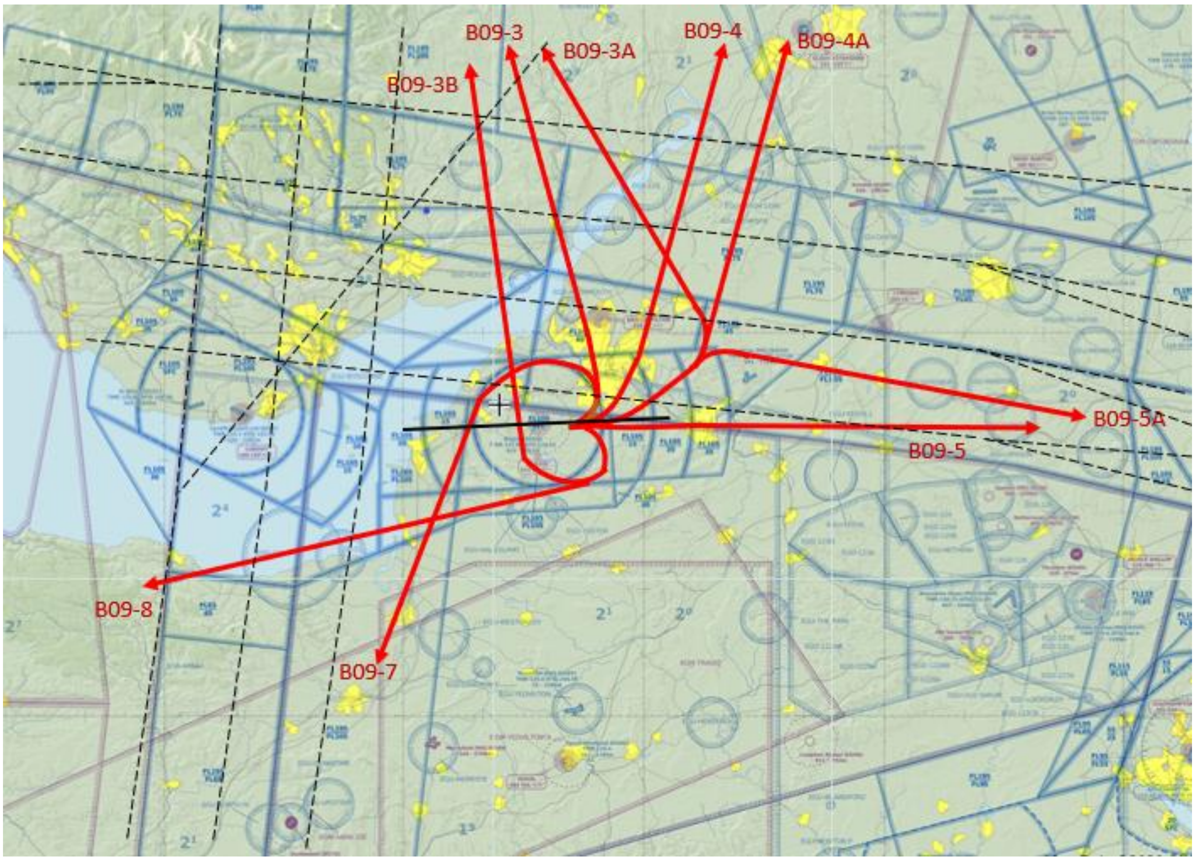

Figure 14: Runway 09 SIDs not being progressed

Runway 09 SID B09-3

SID B09-3 is a direct departure to the north and shorter than what is currently flown. It is anticipated that the early turn would support reduced departure separation from other SIDs.

Unfortunately, if there were to be a Hold to the north of Bristol, this SID would create significant capacity issues from interactions between holding and transitioning aircraft. It would also conflict with Birmingham, Bristol, and Cardiff traffic; alongside requiring additional CAS. Finally, there would be noise impacts for Bristol residents. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B09-3 option has been discounted and will not be taken any further.

Runway 09 SID B09-3A

SID B09-3A is an alternative departure to the north with a later left turn which would avoid overflying central Bristol, providing a noise advantage when compared to B09-3 (above).

The change in turn would unfortunately not alleviate the same issues encountered with B09-3 relating to capacity, impact on other airspace users and additional CAS. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B09-3A option has been discounted and will not be taken any further.

Runway 09 SID B09-3B

SID B09-3B is a further alternate departure to the north which immediately turns right before re-routing to the north. Alongside B09-3A (above) it would avoid overflying central Bristol and furthermore some of its climb would be over water, a further noise management advantage over B09-3.

Unfortunately, B09-3B exhibits the same drawbacks as SIDs B09-3 and B09-3A (covered above) associated with capacity, impact on other airspace users and additional CAS. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this SID B09-3B option has been discounted and will not be taken any further.

Runway 09 SID B09-4

SID B09-4 is a left turn departure to the north and has been included as an option for the small number of destinations in this direction. It is a direct route offering minimal fuel burn and associated emissions.

Unfortunately, a route in this region would cause several issues including flying directly over the centre of Bristol and requiring an increase in CAS. It would also interact with Cardiff traffic, Birmingham traffic and Bristol arrivals, which all operate in this region. If Bristol has a Hold in the north, this route could create significant capacity issues and would also not comply with network connectivity – also likely requiring additional CAS. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this SID B09-4 option has been discounted and will not be taken any further.

Runway 09 SID B09-4A

This is an alternate departure to the north but, unlike B09-4 (above), it routes east of Bristol City. Alongside the noise management benefit, it is likely that this departure option would not require speed limitations due to its wider turn (unlike B09-4).

However, this option would encounter all of the same other issues as B09-4 including an increase in CAS, interaction with other traffic flows, capacity constraints and network connectivity. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this SID B09-4A option has been discounted and will not be taken any further.

Runway 09 SID B09-5

SID B09-5 is a direct departure to the east and shorter than what is flown today, providing an environmental improvement. It would not have any major impact on other airspace users or traffic flows.

A consequence of departing straight to the east is that this route would directly overfly Bath. It has also no network connectivity and would accordingly most likely require additional CAS. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this SID B09-5 option has been discounted and will not be taken any further. B09-5B (covered above) was created as an alternative to this option which benefits from good network connectivity.

Runway 09 SID B09-5A

SID B09-5A is an alternate departure to the east which turns left before routing east. Although this increases the track distance when compared to B09-5 (above), it would completely avoid overflying Bath.

Unfortunately, this departure would have the same lack of network connectivity as B09-5. Therefore, and as covered further in the supporting *Stage 2B Design Principles Evaluation* document, this SID B09-5A option has been discounted and will not be taken any further. SID B09-5B (covered above) was created as an alternative to this option which benefits from good network connectivity.

Design Options: Runway 27 SIDs

Runway 27 SID options being progressed

Figure 15 below shows the departure options from Runway 27 which are being progressed through Stage 2. The Design Principles evaluation can be found on the CAA portal (link) for further information on the assessment.

Note that all SID design options assume the introduction of the London LD1.1 network. The LD1.1 route proposals are shown in all cases as the black dashed lines in the following charts.

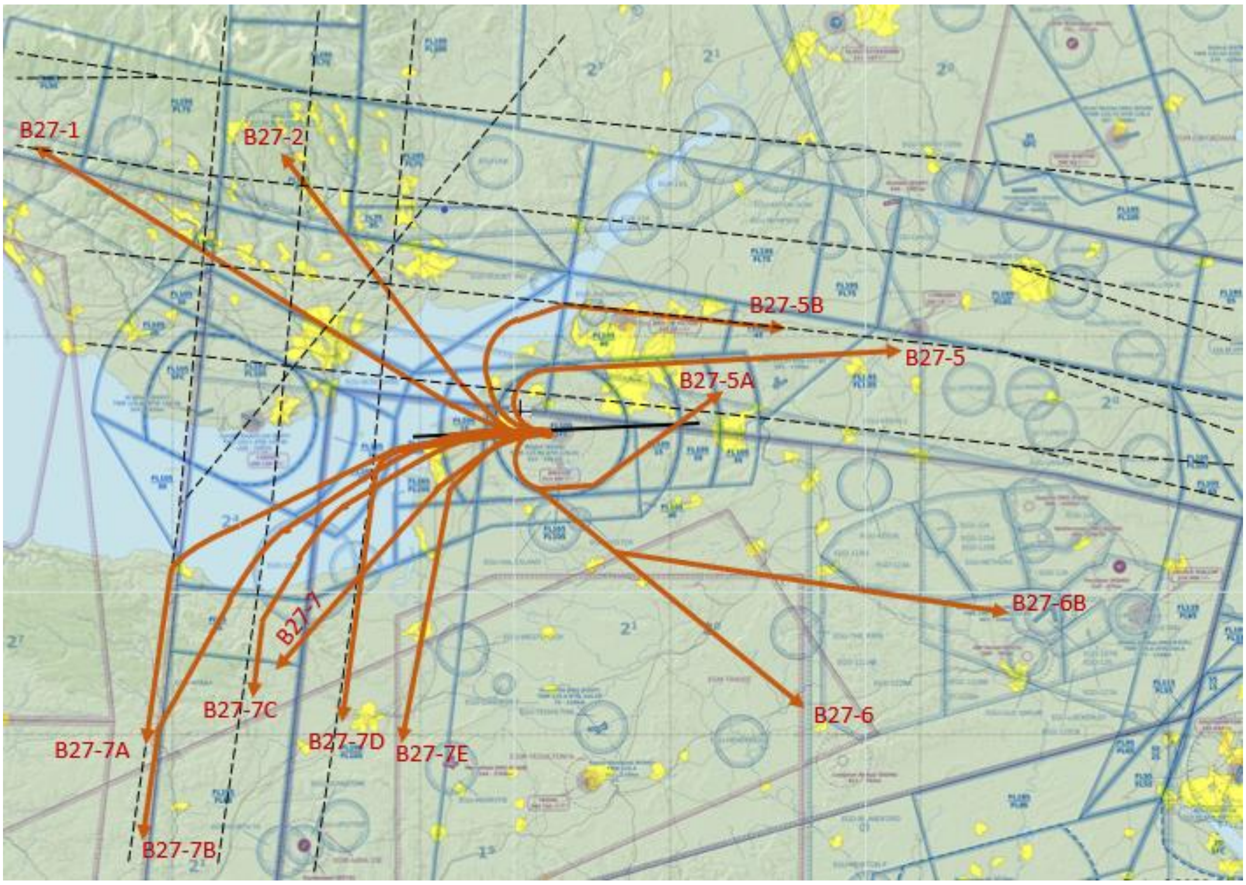

Figure 15: Runway 27 SIDs being progressed

Runway 27 SID B27-1

This is a westbound departure which is a more direct routing than the current route via Brecon (BCN), thus providing an environmental improvement from the reduced track distance. A lot of the climb would be over water and most traffic likely to reach 7,000ft before reaching landfall which would help with noise management.

This would be a more systemised version of what is currently flown tactically and well positioned for connectivity to the onward network. It would also support continuous climb departures, dependent on integration with Cardiff traffic.

A small amount of additional CAS may be required north-west of Cardiff Airport. Alongside, close collaboration required with Cardiff Airport to avoid any possible conflict with their traffic flows. Indicative alignment is shown, but there is flexibility to achieve the above.

Runway 27 SID B27-2

This is a departure to the north to connect with the network in the vicinity of BCN. It is similar to the current northern departure route therefore introducing minimal change. Similar to SID B27-1 (above), some of the climb would be over water; again, providing a noise benefit. It would be well positioned for network connectivity and also enable continuous climb departures (dependent on Cardiff traffic, as above).

Deconflicting this route from Cardiff inbound and outbound traffic would need to be addressed through continued joint development with Cardiff.

Runway 27 SID B27-5

This is a direct departure to the east which would provide a shorter routing than flown today and more suitably aligned for network connectivity. It would utilise current CAS where possible but may need a small revision of certain CTA bases to the North of the airport. This will be fully assessed in order to minimise any negative impacts on other airspace users.

It follows what is tactically flown today therefore reducing workload and further improving network connectivity. An initial earlier turn of this procedure would be intended to support reduced departure separation from other SIDs and continuous climbs.

The intention is to separate the route laterally from Hold A, and to specify a minimum climb gradient (through specific target heights) to separate above Bristol inbounds on the Transition from Hold A, thus enabling increased use of continuous climbs and improving network connectivity. However, as today this route also lies directly above Bristol City.

Runway 27 SID B27-5A

This is an alternate left-turn departure to the east which is also a shorter flight plan option than is currently flown (alongside B27-5 above). It avoids overflying central Bristol and would be well positioned for network connectivity. A key feature is the provision of an alternative route for noise respite.

The procedure may require additional features – such as step-climbs or speed restrictions – in order to procedurally separate from arrivals to Runway 27. The design intention is to contain this route within existing CAS, but this is subject to more detailed design analysis.

Runway 27 SID B27-5B

SID B27-5B is an alternate eastern departure for slow climbing and low performance aircraft. It could be used as a respite route and avoids flying directly over Bristol City. The placement of the route would also take advantage of climbing over the water, providing a further noise benefit.

However, it is a longer track distance than SID B27-5. This could create operational complexity in terms of longitudinal separation requirements for delivery to the network. Although procedural separation from Hold A is intended in a lateral sense (subject to the necessary safety assessments) published continuous climbs may not be possible.

Runway 27 SID B27-6

This is a departure route to the south-east which would be used for first rotation, during a known high demand period for early departures. It would reduce early morning delays and provide a significant fuel saving for airlines through more direct routing, when compared to what is flown today. A secondary benefit may be realised by removing/reducing some traffic flows from the London Middle sectors, although integration of the traffic further downstream would still have to be addressed.

The intention is for a single route. Two alternative designs are shown at this stage at the request of London to cover different possibilities of network re-join positions in the LAC Hurn sector area.

SID B27-6 would overfly a gliding site in the Mendip Hills region alongside the AoNB itself, although gliding is not likely to be operating during the intended period of use for this SID. It may conflict with military operations; and will require new/revised selectable CAS and airspace management procedures to be developed. These impacts could be managed through the application of Flexible Use of Airspace (FUA) which would allow the usage of the route to be limited to certain hours i.e., early morning.

Runway 27 SID B27-6B

SID B27-6B is an alternative design for south-east departure to be used for first rotation. The earlier turn has been included to support reduced departure separation from other SIDs.

Issues associated with other airspace users and resolution through FUA apply as above.

SID 7 group – departures to the South.

Similar to the southerly SIDs from runway 09 (see above) these options are predicated upon both the alternative positions of the Hold and connectivity to the onward network. They will also need to be de-conflicted from Runway 27 downwind left arrivals.

Initial procedure alignment is planned to provide for 1 minute departure separations from SIDs to the North and East, subject to detailed analysis and any requirements for adjustment to CAS. Following on from initial engagement, further detailed work on defining network connectivity following the proposed LD1.1 implementation as well as integration with Cardiff and Exeter traffic will be conducted.

Runway 27 SID B27-7

This SID is associated with Hold F and connects to network route "X". It is more direct than is currently flown, providing an environmental benefit from reduced fuel burn. The intention is to separate this route procedurally from Hold F in order to facilitate regular CCO. Depending on the alignment and climb profile of this route, a small fillet of new permanent CAS may be required. Also dependent on alignment, the route may overfly part of Weston-Super-Mare shortly after take-off.

Runway 27 SID B27-7A

This SID is one of the options associated with Hold C. It will climb largely over the water and is linked to network route "W". It is expected to be contained within existing CAS.

Runway 27 SID B27-7B

This SID is similar to the above and also connects to network route "W". It is associated with Hold B and allows for a slightly shorter route whilst still enabling lateral separation from the Hold.

Runway 27 SID B27-7C

This SID is associated with Hold B but connects to network route "X". It is intended to provide lateral separation from Hold B.

Runway 27 SID B27-7D

This SID is associated with Hold C and connects to network route "Y". However, it would not be laterally separated from Hold C in its currently proposed orientation requiring tactical climb instructions.

Runway 27 SID B27-7E

This SID provides an alternative route but still associated with Hold C.

It sits further to the East to provide potential separation from Hold C, although it would converge with the network further downstream and therefore require new permanent CAS. There is also a cross-over with the inbound Transition which would result in tactical climb (as today's operation).

An advantage would be shorter track distance (thus reduced emissions) and is aligned to where the network currently positions outbound traffic when the airspace is available at weekends.

Runway 27 SID options not being progressed

Figure 16 below shows the departure options from Runway 27 which are not being progressed through Stage 2. The Design Principles evaluation can be found on the CAA portal (link) for further information on the assessment.

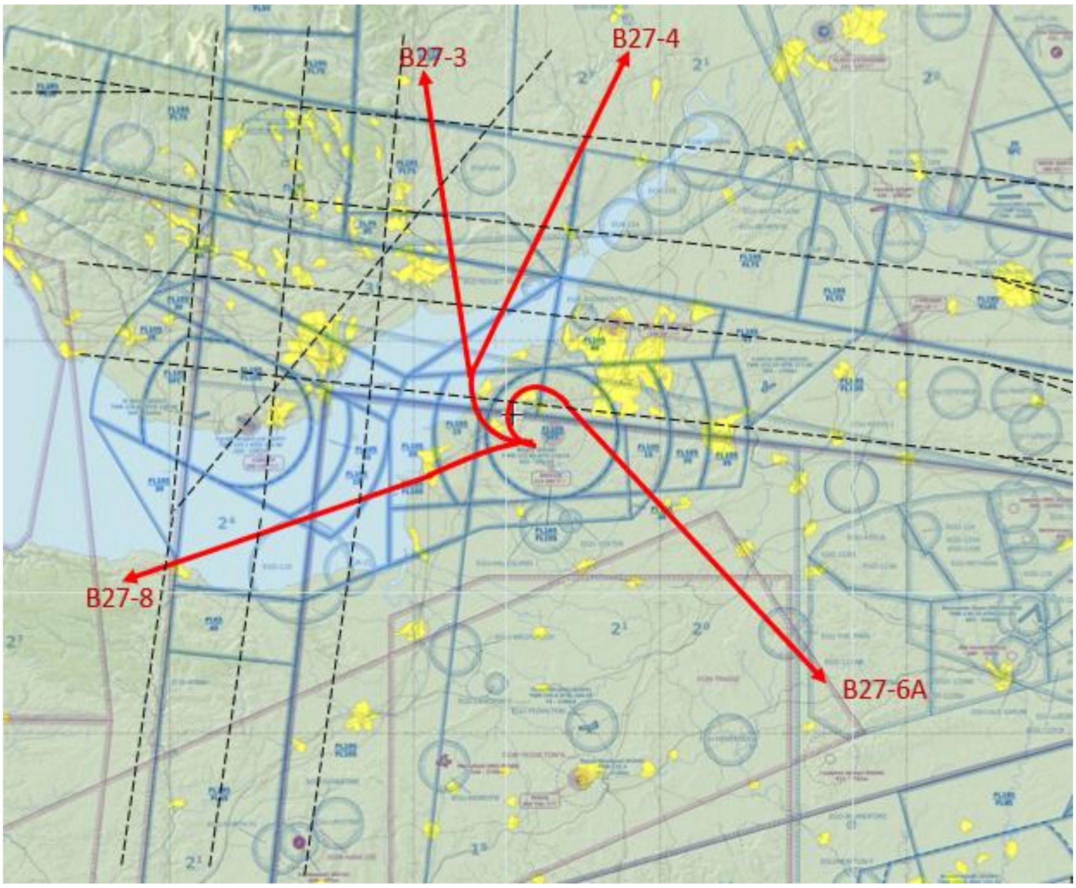

Figure 16: Runway 27 SIDs not being progressed

Runway 27 SID B27-3

This is a northern departure which would be more direct than currently flown. The initial placement over water and minimal populated areas would provide a noise management benefit.

However, it is anticipated that there would be significant capacity issues from the conflict with a potential northern Hold. There would also be interactions with Cardiff, Bristol, and Birmingham traffic.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B27-3 option has been discounted and will not be taken any further.

Runway 27 SID B27-4

B27-4 is a direct departure route to the north-east. Some of the very initial climb would take place over water which would reduce noise impact for ground-based stakeholders. This option would provide a limited environmental improvement as it would be more direct route to a small number of destinations.

However, it is anticipated that there would be a very limited demand for a departure route in this direction which would make the requirement for additional CAS difficult to justify. There would also be interactions with Cardiff, Bristol, Birmingham, and potentially military traffic.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B27-4 option has been discounted and will not be taken any further.

Runway 27 SID B27-6A

This is an alternative south-east departure to B27-6 (as covered above) which could potentially be used as a respite option. The wrap-around part of the procedure may reduce the amount of new CAS required, when compared to SID 6.

However, this would be an incredibly complex procedure whereby traffic would travel “back at” other Bristol traffic. There are significant safety concerns due to the very likely confliction with other traffic.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B27-6A option has been discounted and will not be taken any further.

Runway 27 SID B27-8

SID B27-8 is a departure to the south-west, towards Lands’ End and intended for traffic on Oceanic tracks. It is a direct route and would make use of climbing over the water, thus providing environmental and noise management advantages.

However, there is no current network connectivity within this region and would likely interact with military training, Cardiff, and Bristol traffic. Alongside this, the very low demand for this routing would not outweigh the development cost and potential impact on other airspace users.

As covered further in the supporting *Stage 2B Design Principles Evaluation* document, this B27-8 option has been discounted and will not be taken any further.

Standard Arrival Route (STAR) procedures

A STAR is a published Instrument Flight Rules (IFR) ATS route by which aircraft should proceed from the en-route phase to a Hold.

The proposed positions of Holds are reproduced in the diagram below, along with indications of the approximate alignment of STARs. However, these are indicative only; the links from the en-route network and the resultant design of STARs will be the responsibility of the en-route operating authority (NERL), albeit in consultation with the airports.

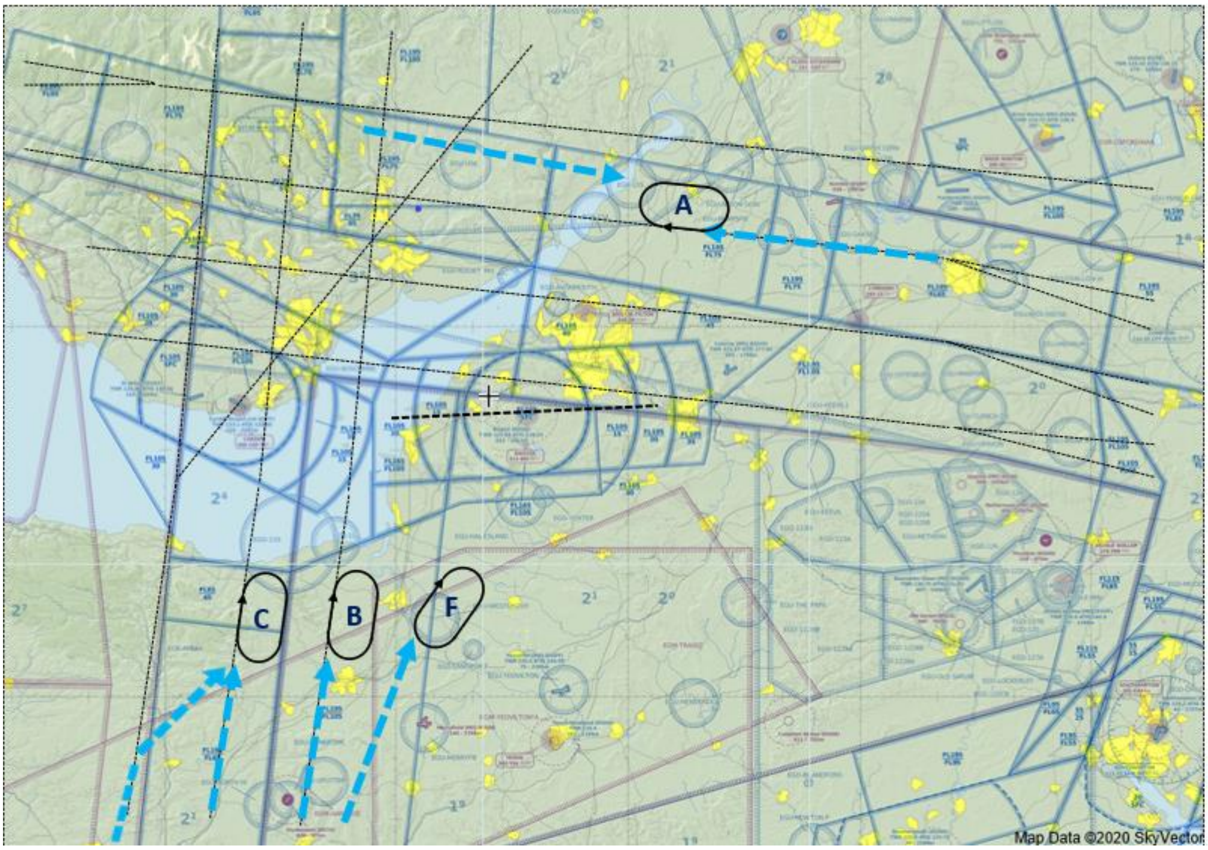

Figure 17: Bristol Airport Holds and Indicative STARs

Conclusion and Next Steps

As part of the CAP16161 Stage 2 Develop and Assess Bristol Airport has conducted comprehensive two-way engagement with the same stakeholders who were engaged during Stage 1B. The outcome of this engagement has influenced the selection of the design options presented herein.

There are a vast number of potential options available for the airport procedures, with numerous possibilities for arrival, departure and holding procedure combinations, and a variety of factors which could impact or be impacted. This document has described a proportional and reasonable number of options, which have been explored with stakeholders through the process documented here.

The comprehensive list of viable options presented within this document are indicative designs which do not represent specific route or procedure options. It is not proportional to present this level of detail at this stage as the number of option permutations would be unmanageable for both the change sponsor and stakeholders. For example, the precise position and classification of CAS will be determined by the final design options and based on the CAA's CAS containment policy. Therefore, it is not possible to present detailed design information such as CAS boundaries at this stage of CAP1616. As the design options that progress through to Stage 3 are developed, the level of detail will be increased, and CAS requirements provided.

We will submit this document to the CAA as evidence to support Stage 2 of the CAP1616 Airspace Change Process. In turn, this will complete the evidence required for the Stage 2 Develop and Assess Assessment Gateway (document deadline 28th January 2022, for the CAA's February 2022 Assessment Gateway).

This document has been submitted alongside the following two which can also be found on the portal:

- *Step 2A Design Principle Evaluation* which evaluates the design options listed in this document against the Design Principles from Stage 1, reducing the longlist to a shortlist for appraisal.
- *Step 2B Initial Options Appraisal* which qualitatively assesses each of the progressed design options against different impacts and also includes a safety assessment.

Towards the end of this document (Appendix E), a number of "scenario" diagrams have been included which show different combinations of the design options presented in this document. This demonstrates the next step Bristol Airport will be taking whereby the individual design options are brought together into complete airport/airspace systems.

This design work will continue when we start Stage 3, and we look forward to engaging our stakeholders to ensure these designs best meet our Design Principles.

Appendix A: Design Principles

The below table summarises the final Design Principles which resulted from the Stage 1 Define work. The Stage 1B Design Principles document submitted to the CAA (link) summarises the engagement completed; feedback received from aviation/community stakeholders; and the final Design Principles which resulted from this feedback.

Design Principles have been split into general categories (e.g., policy, regulation) and prioritised from “A” high – “C” lower. These priorities are partially based on whether the Design Principles are mandatory (e.g., consideration of safety) or where there exist choices and there could be alternative preferences (e.g., should the change minimise the number of people newly overflown or maximise sharing through managed dispersal).

Category	Design Principle and Priority	Details
Safety	DP1) Must maintain and where possible, enhance safety standards *Priority A*	Safety is at the forefront of everything Bristol Airport does. We believe that it is crucial that a new airspace design maintains and where possible enhances current safety standards.
Policy	DP2) Must accord with the CAA’s published Airspace Modernisation Strategy (CAP 1711) and any current or future plans associated with it *Priority A*	CAP 1711 describes what airspace modernisation must deliver including: - the need to increase aviation capacity. - growth to be sustainable. - the need to maximise the utilisation of existing runway capacity
Regulation	DP3) Must be compliant with all relevant laws and regulations *Priority A*	To maintain safety and ensure integration with the wider airspace.
Technical	DP4) Must maximise efficiency by using modern navigation technology *Priority A*	The reliance on legacy technology must be removed. Furthermore, aircraft navigation capabilities have increased. To maximise the benefits that these improvements bring, including satellite navigation standards and route positioning accuracy, arrival and departure routes must be designed to make full use of modern navigation technology.
Operational	DP5) Must provide sufficient capacity to support future demand *Priority A*	We believe that Bristol Airport will need to respond to future growth opportunities and as part of the Airspace Modernisation Strategy programme will, in accordance with government policy, ensure that any new airspace design is sufficient to cope with increased demand and link efficiently into the national network.
Environmental	DP6) Should minimise fuel burn and CO_2 emissions per flight as far as possible *Priority A*	Bristol Airport should, through airspace design, seek to implement the most efficient flight profiles.
Environmental	DP7) Should use noise-efficient operational practices to minimise the impact of aircraft noise on the local	Bristol Airport should, where possible, reduce and mitigate noise and its distribution in order to manage the impact of aviation growth on local communities in line with government policies. The Air Navigation Guidance 2017 states that the

Category	Design Principle and Priority	Details
	community and stakeholders **Refer to the Noise Mitigation Design Principles (11-15) ** *Priority A*	priority for airspace below 7,000ft is to minimise the impact of aviation noise, unless evidence demonstrates a disproportionate increase in CO_2 emissions
Operational	DP8) Should maintain or enhance operational resilience of the Air Traffic Control network *Priority B*	Bristol Airport should consider airspace and route designs that benefit the operation and resilience of the airport and the national airspace network.
Technical	DP9) Should minimise impact on other airspace users *Priority B*	In accordance with the CAA's published Airspace Modernisation Strategy, Bristol Airport should 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.
Technical	DP10) Should minimise controlled airspace (CAS) and impact on adjacent aerodrome and airfields *Priority B*	The volume of CAS considered by Bristol Airport should be the minimum necessary to deliver a safe and efficient operation, taking into account Procedure Design standards and the needs of adjacent aerodromes and airfields.

The following five "sub" Design Principles have been included as noise mitigations alongside the more general noise-focussed Design Principle 7. Bristol Airport will seek to minimise noise impact where possible, and we will consider local circumstances.

Government guidance also states that minimising noise should be the priority for airspace design below 7,000ft. We recognise that there are several applications of this guidance and have therefore provided the following sub-principles.

Noise Mitigation Design Principle and Priority	Details
DP11) Minimise the number of people newly overflown *Priority c*	To avoid exposing people to aircraft noise who are currently not exposed
DP12) Maximise sharing through predictable respite routes *Priority b*	Operate multiple arrival and departure routes and alternate between these routes at different times of the day or days of the week. This would allow communities to have predictable periods of respite
DP13) Avoid overflying communities with multiple routes, including from other airports *Priority c*	Use the opportunity to work with other airports to find a solution for this.

Noise Mitigation Design Principle and Priority	Details
DP14) Maximise sharing through managed dispersal *Priority c*	An alternative approach to maximising sharing is to spread routes over a wider area to share the impact of noise. This would mean each flight path was flown less frequently but a wider area would be affected by noise
DP15) Minimise the total population overflown *Priority b*	Concentrating aircraft along defined routes to minimise the total number of people exposed to aircraft noise.

Appendix B: Summary of Stakeholder Engagement Evidence

The below summarises the engagement activities which were completed as part of *Stage 2: Step 2A Options Development*. Feedback and comments from the workshops have been incorporated into the design option descriptions provided in the main section of this document; the below summarises the format of the workshops.

Appropriate redacted notes summarising engagement activities have been submitted to the CAA and uploaded to the portal.

Bristol Airport Stage 2 Design Workshop (08/01/20)

Attended by representatives from ACOG, Bristol Airport, Cardiff Airport and NERL

Bristol Airport ran a workshop with subject matter experts from the above organisations. A presentation was given on the background of Bristol Airport's current airspace/route structure and typical usage, alongside the requirement for airspace modernisation both locally and in tandem with the rest of the UK. Bristol Airport also provided a recap on the Design Principles and next steps involving the Design Options work.

Participants of the workshop were then encouraged to examine and provide feedback on potential departure routes, inbound routes, a Hold, and alternative delay absorption methods. A rough diagram of each potential design was captured alongside a list of pros and cons, such as environmental or noise related.

Bristol Airport and LAMP Design Surge Workshop (22/01/20)

Attended by representatives from Bristol Airport, Cardiff Airport and NERL

The LAMP design team hosted an interactive workshop where they discussed their upcoming simulations. Bristol Airport were invited to input preferences alongside attending relevant sim sessions. LAMP provided cut-off dates for when design preferences could be supplied by in order to be incorporated into the sims.

Discussion on Bristol's existing requirement set such as a Hold not positioned above the airfield and designing routes to an RNAV1 specification. Bristol unlikely to pursue a point merge option due to traffic volumes not necessitating one and the large volume of CAS required.

The potential for joint engagement/consultation activities was discussed and LAMP offered to support airport appropriate events.

LAMP update provided on design evolution including potential systemised arrival and departure routes (>7,000ft) for Bristol and Cardiff traffic. There will be a defined number (5/6 possibly) of E/W routes including LTMA traffic alongside the West Airports. Participants discussed how Bristol traffic would feed into/off the new LTMA routes and network.

Bristol Airport provided an update on the initial design ideas which were developed in their initial design workshop (08/01/20), covered above.

Bristol Airport Stage 2 Design Workshop (13/02/20)

Attended by representatives from ACOG, Bristol Airport, Cardiff Airport and NERL

Bristol Airport Head of Sustainability provided a presentation on the progress of Bristol's planning application, current noise climate and complaints received.

The Bristol design team gave an update on an initial assessment provided by NATS Procedural Design Group (PDG) on the output of the initial design workshops. This provided a rudimentary assessment on the potential turn radii and climb gradients/speeds of the different design options.

LAMP team provided an update on their ongoing design work including high-level routes applicable to Bristol (and Cardiff) traffic. Suggestion for Bristol Airport to attend upcoming sims and provide feedback.

Bristol Airport delivered an update on the previous design workshops, including issues with specific SID options when considering the network. Participants were asked to specifically provide feedback on the indicative Hold positions previously created in the design work. Feedback received (as summarised in this document) included consideration of potential new CAS required, interaction with known traffic flows and looking individually at the 09/ 27 operations.

Bristol Airport and LAMP Engagement (24/02/2020)

Attended by representatives from Bristol Airport, Exeter Airport and NERL

Individual updates were provided from the LAMP and Bristol Airport design teams such as project timelines and LAMP deployment plan. Agreement that designs currently seem to be complementary although further work required, such as network traffic flows from the south. Bristol confirmed requirement for a delay absorption mechanism, most likely a traditional holding pattern. Exeter Airport also updated LAMP on their future requirements.

Bristol Airport Options Development Workshops – Aviation Stakeholders (25/02/2020 – 26/02/2020)

Attended by representatives from Bath & North Wilts GC, Bristol Airport, Bristol & Gloucester Gliding Club, Bristol & Wessex Aeroplane Club, Brize Norton, Cardiff Airport, Exeter Airport, Gloucester Airport, Light Aircraft Association (LAA), Mendip Gliding Club, MoD, NERL, Ryanair, Stobart air, TUI, Western Region British Balloon & Airship Club

Bristol Airport invited their aviation stakeholders to participate in one of two design workshops which were hosted at the Airport. The purpose of these workshops was to update the participants on the ACP progress since the Stage 1B *Design Principles* engagement and provide an opportunity for them to input on the design work undertaken so far.

Participants were given an update on the design work undertaken so far with an open dialogue for questions and feedback. Comments on the proposed holding pattern locations were received alongside a conversation on the drawbacks of a Point Merge procedure e.g., excessive CAS required.

Alongside feedback on the design options there were additional conversations on noise abatement (mitigation) procedures, the related network changes being led by NERL and expected climb gradients flown by typical aircraft which operate to/from Bristol Airport. Representatives from the GA community raised concerns over the potential lowering of CAS. As stated, any proposed changes would have to be fully justified, and against the mitigating Design Principle in place.

Bristol Airport, Cardiff Airport and LAMP Workshop (03/03/2020)

Attended by representatives from Bristol Airport, Cardiff Airport and NERL

LAMP updated attendees on their latest systemised designs and worked through various scenarios with regards to future connectivity. There was a discussion on where the Bristol (and Cardiff) Holds would be best placed and arrival/departure traffic presented. The group also looked at the current delegated Air Traffic Services (ATS) and whether these might need to change in the future e.g., move the ATS boundary.

Bristol Airport Stage 2 Engagement Presentations (09/11/2021 – 10/11/2021)

All of Bristol Airport's stakeholders (identified during Stage 1) were invited.
Attended by a wide variety of community, local and aviation stakeholders (Air Ambulance, Bristol, Bristol Airport Consultative Committee, Cardiff, Council/ Parish representatives, Department of Health/ Social Care, Duries, easyJet, Executive Jet Charter Ltd, Exeter, Light Aircraft Association, NERL, Residents' Action Group, Ryanair, Trade Unions Congress)

Bristol Airport hosted two online presentations which all their stakeholders were invited to. Attendees were provided with an update on the Stage 2 design work undertaken and next steps. They were also invited to submit questions and comments during the presentations. Questions were answered during the presentations alongside formal Q&As sent out to all of those who attended.

Further Engagement Meetings

The following meetings were also attended by Bristol Airport in relation to the wider programme of airspace modernisation which they are part of. They have been separated from the above design workshops as they were focussed on providing updates across the different various ACPs and the wider UK programme of airspace change.

Engagement Activity	Date	Participating Stakeholders	Summary of Engagement
LD1/ Bristol/ Cardiff engagement meeting	28/01/2021	ACOG, Bristol, Cardiff, NERL	NERL provided an update on their design work using the DesignAir visualisation tool. Bristol and Cardiff provided feedback on the latest LD1.1 designs such as incorporation with their own future changes.
LD1/ Bristol/ Cardiff design workshop	25/02/2021	ACOG, Bristol, Cardiff, NERL	NERL presented an update on their West Airspace design and welcomed feedback from Bristol and Cardiff. Design update included systemised traffic flows, delegated airspace and Holds. Feedback taken forward to upcoming development sims.
FASI S & N Programme Board Meeting	26/03/2021	ACOG, AGS, Bristol, Edinburgh, Gatwick, London City, MoD NERL	Update on ACP remobilisation and secured DfT funding. NERL provided update on restructuring of their en-route ACPs.
LD1/ airports system requirements engagement meeting	26/03/2021	Bristol, Cardiff, Exeter, NERL	Discussion on which airport systems will be impacted by the West programme deployment. Bristol noted their own systems including EFPS, radar displays and their simulator.
LD1/ Bristol engagement	31/03/2021	Bristol, NERL	NERL provided update on LD1.1 and FRA ACP

Engagement Activity	Date	Participating Stakeholders	Summary of Engagement
meeting			progress. Discussion on alignment of the LD1.1 and Bristol ACP plans.
LD1/ Bristol/ Cardiff engagement meeting	26/04/2021	ACOG, Bristol, Cardiff, NERL	LD1 design team provided an update following their development sims. Discussion and feedback received on various elements of LD1 design including truncation of Bristol SIDs and potential raising of airspace bases. Further development sims planned.
LD1/ Bristol engagement meeting	07/05/2021	Bristol, NERL	NERL provided update on WAD – West Airspace Deployment - being a combination of the LD1 and FRA D2 ACPs, and associated timelines. WAD design update provided and associated benefits for Bristol e.g., more CCOs/ CDOs and fewer delays.
LD1/ Cardiff/ Bristol engagement meeting	24/05/2021	ACOG, Bristol, Cardiff, NERL	Participants each provided an update on their design work. NERL (LD1) design at a more mature phase; the design team welcomed feedback on their planned interface with Bristol and Cardiff traffic.
LD1/ Bristol strategic meeting	28/05/2021	Bristol, NERL	LD1 update on their systemised design. Discussion on how Bristol will glean benefits from the LD1 ACP alone but more from their own low-level change (dependent ACPs). Bristol raised concerns regarding the DVOR programme timeline.
Masterplan briefing	17/06/2021	ACOG, Bristol, Cardiff, Exeter, MoD	ACOG provided an update on the development of the airspace change masterplan including the plan for several iterations. The requirements on ACOG and change sponsors were explained, such as working together to identify dependencies between ACPs.
Update on NERL Sim Output	21/06/2021	Bristol, Cardiff, NERL	NERL provided an update on their simulation output including feedback from Bristol and Cardiff traffic runs.
LD1/ Cardiff/ Bristol engagement meeting	28/06/2021	ACOG, Bristol, Cardiff, NERL	Progress on individual ACPs provided. NERL provided an update on the output from a “mini-sim” they had run including potential changes to their design.
West deployment programme coordination	06/07/2021	ACOG, Bristol, Cardiff, Exeter,	ACOG provided an update on the Masterplan and deployment planning.

Engagement Activity	Date	Participating Stakeholders	Summary of Engagement
meeting		NERL	Bristol updated participants on their plan for further Stage 2 engagement and flagged concerns about the DVOR programme timeline again.
LD1 engagement workshop	25/07/2021	ACOG, Bristol, Cardiff, Exeter, NERL	Update on LD1 design provided. Principle of doing a combined assessment between Bristol and Cardiff was supported (with potential for Exeter to join).
LD1/ Cardiff/ Bristol engagement meeting	10/09/2021	Bristol, Cardiff, NERL	NERL update that LD1.1 has passed through Stage 3 and their consultation is live. Discussion held on how Bristol and Cardiff traffic will utilise new en-route routes.
West Programme Sim/ Safety Meeting	29/09/2021	ACOG, Bristol, Cardiff, Exeter, NERL	Discussion on upcoming safety and simulation activities.
West Deployment Programme Coordination Meeting	16/11/2021	ACOG, Bristol, Cardiff, Exeter, NERL	Updates on different ACPs provided. Various elements of upcoming CAP1616 stages discussed included simulations, safety work and overall timelines. ACOG provided update on upcoming Masterplan Iteration 2.
MoD engagement/ update - TEAMs presentation	29/11/2021	Bristol Airport, MoD	Update on Stage 2 design options progress, opportunity for questions/ feedback and next steps outlined.
British Gliding Association (BGA) engagement/ update – TEAMs presentation	30/11/2021	BGA, Bristol Airport	Update on Stage 2 design options progress, opportunity for questions/ feedback and next steps outlined.
NERL West/ Severn Group Airports Engagement Meeting	07/01/2022	ACOG, Bristol, Cardiff, Exeter, NERL	NERL provided a summary on their LD1.1 consultation including responses received. As a result of consultation feedback, NERL provided an update and justification on a revision to the LD1.1 design.
Engagement Meeting	27/04/2022	Cotswolds AoNB, Mendip Hills AoNB and Wye Valley AoNB	Bristol Airport provided an update on their ACP including design work completed so far, next steps and involvement within the wider UK programme of airspace change. Comments and feedback welcome. Attendees were content with the level of detail provided at this stage but keen to be involved in further engagement/ consultation activities.

Appendix C: Summary of Bristol Airport Airspace Change Stakeholders

In July 2019, prior to the Stage 1 engagement activities, Bristol Airport Limited (BAL) identified relevant aviation industry and community stakeholders, alongside an associated representative for each.

Bristol Airport used the "Potentially Affected Area" which covers areas that could potentially be overflown below 7,000ft (as shown on the CAA Airspace Change portal), to identify relevant aviation industry and community stakeholders. This geographical area covered most of the local aviation and community stakeholders listed below however, Bristol Airport also contacted a number of additional organisations they are mandated to engage with, or who could potentially be impacted.

Bristol Airport engaged with adjacent airports who they will need to coordinate any changes with, due to their close airspace and procedure proximity. We ensured that we engaged with appropriate airspace users who use the airspace around Bristol Airport such as Great Western Air Ambulance and the National Police Air Service. We have also engaged with stakeholders who we are required to contact as part of an airspace change: namely the Ministry of Defence (MoD) and representatives from the National Air Traffic Management Advisory Committee (NATMAC), which covers a wide variety of airlines and aviation organisations.

Aviation industry stakeholders:

- Airspace Change Organising Group (ACOG)
- 20 adjacent regional, commercial, and private airports: *Bodmin, Cardiff, Cheltenham Racecourse, Compton Abbas, Eaglescott, Exeter, Henstridge, Kemble Cotswold, Oaksey Park, Old Sarum, Perranporth, Redlands, RNAS Yeovilton, Staverton, Swansea, Truro, Ubley, Wesbury-sub-Mendip, West Zoyland, Yeovil*
- 18 Airlines: *Air Malta, Aurigny, Austrian, BA, Blue Islands, Brussel Airlines, Eastern Airways, easyJet, Flybe, Jet2, KLM, Loganair, Ryanair, Stobart Air, Thomas Cook, Titan Airways, TUI, Wizzair*
- Bristol Airport based companies: *Bristol Wessex, Centreline Aviation, ProFred, Western Power Distribution and Bristol University UAVs*
- Bristol Airport Consultative Committee members (x23)
- Bristol FLOPSC Group
- Great Western Air Ambulance
- Local Flying/ Recreational Clubs: *Bailey's Balloons, Bristol & Gloucester Gliding Club, British Balloon & Airship Club, Mendip Gliding, Avon Hang Gliding & Paragliding, Woodspring Model Aircraft and New Farm Flying*
- MoD (via DAATM and local bases – Boscombe Down, RAF Benson, RAF Fairford, SAS Hereford)
- National Police Air Service
- 34 NATMAC organisations: *Aircraft Owners and Pilots Association (AOPA), Aircraft Owners and Pilots Association (AOPA), Airfield Operators Group (AOG), Airlines UK, Airport Operators Association (AOA), Airspace4All, Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK), Aviation Environment Federation (AEF), BAe Systems, British Airline Pilots Association (BALPA), BA, British Balloon and Airship Club, British Business and General Aviation Association (BBGA), British Gliding Association (BGA), British Hang Gliding and Paragliding Association (BHPA), British Helicopter Association (BHA), British Microlight Aircraft Association (BMAA) / General Aviation Safety Council (GASCo), British Model Flying Association (BMFA), British Parachute Association (BPA), General Aviation Alliance (GAA), Guild of Air Traffic Control Officers (GATCO), Heavy Airlines, Helicopter Club of Great Britain (HCGB), Honourable Company of Air Pilots (HCAP), Light Aircraft Association (LAA),*

Low Fare Airlines, Military Aviation Authority (MAA), Ministry of Defence - Defence Airspace and Air Traffic Management (MoD DAATM), NATS, Navy Command HQ, PPL/IR (Europe), UK Airprox Board (UKAB), UK Flight Safety Committee (UKFSC), United States Air Force Europe (3rd Air Force-Directorate of Flying (USAFE (3rd AF-DOF))

- NATS

Community stakeholders:

- 3 Areas of outstanding Natural Beauty (AoNBs) – Cotswolds, Mendip Hills, and Wye Valley
- Bristol Airport Consultative Committee members (x23)
- Environmental Effects Working Group members (x9)
- 19 local constituency MPs from: *Bath, Bridgwater and West Somerset, Bristol East, Bristol North-West, Bristol South, Bristol West, Chippenham, Filton & Bradley Stoke, Monmouth, Newport East, Newport West, North-East Somerset, North Somerset, North Wiltshire, Somerton & Frome, South-West Wiltshire, Thornbury & Yate, Wells and Weston-Super-Mare.*
- Local Authorities, District Councils and Planning Teams from: *Bath & North-East Somerset Council, Cotswold District Council, Mendip District Council, Monmouthshire County Council, Newport City Council, North Somerset Council, Sedgemoor District Council, South Gloucestershire Council, South Somerset District Council, Stroud District Council and Wiltshire Council*
- Town and Parish Councils (x293)

Appendix D: Current Operation Descent Profiles

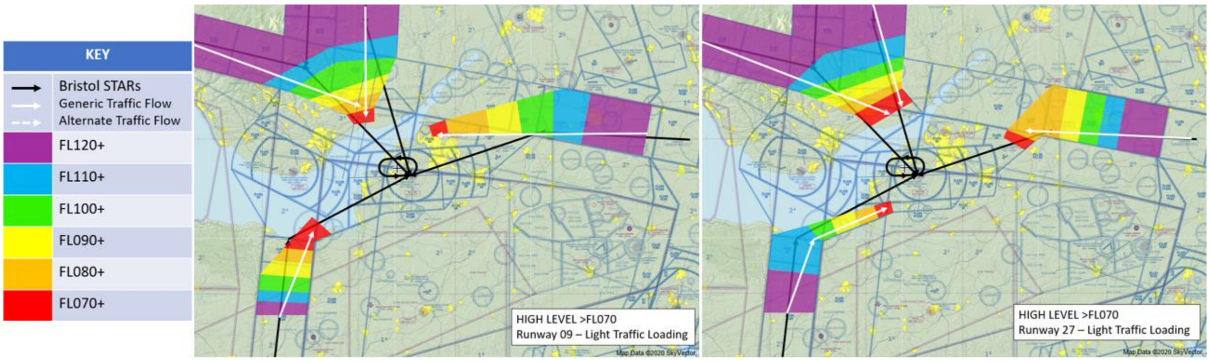

Figure 18: Bristol Runways 09 and 27 Current Arrivals Light Traffic Loading (high level)

Figure 18 above shows the typical altitudes of Bristol arrivals for both Runway 09 and 27, as they descend from the Upper region, via the white arrows, and their typical spread. Arrivals to Bristol Airport following one of 4 standard routes between 06:00 and 23:00 with slightly amended tracks applicable at night.

Aircraft from the north and west are generally under the control of Cardiff radar whilst above 9,000ft whereas from the south, this level is 8,000ft. From the east, Bristol Airport routinely has control of the aircraft at or above 12,000ft. When traffic loading is light, aircraft are routed towards final approach whilst still at or above 7,000ft.

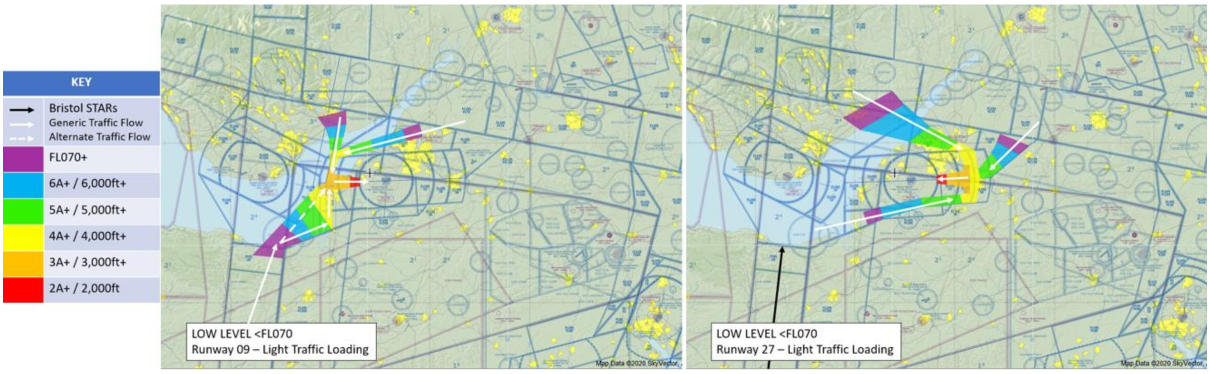

Figure 19: Bristol Runways 09 and 27 Current Arrivals Light Traffic Loading (low level)

As shown in Figure 19 above, controllers aim to a achieve a continuous descent profile once the aircraft leaves 6,000ft. This is achieved by providing pilots with ranges from touchdown so that they can adjust their descent rate accordingly. Aircraft are vectored to intercept the final approach track between 7.8 and 12 nautical miles (nm) from touchdown.

Controllers use vectors and speed control to establish the arrival sequence. They turn aircraft 90˚ to the runway (base leg) and time each aircraft's turn precisely. The last turn, intercepting final approach, is also precisely given to fine-tune the gap between aircraft. This is usually 7nm, which allows aircraft to land, leave the runway and a departing aircraft to safely line-up, and take off.

If there are more arrivals than departures, controllers will tighten the spacing. If there is a need to get more departures airborne, the controller might need to increase the spacing, or that spacing might naturally increase if there is any lull in the arrival flow from the upper region.

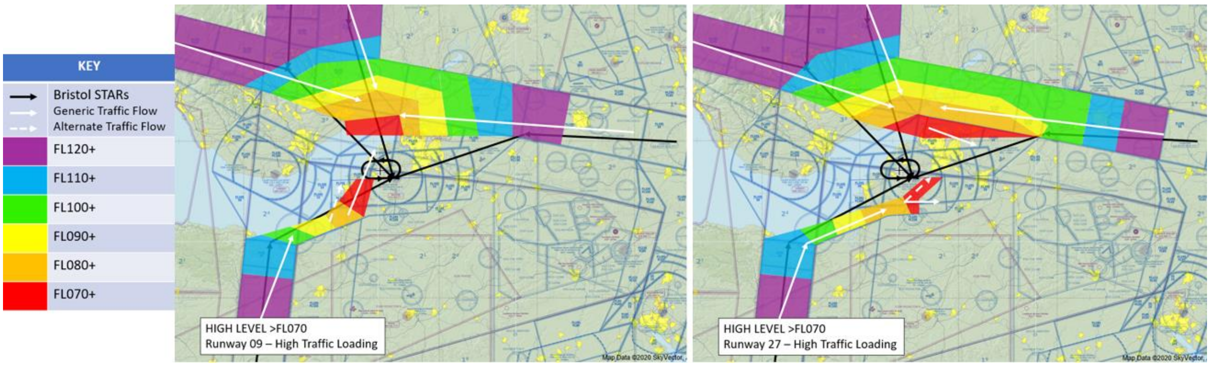

Figure 20: Bristol Runways 09 and 27 Current Arrivals High Traffic Loading (high level)

When traffic loading increases, as demonstrated in Figure 20, there is relatively little manoeuvring room within the existing airspace structure to vector aircraft into a sequence. Controllers may extend arrivals from the east further to the west towards Newport, to sequence them with aircraft inbound from the north and west. Arrivals from the south are more likely to be taken to the east of the airport and turned into the sequence to the north and east of Bristol city.

Aircraft at or above 7,000ft are generally not vectored towards final approach but are sequenced prior to doing so.

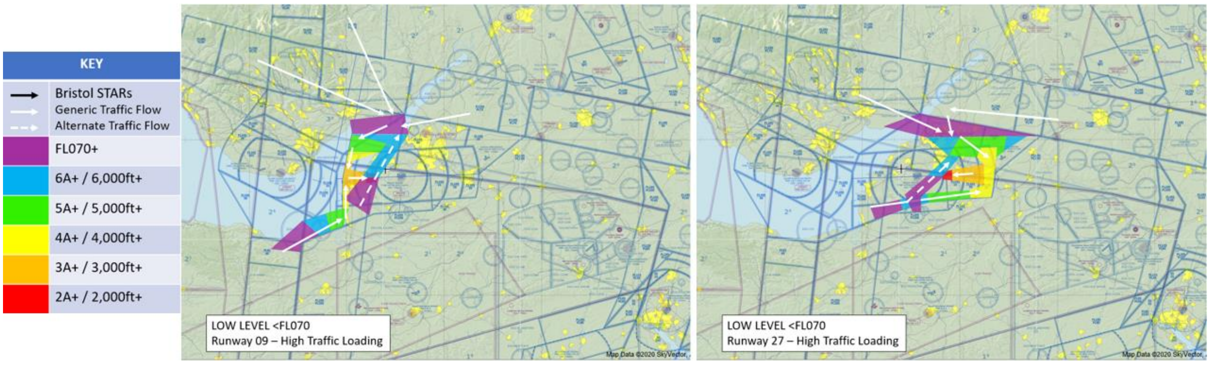

Figure 21: Bristol Runways 09 and 27 Current Arrivals High Traffic Loading (low level)

Controllers will manage the sequence in the largest area of available airspace which is clear of the departure routes. For Runway 09 arrivals (shown on the left in Figure 21) this tends to be over the Severn estuary; and for Runway 27 arrivals (on the right), over the northern and north-eastern suburbs of Bristol city with aircraft extending their track towards Junction 18 of the M4 and south towards Bath city.

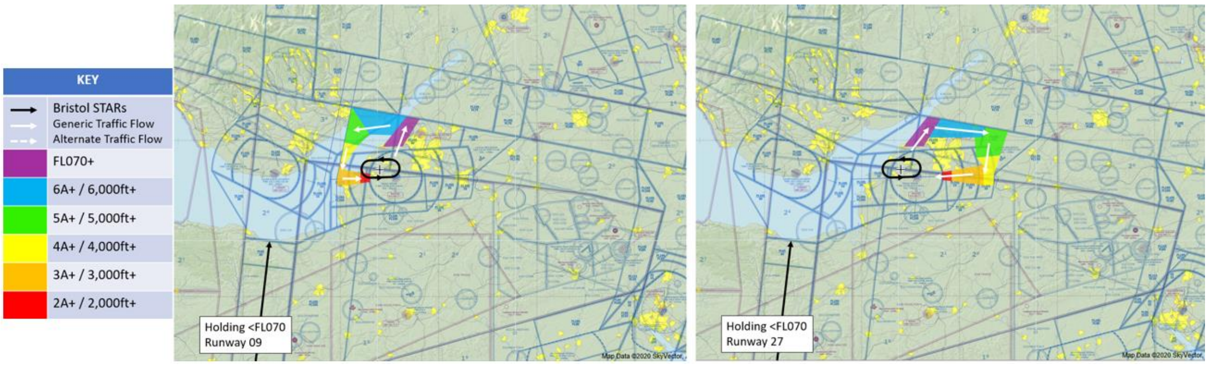

Figure 22: Bristol Runways 09 and 27 Current Holding

When Bristol Airport experiences fog or low cloud, the preferred runway is Runway 27 (on the right of Figure 22) as this is the only runway equipped with a category 3 (blind landing) Instrument Landing System (ILS). Due to the lack of a category 3 ILS on Runway 09 aircraft seldom hold prior to making approaches to that runway. However, in rare circumstances, when the wind is too strong from the west to permit aircraft to land on Runway 27, this can occur.

At present, shown above, aircraft are held overhead the airport in a left-hand racetrack pattern at 7 or 8,000ft as they await their turn to make an approach. In such circumstances the minimum spacing between aircraft is increased to 8nm if no departure is pending and 12nm if a departure is to get airborne between 2 successive arrivals.

The location of the hold often forces controllers to delay the climb of departing aircraft; thereby increasing their noise profile.

Appendix E: Scenario Diagrams (upcoming Stage 3 work)

The following section demonstrates a variety of "scenario" options which have been constructed using Bristol Airport's Stage 2 design options (covered above). The intention is to provide context by illustrating which SIDs are associated with which Hold options and how the Transitions relate. These are illustrative diagrams and more accurate procedure design work will follow. These scenarios will be further matured through our Stage 3 design work prior to consultation and developed to produce integrated designs with the en-route network and adjacent airfields. They have been included to demonstrate the next steps Bristol Airport will be undertaking.

Runway 27 Scenario Diagrams (LD1.1 network routes also shown)

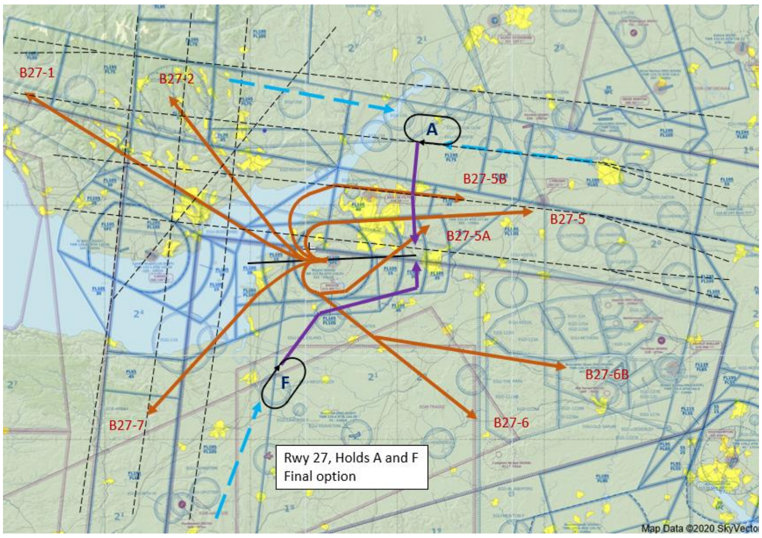

Figure 23: Runway 27 Option with Holds A and F

- SID B27-5 to provide continuous climb above Transition for high-performance departures.
- New CAS would be required for Hold F containment.
- SID B27-5A re-aligned from earlier versions to diverge earlier from South transition.
- South transition from Hold F re-aligned to reduce new CAS required and impact on Yeovilton AIAA (note: the existing RNAV STAR and Instrument Approach do not comply with CAS containment requirements).
- SID B27-5A will be a tactical climb (initial SID level below transition; climb by ATC).
- SIDs B27-6 & B27-6B re-aligned for stepped climb (initial SID level below transition; climb by ATC).
- Note: In all scenarios there will only be one SID 6; two alignments are shown due to uncertainty of network re-integration.

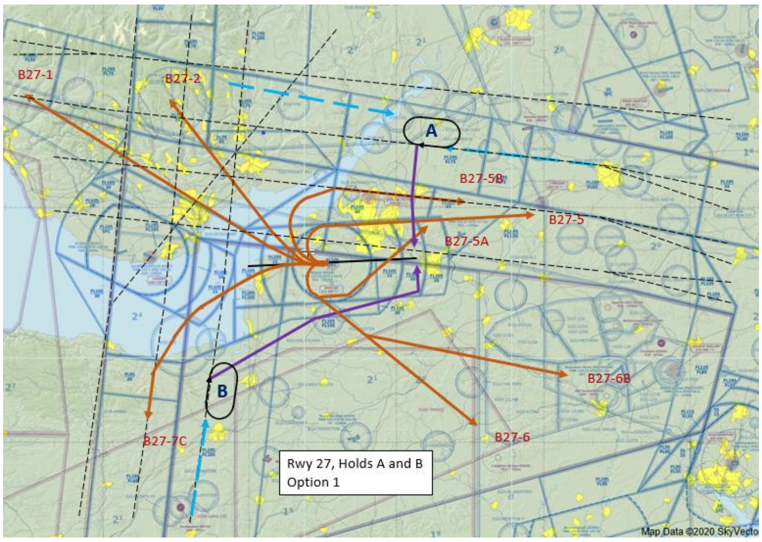

Figure 24: Runway 27 Option 1 with Holds A and B

- New CAS would be required for Hold containment.
- SID B27-7C intended to be separated from Hold B and is aligned with network route X.
- South transition from Hold B re-aligned to reduce CAS requirement.
- SIDs B27-5A, B27-6 and B27-6B re-aligned (stepped climb) as for Hold F variant above.

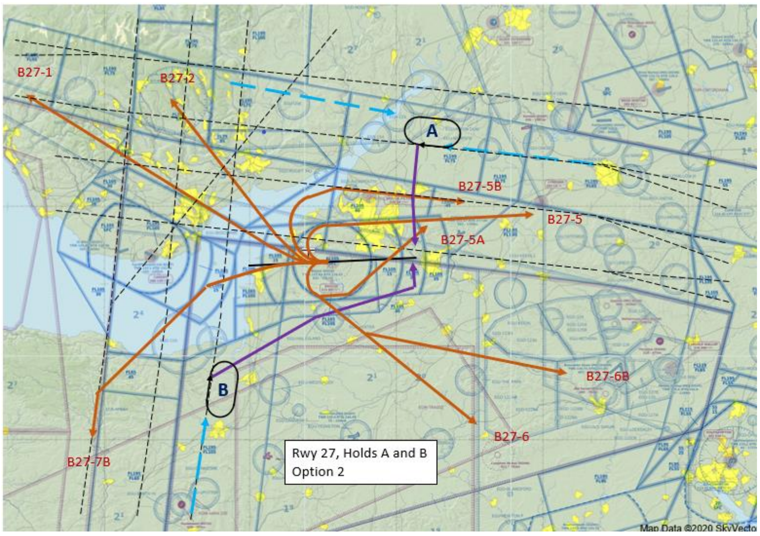

Figure 25: Runway 27 Option 2 with Holds A and B

- Alternative SID to connect with network route W

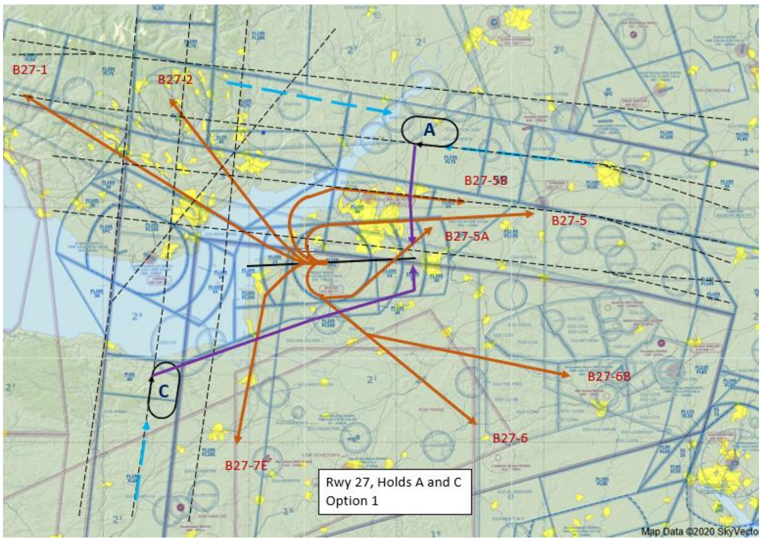

Figure 26: Runway 27 Option 1 with Holds A and C

- Hold C aligned with network route X.
- Smaller amount of new CAS required for Hold containment (subject to assessment).
- SID B27-7E positioned to be laterally separated from Hold C (subject to assessment).
- SID B27-7E likely to conflict with transition from Hold C (thus ATC tactical climb).

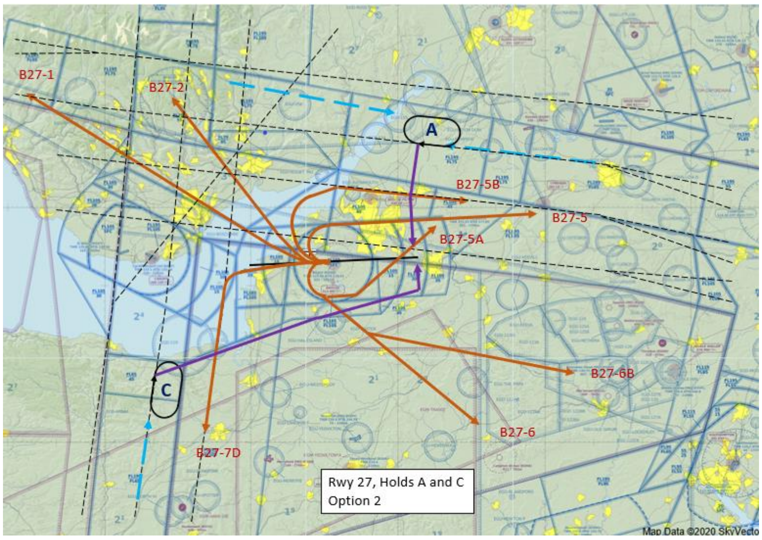

Figure 27: Runway 27 Option 2 with Holds A and C

- SID B27-7D extended route distance and aligned with network route Y.
- Intention is to gain sufficient height for SID B27-7D to be separated above transition from Hold C for high performance aircraft. However, not laterally separated from Hold C.

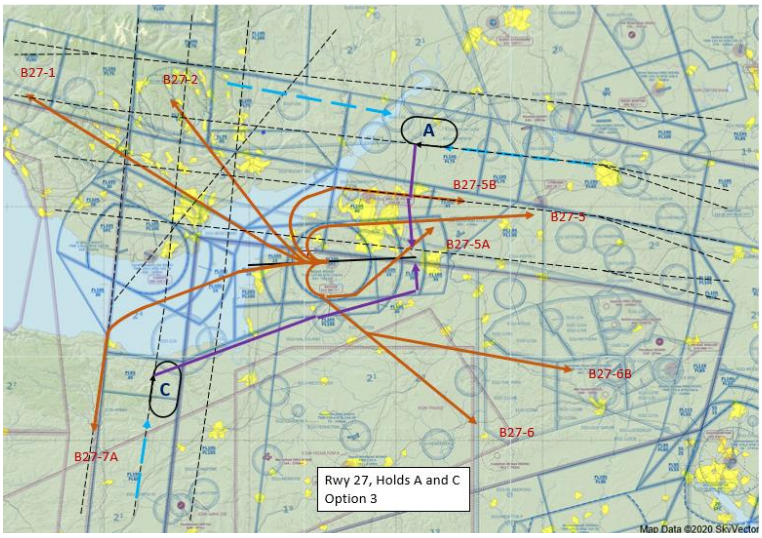

Figure 28: Runway 27 Option 3 with Holds A and C

- SID B27-7A aligned with network route W.
- Hold C to be separated from SID B27-7A (subject to assessment).

Runway 09 Scenario Diagrams (LD1.1 network routes also shown)

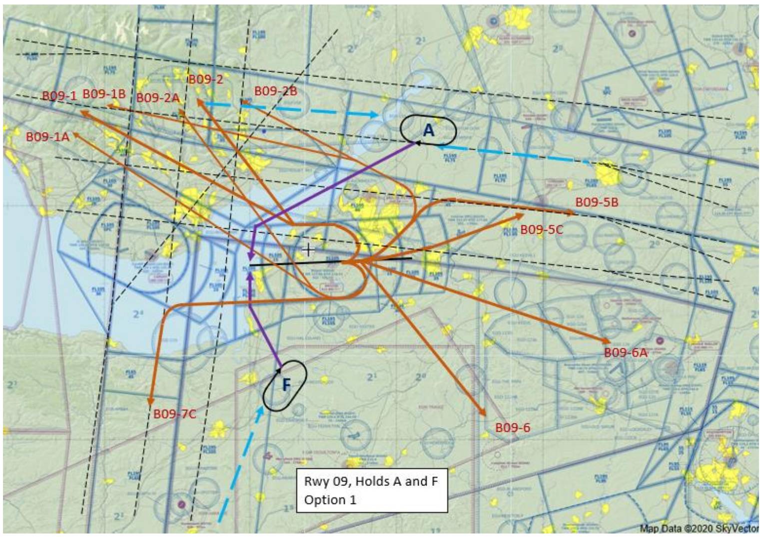

Figure 29: Runway 09 Option 1 with Holds A and F

- SIDs B09-1 and B09-2 extended West to allow climb above Transition for high performance departures.
- Hold F most equidistant to both runways.
- SID B09-7C aligned with network route X.
- SID B09-7C to be laterally separated from Hold F (subject to assessment) and to be separated above transition (minimum climb gradient to be further assessed).
- Additional CAS required for Hold F containment (subject to assessment).

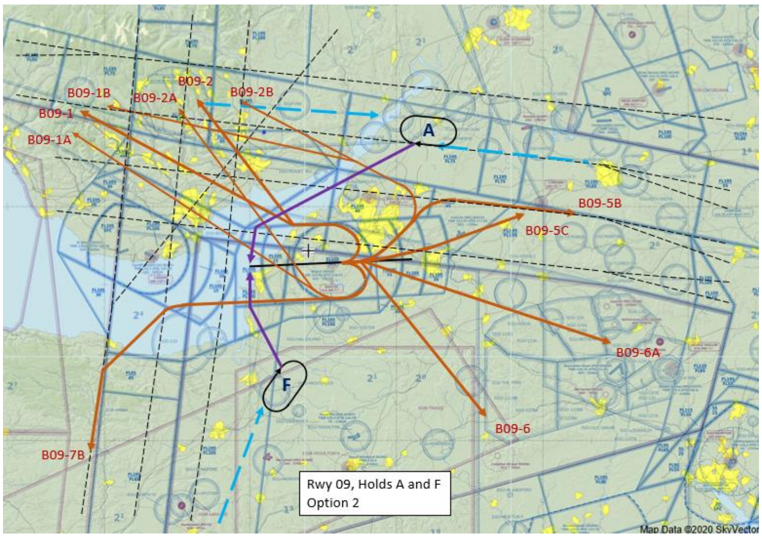

Figure 30: Runway 09 Option 2 with Holds A and F

- Alternative with SID B09-7B aligned with network route W.

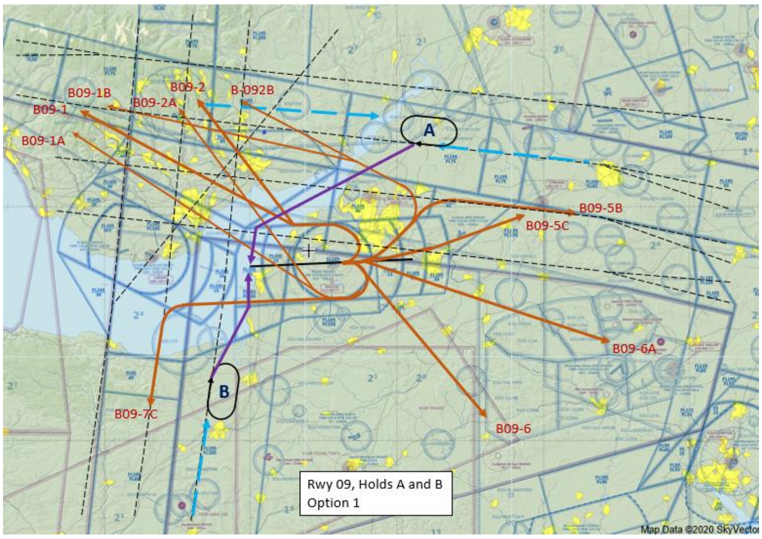

Figure 31: Runway 09 Option 1 with Holds A and B

- Hold B aligned with network route Y.
- SID B09-7C aligned with network route X.
- SID B09-7C to be laterally separated from Hold B (subject to assessment) and separated above the transition (minimum climb gradient to be further assessed).
- Additional CAS required for Hold B containment (subject to assessment).

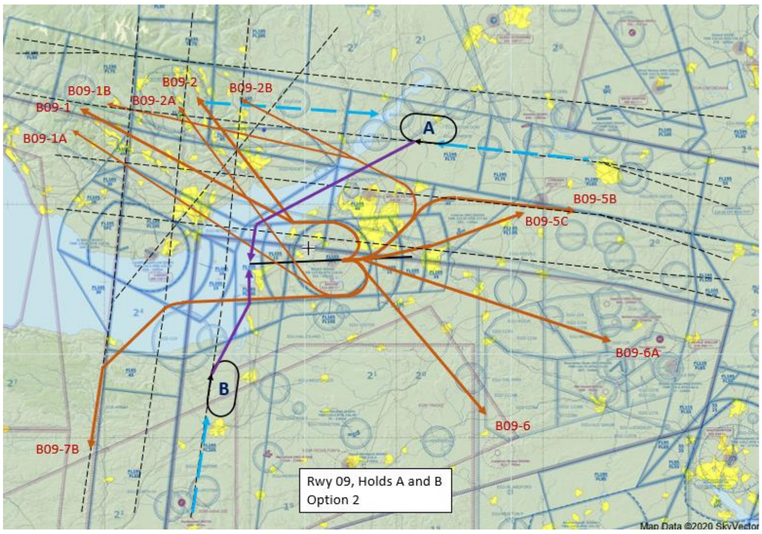

Figure 32: Runway 09 Option 2 with Holds A and B

- Alternative with SID B09-7B aligned with network route W.

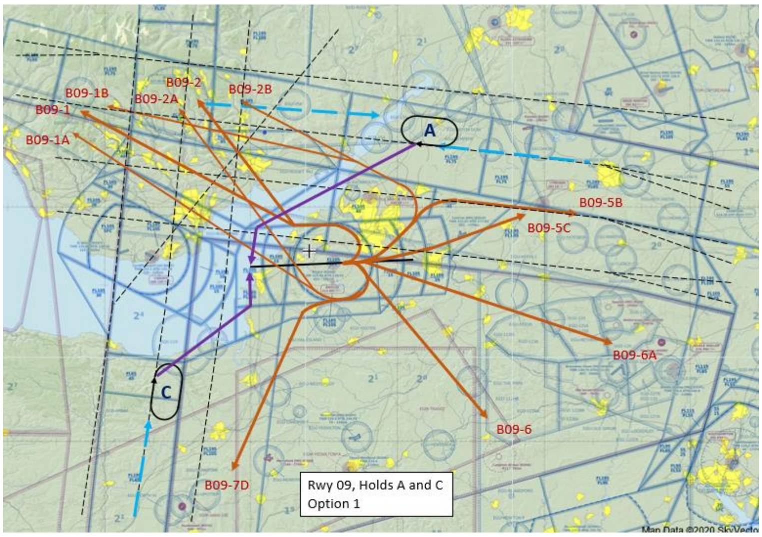

Figure 33: Runway 09 Option 1 with Holds A and C

- Hold C aligned with network route X.
- SID B09-7D to be laterally separated from Hold C (subject to assessment).
- New CAS required for SID containment (subject to assessment).

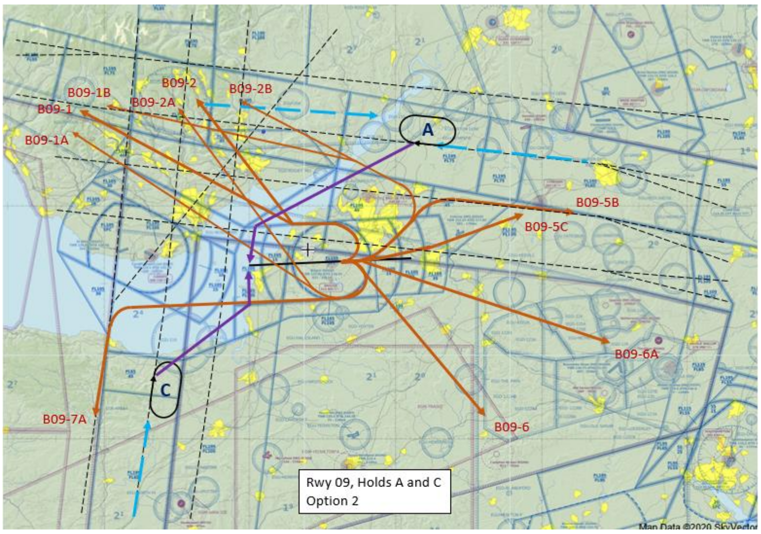

Figure 34: Runway 09 Option 2 with Holds A and C

- SID B09-7A aligned with network route W.
- SID B09-7A to be laterally separated from Hold C (subject to assessment) to climb above transition (minimum climb gradient to be further assessed).

Appendix F: Glossary

ACOG	Airspace Change Organising Group
ACP	Airspace Change Proposal
ADA	Arrival/ Departure Arrival
AIAA	Area of Intense Aerial Activity
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATS	Air Traffic Service
BCN	Brecon
CAA	Civil Aviation Authority
CAS	Controlled Airspace
CCO	Continuous Climb Operation
CDO	Continuous Descent Operation
CTA	Control Area
DfT	Department for Transport
FASI-S	Future Airspace Strategy Implementation - South
FUA	Flexible Use of Airspace
GA	General Aviation
IAF	Initial Approach Fix
ILS	Instrument Landing Strip
IFR	Instrument Flight Rules
LAMP	London Airspace Modernisation Project
LD1.1	LAMP Deployment 1.1
LVP	Low Visibility Procedure
NDB	Non-Directional Beacon
NERL	NATS En Route Ltd
NM	Nautical Mile
NPR	Noise Preferential Route
OAT	Operational Air Traffic
RMA	Radar Manoeuvring Area

RNAV	Required navigation (Area Navigation Basic 5nm Precision 1nm)
SID	Standard Instrument Departure
SoN	Statement of Need
STAR	Standard Arrival Route
VFR	Visual Flight Rules
WTA	West Terminal Airspace