Swanwick Airspace Improvement Programme

Airspace Development 5

Proposed changes to LAC West to improve ATS route connectivity

SAIP AD5 Documentation:

Step 4A Update and Submit

Step 4B Airspace Change Proposal

Issue 1

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Table 2 Publication history

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2. Introduction

NATS' Swanwick Airspace Improvement Programme (SAIP) is proposing a number of modular airspace changes within the London Flight Information Region (FIR), managed by NATS Swanwick. It aims to modernise each region via airspace deployments (AD) in different regions of the FIR.

This module, SAIP AD5, concerns the development of the following distinct areas of LAC west airspace:

- Establish appropriate CAS and ATS Routes for Birmingham arrivals and departures via the MOSUN area
- Provision of an offload route and appropriate CAS for some traffic inbound to Heathrow
- Establish or revise a number of high-level ATS Routes in the West End Sector Group
- Amend the boundary of TRA 002, in conjunction with the MoD

The current airspace structure does not provide a predictable controlled environment for Birmingham traffic, which routes via MOSUN. This traffic is often given tactical shortcuts taking it outside of controlled airspace which is different to the longer flight planned route; thus, aircraft frequently carry more fuel than required.

Currently, if the Heathrow OCK (Ockham) stack is above capacity, arrivals are tactically routed from OCK to BNN (Bovingdon). This can lead to an incredibly complex operational environment which has previously led to extreme traffic loading and an unsustainable workload.

As part of the SAIP project's requirement to, where possible, enable fuel and CO_2 savings for operators; a number of amendments to ATS routes within the western region are being proposed. They will provide more flight planning options and enable the reduction of fuel uplift/ burn and associated emissions.

This is considered to be a Level 1 airspace change proposal (ACP) under CAP1616, due to the proposed CAS volume close to Birmingham, with a base of FL65. This would not change commercial aircraft traffic patterns below 7,000ft, however it could theoretically change some GA patterns outside CAS and below 7,000ft. To reflect this, the environmental analysis requirements for this proposal have therefore been scaled equivalent to a Level 2 change (CO_2 emissions only). This is summarised in a compliance paper which was submitted as part of Stage 2 (Ref 8).

If the proposal is approved by the CAA, the proposed design would be implemented on 7th November 2019.

3. Executive Summary

To facilitate the change summarised above, NATS developed a number of relevant design principles; used these to evaluate design options; and further analysed the leading option. NATS also created a consultation strategy to identify, engage and target specific stakeholders; launched & completed a focussed consultation; and finally, analysed & categorised the thirteen consultation responses submitted by fourteen stakeholders – please see the table of references on Page 33 for links to the relevant documents.

As covered in the Stage 3 Step 3D Collate and Review Responses document (Ref 12), there were twelve response elements identified as having the potential to impact the proposed design. Of these twelve elements:

- Eight elements were either fully progressed or partially compromised into the final design. This included changes to FUA timings and splitting a proposed volume of CAS adjacent to Birmingham.
- Four elements were rejected due to the impact on other airspace users and operational complexity; which contradicted the Design Principles.

Feedback from operational simulations also resulted in a number of small changes to the proposed high-level ATS Routes. This is all detailed in the Stage 4 Step 4A Update Design document (Ref 13).

4. Current Airspace Description

4.1 Structures and Routes

This proposal concerns the development of distinct areas of airspace within Swanwick LAC West. These have been summarised below, but further details can be found in the Consultation Document (Ref 11).

Birmingham Traffic Flows

The current Birmingham traffic flows relevant to this proposal are the arrivals and departures which route via MOSUN, as shown in Figure 1 below. These traffic flows currently join and leave CAS via MOSUN at FL170 and above; and are provided with a service outside controlled airspace.

The Birmingham-MOSUN departure procedure is restricted and only available during the following times (for non-turboprop aircraft):
Mon-Fri 1700-1000 (1600-0900); Fri 1700 (1600) - Mon 1000 (0900).

Birmingham inbounds can flightplan via MOSUN during the same restricted times as departures, listed above. Although the MOSUN procedure is flightplannable, it forces aircraft outside of Controlled Airspace. Aircraft are often given tactical short cuts however they have to fuel for the original (often longer) flightplanned route; thus, carrying more fuel than required.

The current airspace does not provide an efficient or predictable controlled environment for Birmingham traffic which routes via MOSUN. This traffic sometimes converges; resulting in a high level of complexity and workload due to the tactical vectoring of aircraft leaving CAS, by ATC. The ATSOCAS service for Birmingham traffic is provided by either NATS Western Radar or the MoD.

Further details on these current traffic flows can be found in Section 3 of the Consultation Document (Ref 11).

Heathrow Arrival Flows

The relevant Heathrow traffic flows are two-high level arrival routes: one main flow over South Wales into Ockham (OCK); and another over North Wales into Bovingdon (BNN). When the OCK Hold is at full capacity or weather conditions dictate, flights are manually vectored from the southern flow to the northern flow; as seen in Figure 2 below. These are referred to as 'Stack Swaps' and they occur throughout the year (c2,600 in 2017).

Stack Swaps increase the operational complexity and have led to extreme traffic loading and complexity within this region resulting in a high increase in ATC and pilot workload. Sectors AC S23, TC SW Deps/ OCK (if split from TC SW Deps) and TC North currently initiate and manage these Stack Swaps.

4.2 Airspace usage and proposed effect

Figure 1 and Figure 2 below illustrate the current day Birmingham arrival/ departure and Heathrow arrival traffic flows which are relevant to this proposal.

4.2.1 Airlines and Aircraft Types

As covered fully in Section 6, there were a number of design changes which were made post-consultation and simulation, considering feedback and observations from both. As such. the analytics fuel modelling work was updated, upon which the forecasted aircraft type and airline usage figures below are based.

The proportion of aircraft types or airlines is not expected to change as a consequence of this airspace change. The following sections give a breakdown of the most common aircraft types and airlines which use the relevant airspace/ routes associated with the proposed changes.

The following traffic flow counts were taken from the EUROCONTROL scenario-based modelling tool NEST for 2017. This is used by the NATS Analytics team for a number of purposes including airspace design and capacity/ traffic flow analyses, at local and network level. Appropriate filters were applied for when each of the below routes/ flows are available. The usage figures are based on this 2017 data which has been grown to a

predicted 2020 dataset using the traffic forecast. As these totals are likely to change, the proportion of aircraft types and airlines have been presented in this section rather than predicted totals.

Birmingham Traffic Flows

In 2017 there were 120,655 departures and arrivals to/from Birmingham International Airport. This data was summarised in the Consultation Document [Ref 11]. As this data was not filtered for specific flights via the MOSUN region, an updated document was provided during the consultation which contained figures for the following traffic flows: Birmingham arrivals/ departures via MOSUN; and Birmingham arrivals/ departures via NUMPO GROVE. These two flows are applicable to the proposed changes.

Table 3 below summarises the top 10 most frequent aircraft types found in this data, accounting for 91% of the traffic. The turbo-jet B738 made up nearly two fifths of all traffic.

Aircraft Type	Generic AC Type	Proportion	Aircraft Type	Generic AC Type	Proportion
B738	2-engine turbo-jet	38.27%	A320	2-engine turbo-jet	3.10%
A321	2-engine turbo-jet	17.89%	E75S	2-engine turbo-jet	1.66%
AT76	2-engine turbo-prop	8.95%	B788	2-engine turbo-jet	1.63%
B752	2-engine turbo-jet	8.90%	E195	2-engine turbo-jet	1.52%
DH8D	2-engine turbo-prop	7.96%	LJ35	2-engine turbo-jet	1.08%

Table 3: Birmingham (MOSUN region) Aircraft Types, 2017

Table 4 shows these flights, which flightplanned via the MOSUN area, categorised by airline. Ryanair made up nearly a fifth of all flights; followed closely by Jet2, Thomas Cook and Thomson Airways.

Airline	2017 Count	Proportion	Airline	2017 Count	Proportion
Ryanair	824	18.95%	Stobart Air	388	8.92%
Jet2	748	17.20%	Primera Air	130	2.99%
Thomas Cook	729	16.77%	Air Alliance Express	44	1.01%
Thomson Airways	634	14.58%	Capital Trading Aviation	40	0.92%
Flybe	486	11.18%	BA Cityflyer	23	0.53%

Table 4: Birmingham (MOSUN region) Airlines, 2017

Heathrow Arrival Flows

Table 5 and Table 6 below show the aircraft types and airlines, in the 99th percentile, which could have used the proposed Heathrow offload route and CAS. As summarised in the Consultation Document [Ref 11] this data is taken from 2017 data, grown to 2020 traffic levels, which flew over a specific waypoint pair and flew from Newark/ JFK. The turbo-jets B744 and B772 each accounted for a quarter of all flights. British Airways accounted for the majority of airlines, at just under 45%.

Aircraft Type	Generic AC Type	Proportion	Aircraft Type	Generic AC Type	Proportion
B744	4-engine turbo-jet	25.1%	A333	2-engine turbo-jet	5.4%
B772	2-engine turbo-jet	24.6%	B789	2-engine turbo-jet	5.0%
B763	2-engine turbo-jet	22.1%	B764	2-engine turbo-jet	1.3%
B77W	2-engine turbo-jet	7.5%	B752	2-engine turbo-jet	1.3%
A346	4-engine turbo-jet	6.8%	B788	2-engine turbo-jet	0.7%

Table 5: Heathrow Aircraft Types, 2017

Airline	2017 Count	Proportion
British Airways	876	44.49%
Virgin Atlantic	332	16.86%
American Airlines	258	13.10%
United Airlines	250	12.70%
Delta	235	11.93%

Table 6: Heathrow Airlines, 2017

High-Level ATS Routes

NATS are also proposing changes to a number of high-level ATS Routes in order to provide environmental benefits for airlines, by replicating common trajectories or future FRA trajectories. Alongside the Birmingham and Heathrow traffic flows above, a breakdown of aircraft types and airlines expected to use these routes can be found below. This is also using 2017 data which has been grown to a predicted 2020 dataset.

ATS Route Realignment and extension of Q60; KOPUL – UGNUS

Table 7 and Table 8 show the proportion of flights, by aircraft type and airline, that would potentially benefit from the proposed ATS Route Q60 (KOPUL – UGNUS). The 10 most frequent aircraft types, accounting for nearly 70% of the traffic, were all 2-engine or 4-engine turbo-jets. There were a large number of airlines which could use the route, with Lufthansa making up a small majority of 17%.

Aircraft Type	Generic AC Type	Proportion	Aircraft Type	Generic AC Type	Proportion
A333	2-engine turbo-jet	14.20%	B77W	2-engine turbo-jet	5.52%
A332	2-engine turbo-jet	10.39%	B744	4-engine turbo-jet	4.93%
B772	2-engine turbo-jet	8.80%	B788	2-engine turbo-jet	3.98%
B763	2-engine turbo-jet	8.04%	B748	4-engine turbo-jet	3.11%
A320	2-engine turbo-jet	6.39%	A388	4-engine turbo-jet	2.79%

Table 7: Q60 (KOPUL - UGNUS) Aircraft Types, 2017

Airline	Proportion	Airline	Proportion
Lufthansa	17.08%	Air Canada	3.81%
Delta Airlines	9.49%	Brussels Airlines	3.77%
United Airlines	7.88%	Air Berlin	2.70%
Aer Lingus	5.05%	Turkish Airlines	2.68%
American Airlines	4.18%	Kuwait Airways	1.99%

Table 8: Q60 (KOPUL - UGNUS) Airlines, 2017

ATS Route eastbound only extension of P155; MORAG – HON

Table 9 and Table 10 show the proportion of flights, by aircraft type and airline, that would potentially benefit from the proposed extension of the eastbound ATS Route P155 (MORAG – HON). The 10 most frequent aircraft types, accounting for 85% of the traffic, were all 2-engine turbo-jets except for two 4-engine turbo-jets. United and KLM combined made up over a third of all airlines.

Aircraft Type	Generic AC Type	Proportion	Aircraft Type	Generic AC Type	Proportion
B763	2-engine turbo-jet	19.64%	B77W	2-engine turbo-jet	5.77%
B744	4-engine turbo-jet	13.51%	B788	2-engine turbo-jet	5.54%
B772	2-engine turbo-jet	10.18%	B748	4-engine turbo-jet	5.18%
A333	2-engine turbo-jet	8.45%	B752	2-engine turbo-jet	5.06%
A332	2-engine turbo-jet	6.79%	B764	2-engine turbo-jet	4.64%

Table 9: P155 (MORAG - HON) Aircraft Types, 2017

Airline	Proportion	Airline	Proportion
United Airlines	22.92%	American Airlines	4.05%
KLM	15.12%	Turkish Airlines	3.99%
Delta Airlines	8.63%	Atlas Air	3.33%
Kalitta Air	4.94%	Air Transat	2.74%
LOT	4.82%	Aeromexico	2.26%

Table 10: P155 (MORAG - HON) Airlines, 2017

ATS Route Realignment of Q60; MORAG – LANON and LANON - UGNUS

Table 11 and Table 12 show the proportion of flights, by aircraft type and airline, that would potentially benefit from the proposed realignment to Q60 (MORAG – LANON, LANON – UGNUS). The aircraft type A320 made up a significant 36% of the traffic, and the airline Aer Lingus similarly accounted for a large 34% proportion.

Aircraft Type	Generic AC Type	Proportion	Aircraft Type	Generic AC Type	Proportion
A320	2-engine turbo-jet	35.81%	B789	2-engine turbo-jet	2.84%
B738	2-engine turbo-jet	6.61%	B763	2-engine turbo-jet	2.82%
B77W	2-engine turbo-jet	4.23%	A333	2-engine turbo-jet	2.42%
A319	2-engine turbo-jet	4.20%	B772	2-engine turbo-jet	2.18%
A321	2-engine turbo-jet	3.40%	B788	2-engine turbo-jet	2.11%

Table 11: Q60 (MORAG - LANON; LANON - UGNUS) Aircraft Types, 2017

Airline	Proportion	Airline	Proportion
Aer Lingus	33.56%	Easyjet	4.17%
Ryanair	6.20%	United Airlines	2.82%
Air France	6.19%	Ethiopian Airlines	2.31%
Air Canada	5.02%	Virgin Atlantic Airways	2.29%
Lufthansa	4.86%	British Airways	2.17%

Table 12: Q60 (MORAG - LANON; LANON - UGNUS) Airlines, 2017

Data analysis was not completed for the proposed amendment to ATS Route UL18 (GAVGO – DIKAS) as this is just an administrative change (decoupling of L18 from UL9) which enables the other proposed ATS Route changes.

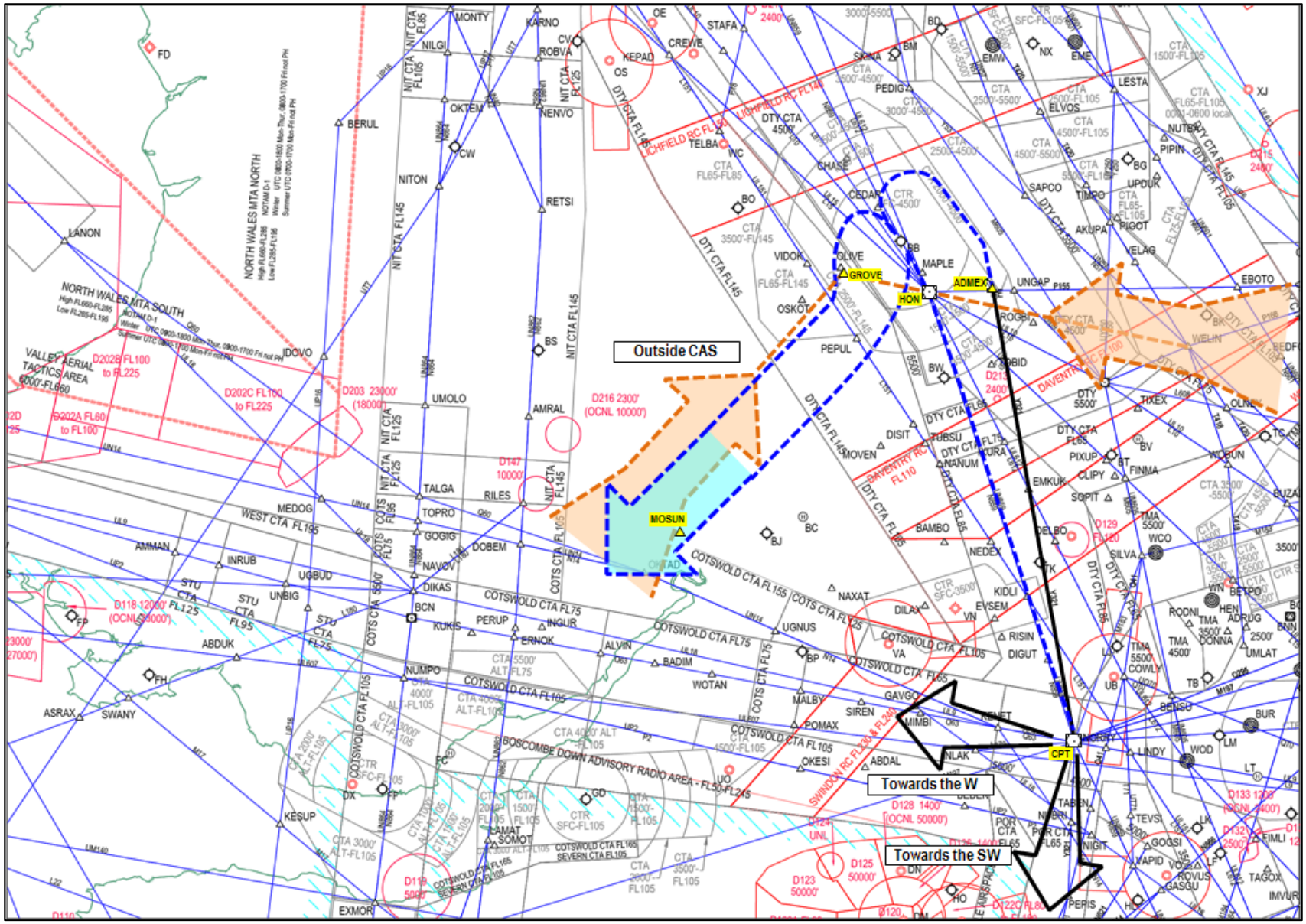

Figure 1: Current Birmingham Traffic Flows via MOSUN

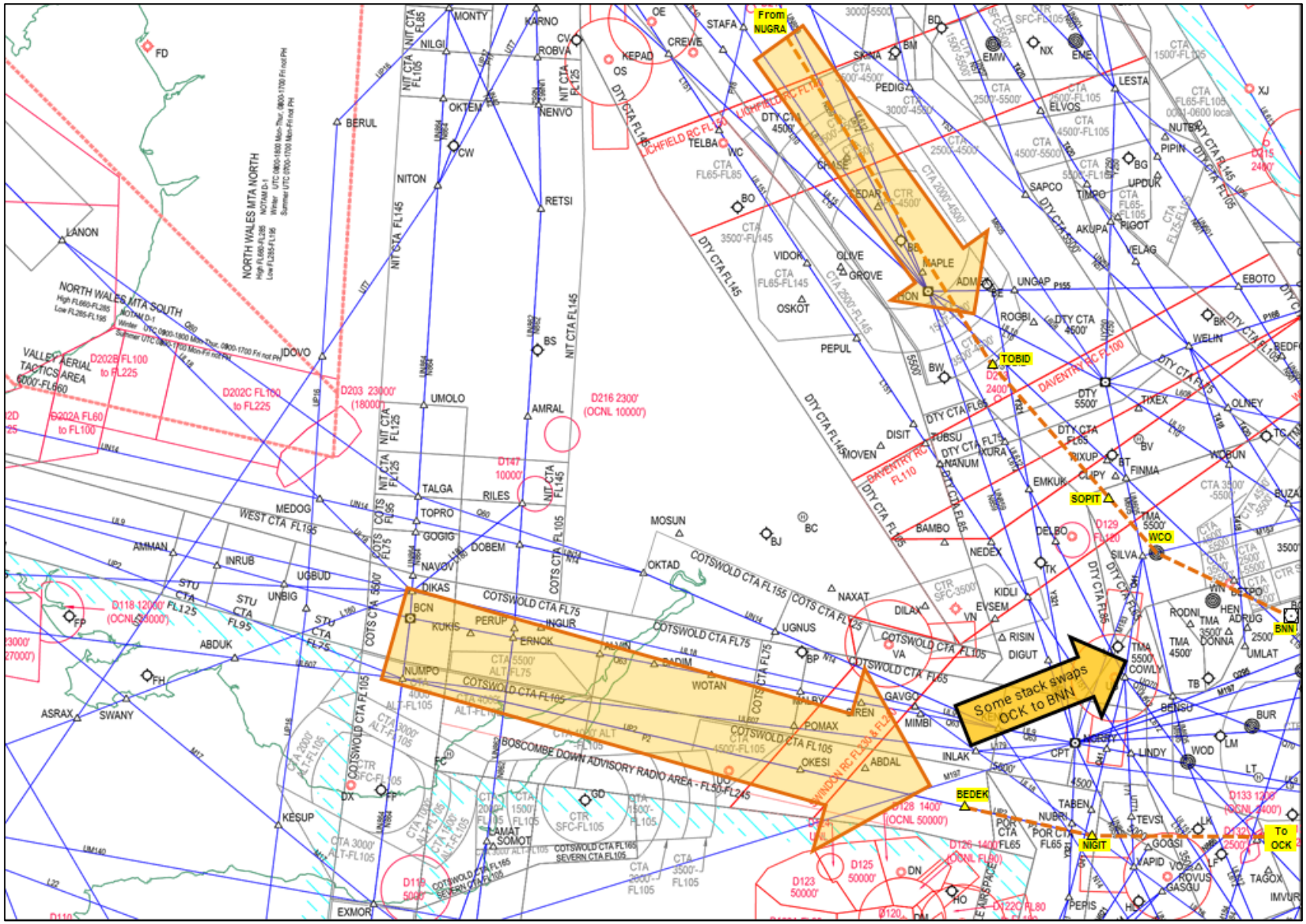

Figure 2: Current Heathrow Arrivals

4.3 Operational efficiency, complexity, delays and choke points

This proposal has been used as an opportunity to improve upon the current traffic flows within the Swanwick west LAC airspace. Airspace systemisation offers benefits including a reduction in complexity and workload, from less tactical management and intervention. Design Principle 1 (DP1) was created in order to ensure that proposed designs give more flightplanning choices for operators, alongside ATC flexibility to better manage traffic flows (Ref 4).

The Birmingham changes have been designed to provide a predictable and more efficient controlled environment for traffic, where there currently exists no flight plannable route within CAS. The proposed design will provide maximum flexibility for controllers accommodating Birmingham and operators which use this airspace. This will also help to minimise the risk of CAS excursions around the Cotswold CTA, thus reducing the complexity within this region.

The proposed Heathrow offload route and CAS have been designed to route flights to the BNN hold for when the OCK hold is close to full capacity. Currently this is done on a reactive and tactical basis, which has previously led to an incredibly complex operational environment; severe traffic loading; and an unsustainable operational workload.

Despite these operational benefits, the aim of this proposal is not specifically to improve upon the capacity or delay of the associated airspace or routes. NATS is therefore not citing any benefit (or disbenefit) in terms of conflict or delay.

4.4 Safety issues

The main safety issues which this proposal seeks to address are: the associated safety risks from the manual Heathrow stack swaps; and from the amount of civil traffic flying outside of CAS around Birmingham.

Heathrow arrivals can be re-routed from the BNN Hold when OCK is near capacity. This often occurs at very late notice and can create an unsustainable increase in cockpit/ controller workload as a result of increased monitoring and interactions. The flows proposed would provide a more predictable method for the tactical balancing of flows by reducing the need for late tactical stack swaps. This would reduce the operational complexity, workload and interactions within this airspace.

Birmingham arrival and departure traffic, which routes via the MOSUN area, currently leaves CAS. This is a complex procedure which requires a large amount of coordination, monitoring and controller/ pilot interactions. The proposed changes would provide more systemised and predictable flightplanning options; thus, reducing the overall cockpit/ controller workload.

The over-riding Design Principle 0 (DP0) for this proposal has ensured that safety is always the highest priority in designs (Ref 4). NATS has a dedicated safety manager for the SAIP project who ensures that the safety representatives from SARG have oversight of the safety assurance process. Section 10 contains further details on the safety assessment for this proposal.

4.5 Environmental issues

There are no specific environmental issues within the relevant areas of airspace, in the current operation; however, there are currently limited flightplanning options for flights between Birmingham and the south/ south-west. This has caused frequent occasions when aircraft flightplan a longer route than the tactical 'short cut' they are given, resulting in more fuel being carried than required. The proposed Birmingham arrival and departure routes would provide a reduction in fuel and CO_2 as they would offer operators more direct routings and therefore less track mileage.

This proposal has also been used as an opportunity to reduce fuel uplift/ burn and associated emissions through the introduction and extension of high-level ATS Routes within the West End Sector Group. These ATS Routes have been designed to replicate common tactical behaviour used today or future trajectories expected to be seen in FRA.

All of the proposed changes have been designed to prioritise minimising the environmental impact throughout the whole design. The environmental Design Principle (DP3) has ensured that proposed designs reduce CO_2 emissions and fuel burn, where possible (Ref 4). Further information on the specific fuel and CO2 savings of the proposed changes can be found in Section 7.6.

5. Statement of Need

The following text is v3 of the DAP1916 Statement of Need form, as submitted in October 2018:

Current Situation:

Traffic from the Irish FIR boundary into UK airspace essentially uses two main high-level flows, one from central northern Eire across the Irish Sea over the North Wales coast towards the Manchester area and the other from southern Eire across southern Wales towards the London Area. There are limited flight planning options for LTMA overflights from Irish airspace over mid-Wales. There are also limited flight planning options to access the Midlands area to and from the south-west.

Issue or opportunity to be addressed and the cause:

The proportion of eastbound flights using the southern flow increased after the IAA implemented FRA in Irish airspace in December 2009. This proportion change means some Heathrow arrivals need to be 'stack swapped' from the OCK Hold to the BNN Hold more often and at short notice, causing tactical complexity for NATS Swanwick ATC. There is an opportunity to add an additional flow in the 'gap' between the two main flows and make additional route connectivity improvements in this area as part of a single airspace change deployment.

Desired outcome:

Partial re-dressing of the balance between main flows for Heathrow arrivals. Additional flight planning options for aircraft operators whether landing or departing in the UK or overflying. Reduction in flight plan track miles flown in UK airspace with consequential fuel/emissions and route change savings for AOs.

Specific challenges:

Managing the proportions of traffic using the new system of flows so that no single flow causes issues to the network.

6. Proposed Airspace Description

6.1 Objectives/Requirements for Proposed Design

The primary objective for this proposed airspace change is to reduce complexity in the Swanwick West End sectors through streamlined procedures, which allow improved routing and flightplanning options. The changes will provide improved routing and flight planning options for airline and airport operators, alongside increased operational flexibility to airspace capacity management.

6.2 Proposed New Airspace/ Route Definition and Usage

The proposed changes have been split out into the following individual areas of work:

- Establish ATS Routes, STAR and CAS for Birmingham arrivals and departures via MOSUN (Section 6.2.1)
- Provision of an offload route, STAR and CAS for specific Heathrow inbounds (Section 6.2.2)
- Establish a number of high-level ATS Routes in the West End Sector Group (Section 6.2.3)
- Amend the boundary of TRA002 (Section 6.2.4)
- Technical amendments such as new intermediate waypoints, removal of "U" from ATS routes in the vicinity, and other no-impact administrative items (Ref 13/ 14abc/ 15/ 16)

The following technical documents provide further information on the proposed design:

- A technical definition document which contains the WGS84 data in excel format. This contains information on ATS routes such as levels, route designators and significant waypoint names. Reference 14.
- A document summarising the draft AIP changes, which lists the changes alongside the AIP pages where these changes will occur. Reference 15.
- An Airspace Design Definition (ADD) document. This is the main repository of ATC design information relating to network connectivity; how the changes impact specific sectors; and other items required to make the changes to ATC operational environmental. Note that the ADD covers all the administrative and technical information for the London Area and Terminal Control Centre's operational and engineering team, to prepare for the changes – as such, it covers a wider geographical area and range of subjects than typically would be covered by an ACP. Reference 16.

6.2.1 Proposed Birmingham Changes

This proposal will introduce new CAS and RNAV1 ATS Routes for Birmingham arrivals and departures via the MOSUN area; where currently there does not exist a flight plannable route within CAS. The proposed changes will provide aircraft operators and ATC with more predictability for flight and fuel planning, as well as reducing the overall workload. They will also provide a shorter route option to and from Birmingham to the south-west/ west destinations, than is often currently used.

The proposed Birmingham arrival/ departure routes, asides from one minor change to a STAR, presented in the Consultation Document all remain the same [(Ref 11)]. The consultation document contains complete descriptions of the routes including routings and new waypoints. The division of ATS responsibility will also remain the same.

Changes between Consultation and Final Proposal

NATS is responding to the consultation by making a number of additional changes to the final proposed design; as fully described in the Stage 4 Step 4A Update Design document [(Ref 13)] which includes the feedback which led to these changes. The changes to the Birmingham aspects of the design are summarised below.

FUA Timings

The FUA timings, which will be applied to the proposed CAS and routes, will alter slightly to the following times of operation:
Monday to Friday from 1700L to 0900L; and Friday 1700L until Monday 0900L.

NATS and BAL preferred 1000L rather than 0900L, as per the consultation; however, this compromise has been accepted in recognition of the adverse impact it would have on the MoD. This change to FUA timings is covered fully in Section 3.2 of the Stage 4 Step 4A Update Design document [(Ref 13)].

Proposed STAR

We are now proposing to remove the slight dogleg on the FIGZI 1B STAR at OSKOT, routeing FIGZI – BIFIN – GROVE. This shortens the route by a small amount and reduces the CAS required to contain the STAR; thus, reducing the impact on other airspace users. The final track, before the GROVE Hold, would become a simpler straight segment and the CAS lateral boundaries would also be less complex, as shown on Figure 3 below.

The diagram also shows the correct depiction of low-level Birmingham departures in blue. The UMLUX waypoint was shown in the wrong place in the Consultation Document [(Ref 11)] however this has no impact on the proposed changes. These procedures are managed by Birmingham Airport.

This final proposed amendment can be seen in Figure 12 below and is fully explained in Section 3.4 of the Stage 4 Step 4A Update Design document [(Ref 13)].

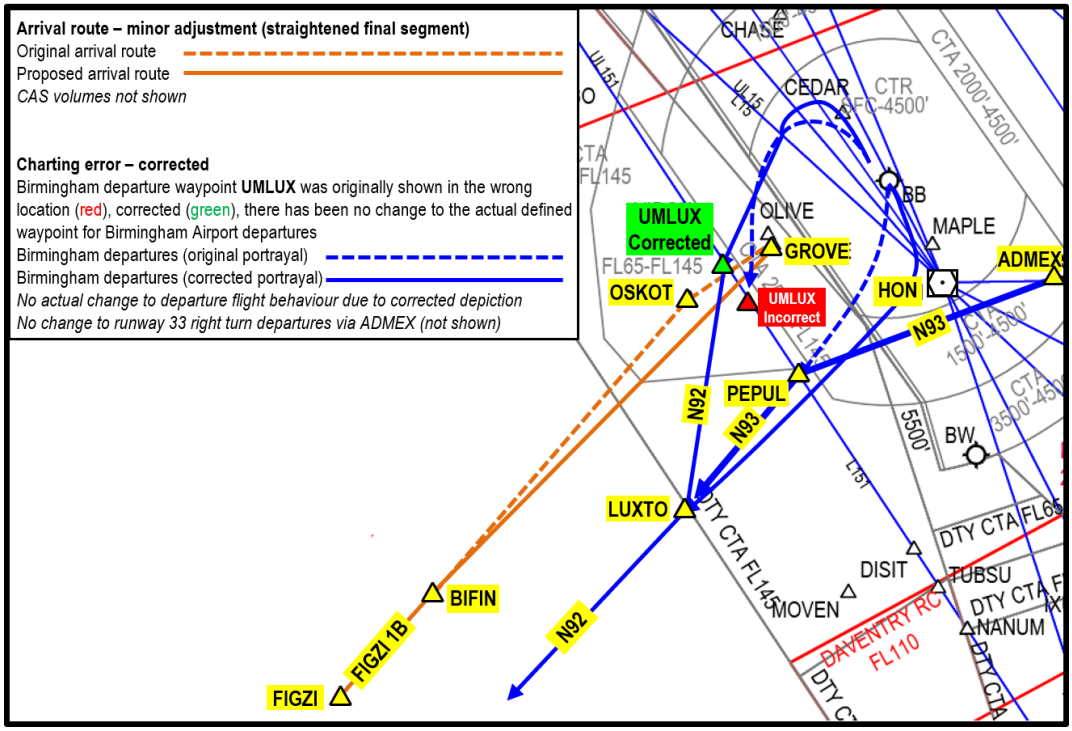

Figure 3: Final amendment to Birmingham FIGZI 1B STAR

Birmingham CAS Volumes

The proposed volume of CAS adjacent to Birmingham (coloured green on Figure 4) will be split into the following sections; allowing the RAF(U) to transit without coordination and not impacting other airspace users:

- The lower section FL65 – FL105 would match the smaller dimension of Options 2A/ 2B, which were consulted on [Ref 11], and be Class D FUA airspace
- The upper section FL105 – FL145 would match the larger dimension of Options 1A/ 1B and be Class C H24 airspace

These differences can be seen in Figure 4 below and are covered fully in Section 3.5 of the Stage 4 Step 4A Update Design document [Ref 13].

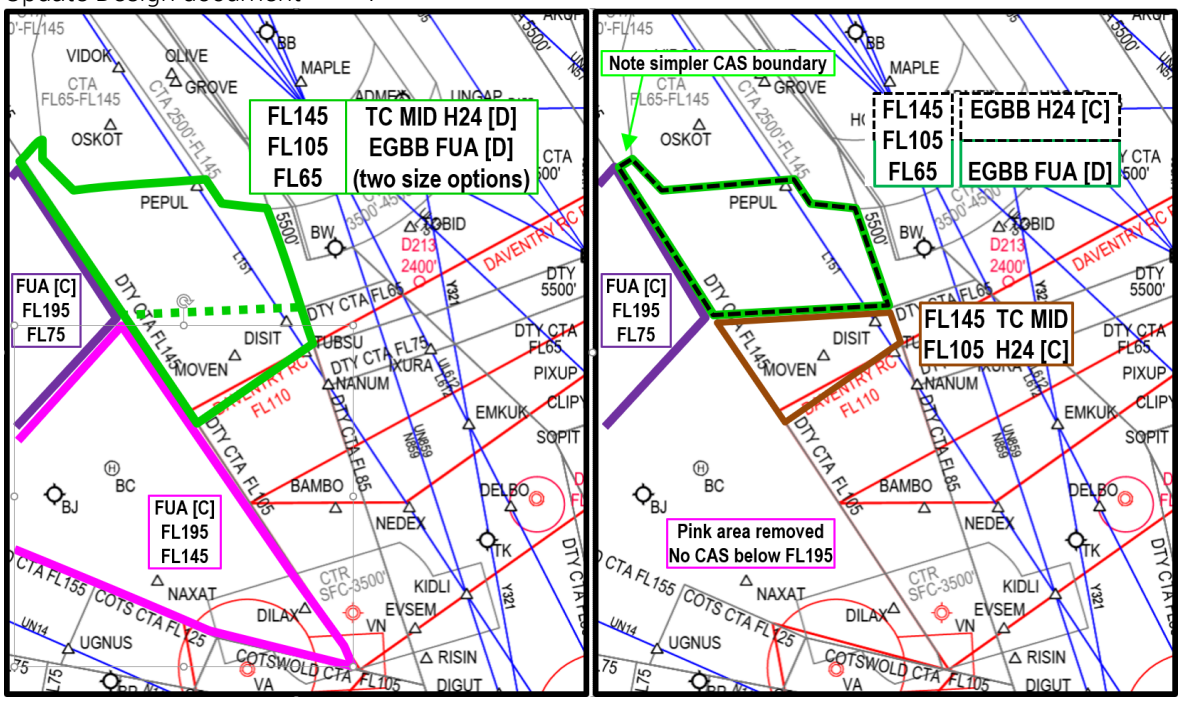

Figure 4: Consulted (left) and Proposed (right) CAS volumes near Birmingham

Additionally, the proposed light blue volume of airspace will have a raised base of FL125, rather than FL105 as consulted upon. Focussed simulations concluded that the lower base was not required, thus allowing a reduction in complexity and impact on other airspace users. This will also allow this volume to be combined with the abutting yellow volume of CAS with the same proposed based of FL125. Birmingham Airport has agreed to the raising of this CAS base, provided their arrivals descend to FL130 by waypoint BIFIN. Departures would be above FL130 by the base level change point DUCNO (an additional waypoint on the base level change of the volumes).

We originally proposed to amend the western boundary of the Cotswold CTA5 which we will now retain, by fitting the proposed FUA volumes around it.

These differences can be seen in Figure 5 below and are covered fully in Section 3.1 of the Stage 4 Step 4A Update Design document (Ref 13).

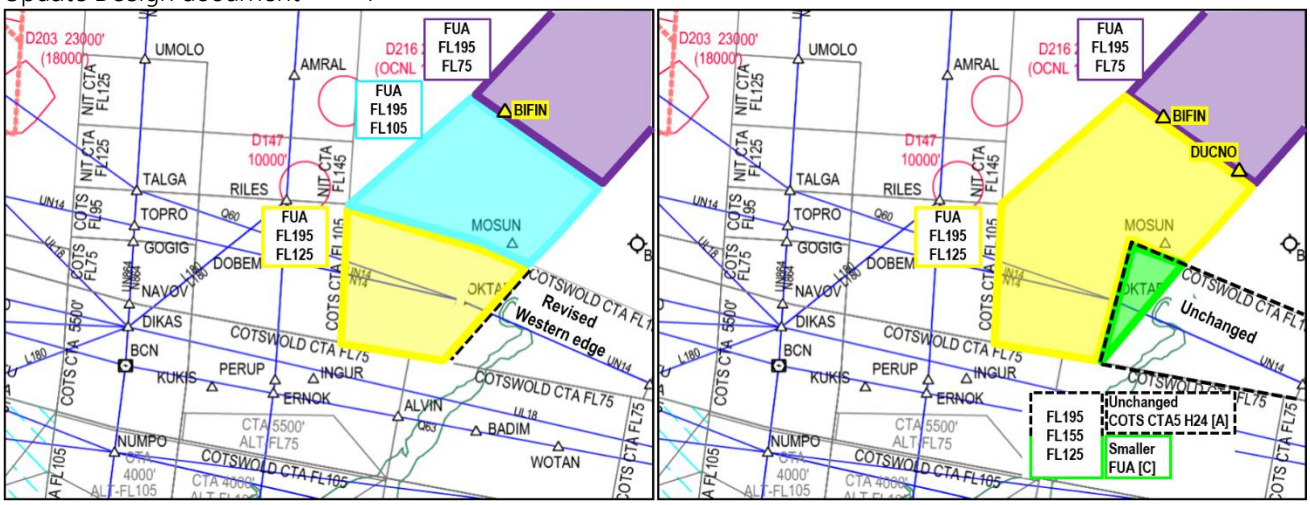

Figure 5: Consulted (left) and Proposed (right) CAS arrangements in vicinity of MOSUN and OKTAD

The other proposed blocks of Class C/D CAS presented in the consultation will remain the same.

The current (Figure 1) and proposed Birmingham traffic flows (Figure 12) can be seen in the referenced figures within this document.

6.2.2 Proposed Heathrow Changes

This proposal will introduce a new unidirectional offload route and CAS, for Heathrow arrivals from the Irish boundary, across Sectors 5, 23 and 35 into TC Midlands. This will allow for more pre-planned tactical offloading and rerouting of flights, which will reduce workload and complexity. The proposed route will be restricted as a tactical offload route which is not flight plannable, such that it is not used significantly more often than how frequently aircraft are currently re-routed from the OCK to BNN hold. This will ensure that no additional complexity is introduced to AC Sectors 5 and 23.

The proposed offload route presented in the consultation will remain geographically identical; this is fully described in the Consultation Document (Ref 11). The proposed timings will also remain the same, ensuring the route is not available when either the NWMTA (North Wales Military Training Area) Upper/ Lower are active. The offload route will not be flight-plannable and it will be RAD restricted to ensure it is being used appropriately.

Changes between Consultation and Final Proposal

As explained in the Stage 4 Step 4A Update Design document (Ref 13), NATS is making a number of changes to the final proposed design in response to the consultation feedback. The changes related to the Heathrow elements of the proposal are summarised below.

The placement of waypoint SEMMU would be better placed further east along the proposed Heathrow offload route Y125, in order to provide improved level planning for descent. This is a technical change with no impacts except for ATC operational planning. This change in placement can be seen in Figure 6 below and is covered fully in Section 3.3 of the Stage 4 Step 4A Update Design document [Ref 13].

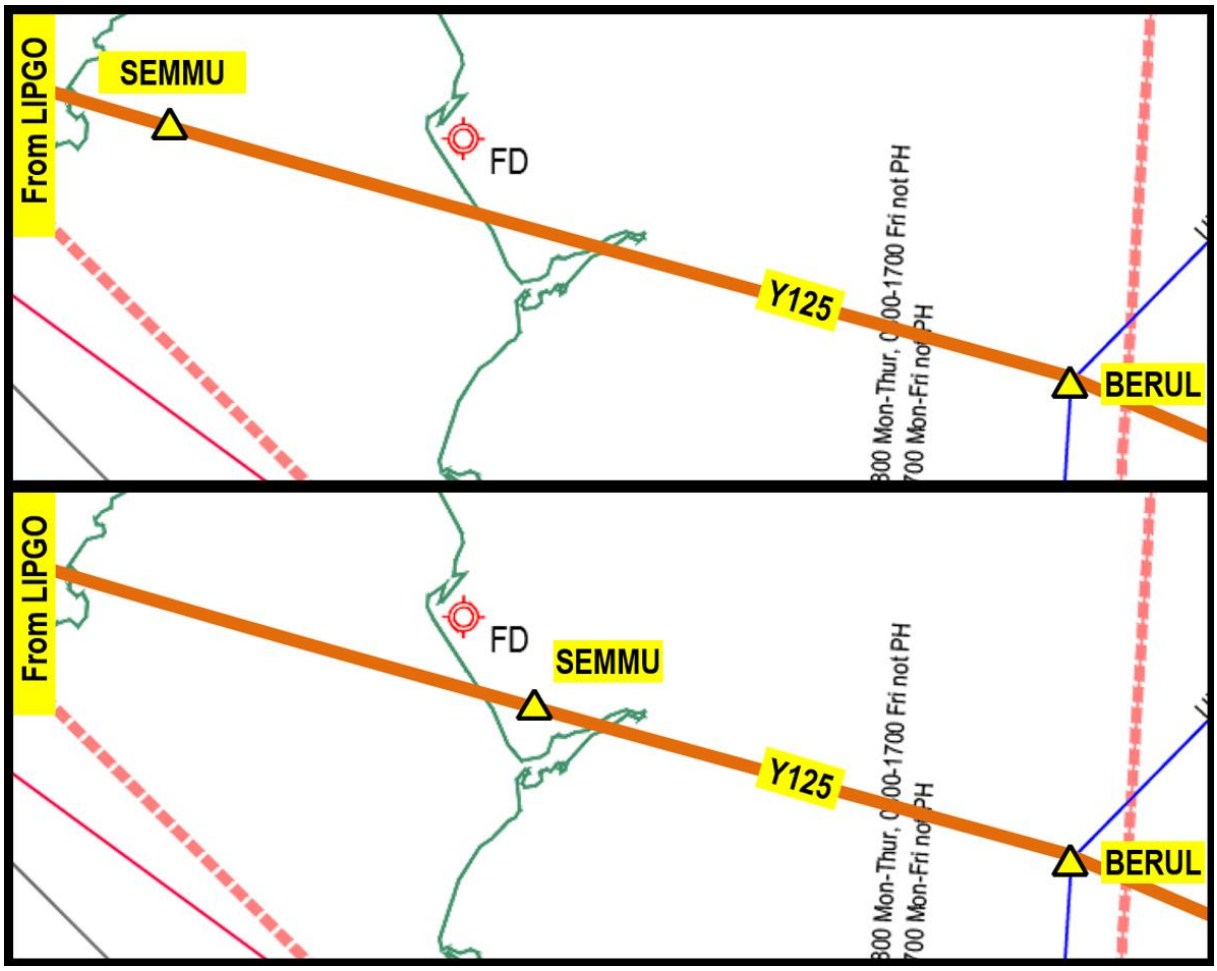

Figure 6: Consulted (top) and proposed (lower) SEMMU placement

The Heathrow offload route will not be flightplannable as the use of it needs to be entirely tactical and under the control of NATS (Airspace Capacity Management). The transatlantic operation will be continuously monitored (2-3 hours from the LTMA) and the offload route will be used appropriately when required, with relevant traffic picked tactically.

The southern block of proposed FUA CAS (coloured pink in the Consultation Document, Ref 11) will no longer be included in this proposal, following consultation feedback and operational feedback from simulations which concluded that this volume was not needed. This reduces the impact on airspace users alongside allowing the military to complete uninterrupted climb/ descents in this airspace.

The current (Figure 2) and proposed Heathrow traffic flows (Figure 12) can be seen in the referenced figures within this document.

6.2.3 High-Level ATS Routes

SAIP has a Specific Project Requirement (SPR) to enable fuel savings for airline operators as part of NATS 10% target for RP2. This proposal aims to contribute by establishing a number of ATS routes within the West End Sector Group, which have been designed to replicate common tactical behaviour and reduce fuel uplift/ burn.

Alongside the Birmingham and Heathrow designs, following on from simulation feedback, a number of changes have been made to the proposed ATS Routes; these are summarised below. Visual diagrams show the proposed routes in purple, alongside any appropriate existing route or DCT which is used, in orange.

The Stage 4 Step 4A Update Design document (Ref 13) provides a full description of the differences between the proposed ATS routes we consulted upon, and our final proposed design presented here. This document also includes diagrams which show these changes.

ATS Route Q60; Realignment and extension KOPUL – UGNUS

This proposed westbound route would provide a more direct route for LTMA overflights which route from Europe and further east, to Ireland and the North Atlantic. It improves on the currently available route which takes aircraft via KOPUL – CPT – KENET – UGNUS.

Since the consultation, we are also proposing to introduce a new waypoint UGBET which would create an intersection with the existing L179. This would allow traffic routing L179 LAM CPT to utilise Q60 and route via UGNUS, which would also reduce the possibility of these flows crossing. This additional intersection would allow more eligible flights to use this ATS route thus enabling a greater fuel benefit.

Due to possible interactions with MTMA departures which climb into S24 at an agreed level of FL310, the minimum level for flight planning Q60 will be FL340 and above.

Figure 7 below shows the proposed route in purple, alongside the extant DCT as a dashed orange line.

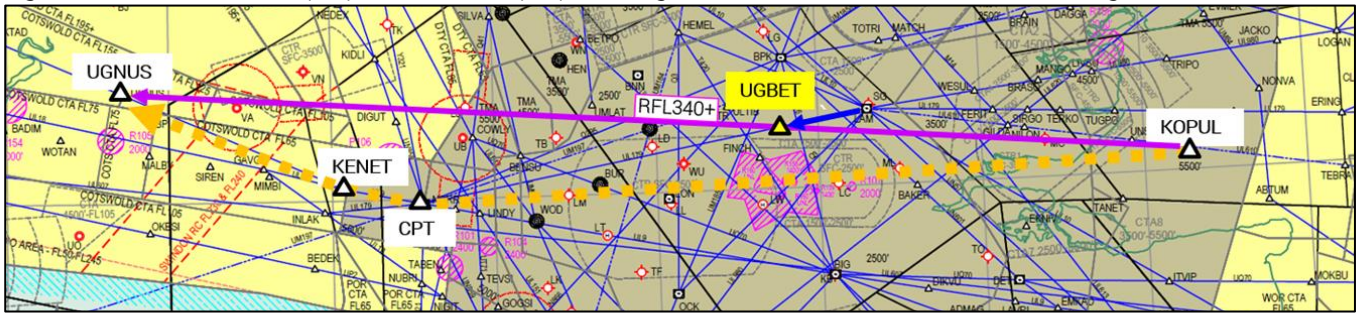

Figure 7: Q60 westbound KOPUL UGNUS, proposed route (purple)

ATS Route eastbound only extension of N24; PEMOB – NIGIT (FL285+)

This proposed eastbound route extension has been removed from this proposal. An error was found in the environmental analysis completed for the consultation, which means that this change would not provide any fuel benefit.

ATS Route eastbound only extension of P155; MORAG - HON

This proposed eastbound only route would allow UK overflight traffic to exit the UK FIR via SOMVA and REDFA, which would take traffic out of the Central and/ or Lakes sector groups. This would only be available when NWMTA Upper is not active and traffic may have to be destination limited via the RAD in order to manage demand. Simulation feedback highlighted potential interactions with S32/ S27 southbound LTMA traffic flows. Ensuring the route has minimum level of FL345 reduces this possibility with no impact on fuel benefit.
Figure 8 below shows the proposed route (purple).

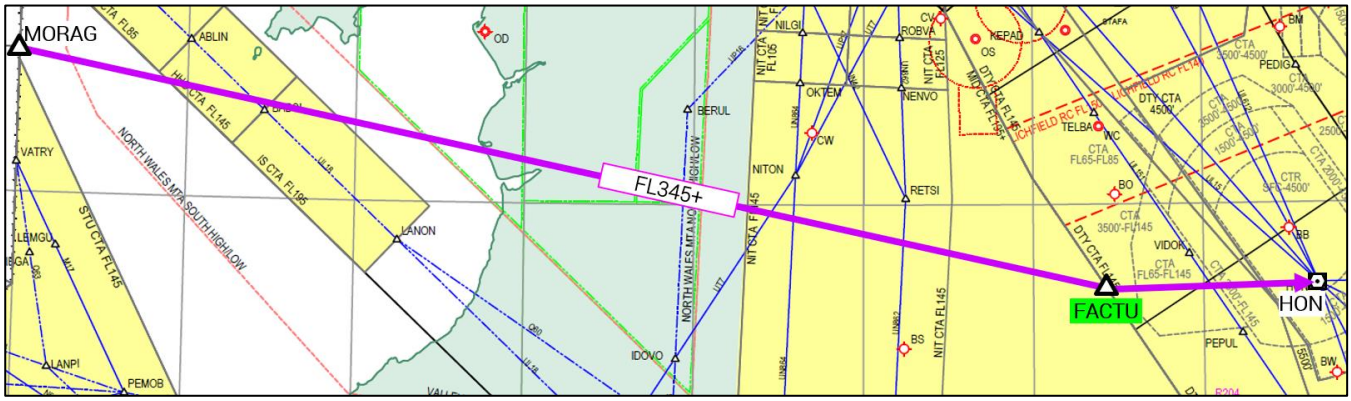

Figure 8: Extension of P155 MORAG - HON, proposed route (purple)

Bi-directional ATS Routes Q60 and L18 (MORAG/ LIPGO to DIKAS/ UGNUS), proposed routes (purple)

These proposed bi-directional routes were proposed to provide more direct routes for LTMA overflights and Dublin arrivals.

They would replicate common tactical bidirectional direct routes and would allow aircraft operators to flightplan these routes and enable fuel savings.

The same route structure is proposed, however a number of changes to flow directions and level restrictions have been included in order to reduce the complexity of this airspace.

The route orientation would become westbound via L18 LIPGO and eastbound via MORAG; and route segments east of LANON set to bidirectional at certain times/FLs; thus, better balancing the flows in the area.

These flow and level restrictions reduce some of the opportunities for savings because some lower flights were originally eligible for the shorter Q60 but must now follow the original longer route (except Dublin arrivals which remain eligible). There is thus a slightly reduced benefit.

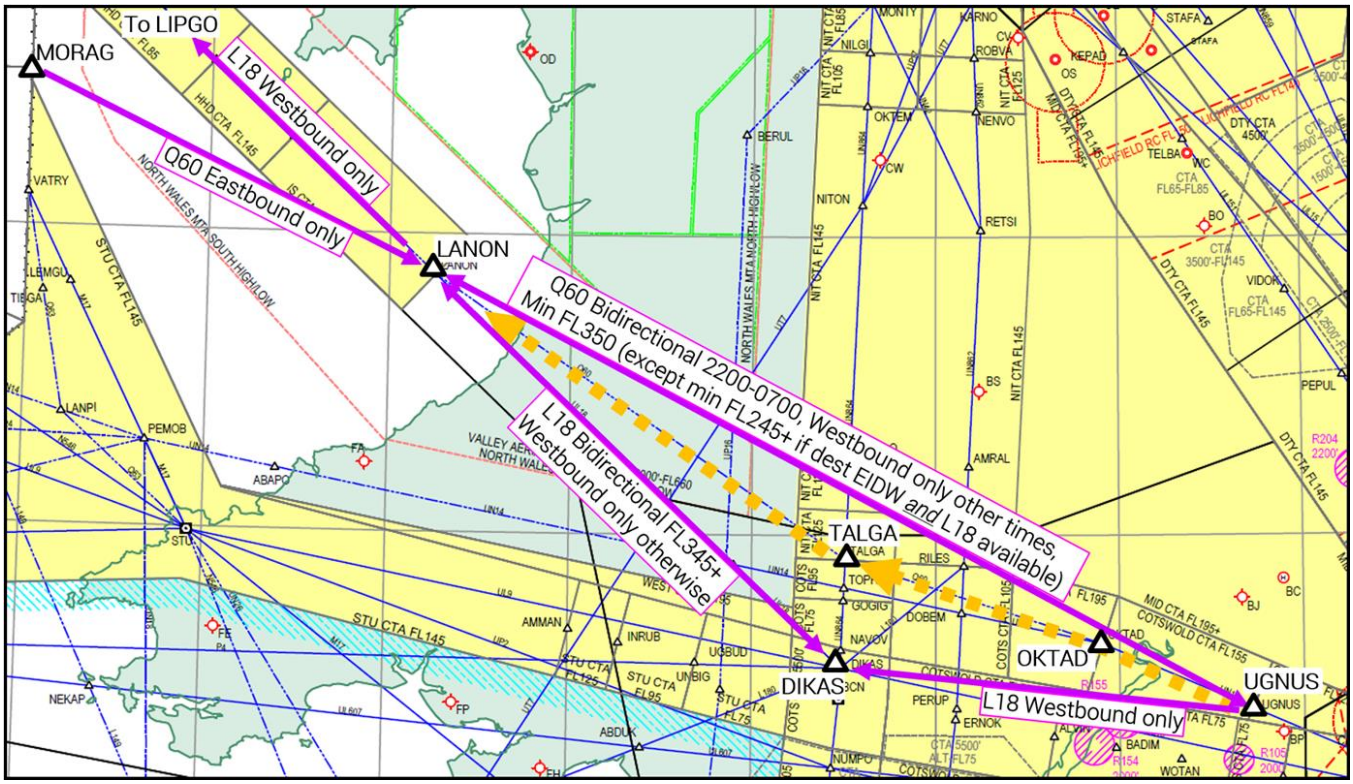

Figure 9: Bi-directional Routes Q60 and L18 (MORAG/ LIPGO to DIKAS/ UGNUS), proposed routes (purple)

ATS Route UL18; GAVGO - DIKAS

The proposed administrative change to UL18 would re-align UL18 between GAVGO – DIKAS. The route would be re-aligned from GAVGO – DIKAS; to GAVGO – UGNUS – DIKAS; allowing UL18 to be uncoupled from UL9. This route was initially consulted upon to be eastbound only, aligning with the original Q60/ L18 route structure. However, simulations showed that it would not provide adequate westbound connectivity with the revised Q60/ L18 flows; thus, the direction of UL18 has been amended for connectivity and flow direction purposes. The directionality of the route between UGNUS and GAVGO has also been amended to provide westbound connectivity, allowing maximum benefit to operators who will use this. This does not provide a defined fuel benefit as a standalone route, but it enables the benefit for the western part of Q60. Figure 10 below shows the proposed realigned route (purple) alongside the current route which is used (dashed orange).

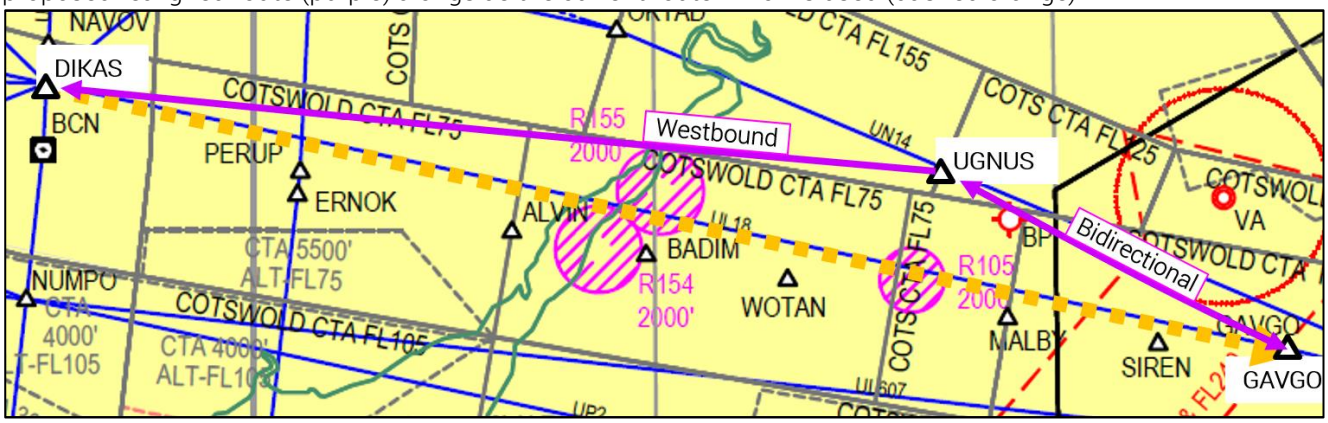

Figure 10: UL18 (GAVGO - DIKAS) proposed route (purple) decoupled from UL9

6.2.4 Proposed TRA002 changes

Slow climbing Birmingham departures on the proposed ATS Route N92 would need to be tactically vectored around the Temporary Restricted Area (TRA) 002. As such, we have engaged with the MoD and negotiated for the north-west corner of TRA002, above and coincident with the boundary of Cotswold CTA 2, from FL195 – FL245 to be reclassified as permanent Class C airspace. NATS will formally action and submit this change. The proposed change to the TRA002 remains the same as that which we consulted on and can be seen in Figure 11 below. The existing TRA002 boundary can be seen in orange.

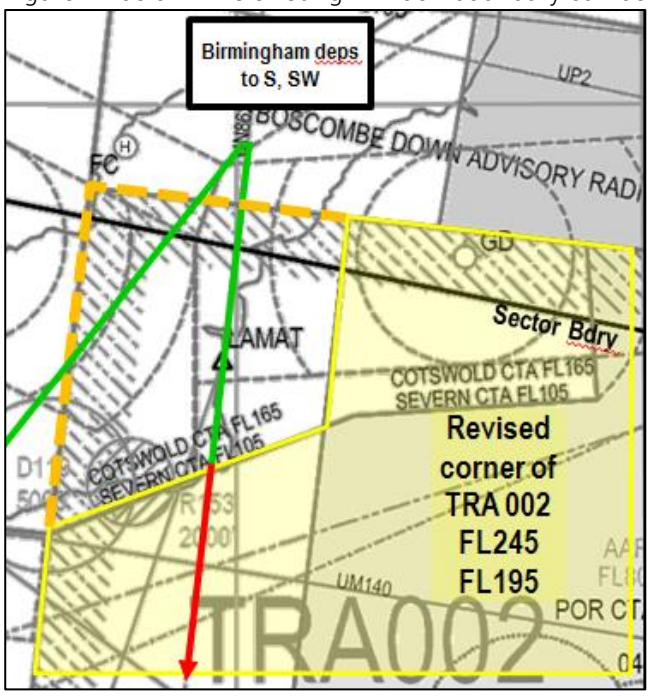

Figure 11: Proposed Change to TRA002

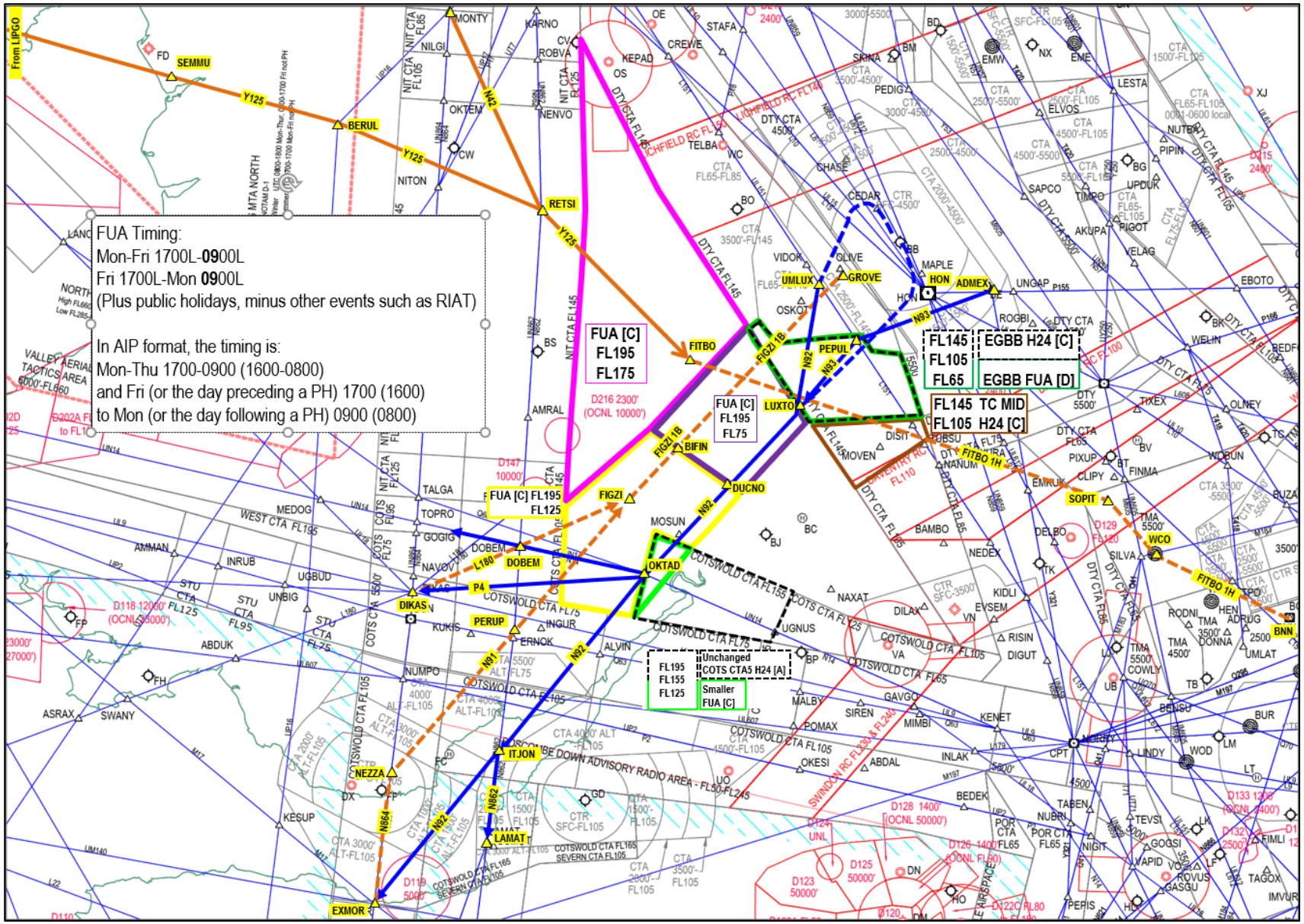

Figure 12: NATS' Proposed Design (Birmingham and Heathrow FUA/routes)

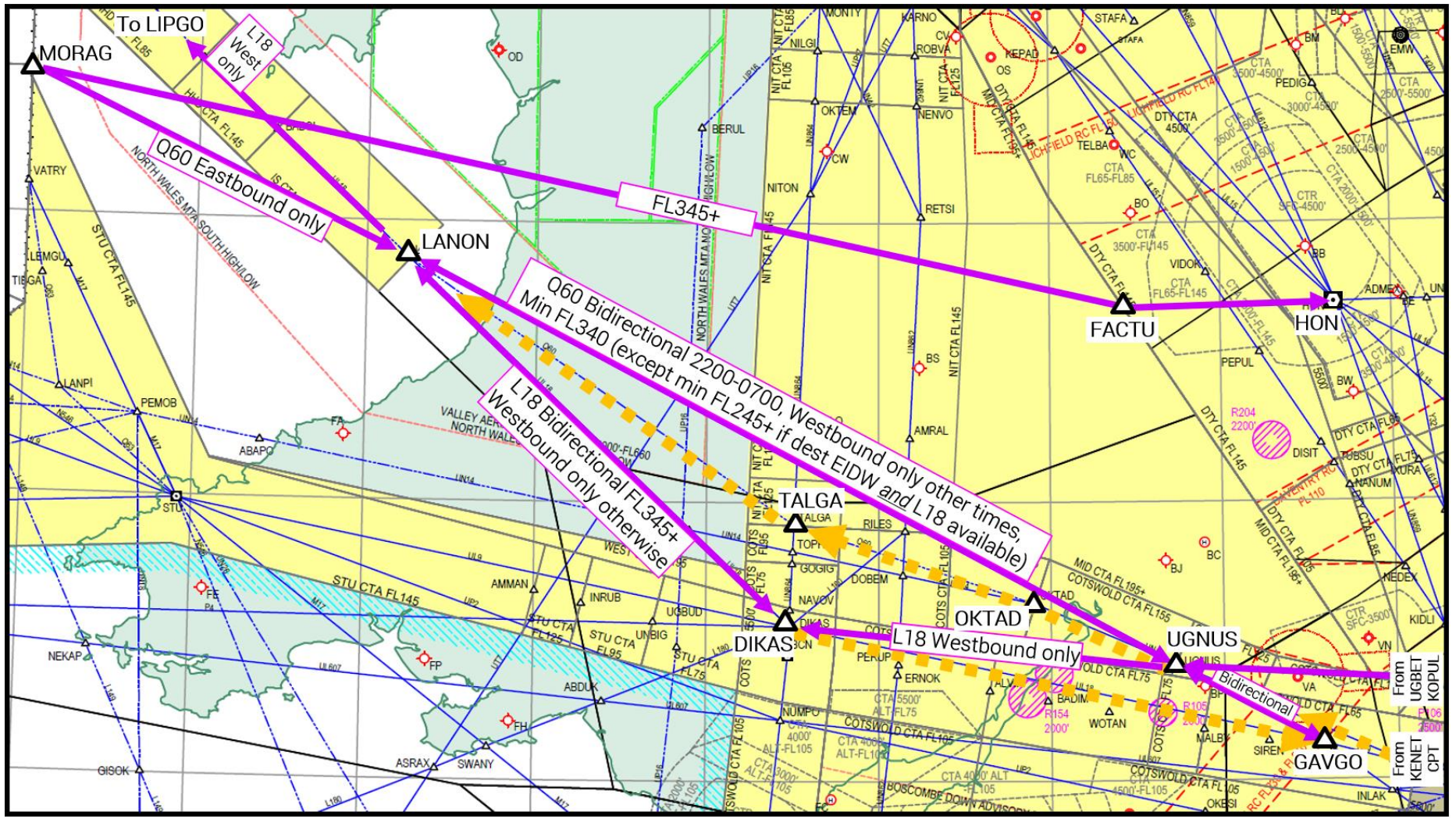

Figure 13 Overview of high-level ATS route changes

7. Impacts and Consultation

NATS completed engagement activities with stakeholders identified as those being most likely to be affected by the proposed design. These targeted stakeholders are listed in Annex Section 15.1 below. NATS engaged with all of the stakeholders on the planned changes through individual briefings; design workshops; and through wider groups and forums such as the Airspace and Flight Efficiency Partnership (AFEP) meeting. The Consultation Strategy Document (Ref 9) details all of the engagement activities completed prior to the consultation going live.

NATS commenced a focussed consultation on these proposed airspace changes on Thursday 31st January 2019. The consultation was conducted via an online portal where users could submit a formal response alongside viewing the Consultation Document (Ref 11). The consultation document provides information on how the consultation was administered; an overview into the current airspace; the proposed changes and impacts of the proposed changes.

The consultation was open for eleven weeks; closing on Thursday 18th April 2019. A total of thirteen responses were received during this period; which are covered in the following sections. A full summary of how the consultation was run and a theming of all responses can be found in the Stage 3 Step 3D Collate and Review Responses Report (Ref 12).

7.1 Net impacts summary

Category	Impact	Evidence
Safety/Complexity	Increased predictability of flight paths and a reduction in complexity/ workload	See Sections 4.3 and 4.4
Capacity/Delay	No impact on capacity or delay	See Section 4.3
Fuel Efficiency/CO_2	Total annual savings: -1,369 tonnes fuel / -4,353 tonnes CO_2 (2020) -1,784 tonnes fuel / -5,673 tonnes CO_2 (2030)	See Section 7.6
Noise – Leq/SEL	No impact – environmental analysis scaled equivalent to a Level 2 change	See Section 7.7
Tranquillity, visual intrusion (AONBs & National Parks)	No impact – environmental analysis scaled equivalent to a Level 2 change	See Section 7.7
Local Air Quality	No impact – environmental analysis scaled equivalent to a Level 2 change	See Section 7.7
Other Airspace Users	This proposal would introduce new routes and volumes of classification. All affected users and stakeholders have been engaged and consulted with.	See Sections 7.2 to 7.5

7.2 Units affected by the proposal

During Stage 1 of this process, seven Design Principles were agreed with the CAA. These can be found in the Stage 1 Step 1B Design Principles document (Ref 4). Design Principle 6 (DP6) stated there must be agreement between stakeholder ANSPs, that the design concept being progressed suits all operations.

NATS engaged with the Irish Aviation Authority (IAA) early in the design development work, particularly in relation to the Heathrow offload route. Birmingham Airport Limited (BAL) and Heathrow Airport Limited (HAL)

were both engaged and consulted with as key stakeholders. They have been involved throughout the entire design process, specifically in relation to the airspace changes pertinent to them.

HAL responded to the consultation stating that they support the proposed changes and recognise the network efficiency benefits they will provide.

BAL responded to the consultation with two specific suggestions which were categorised as potentially impacting the proposal. Firstly, BAL expressed a preference for a larger area of CAS adjacent to the Birmingham CTR. NATS responded with a compromise design solution which would vertically split this airspace volume into a larger Class C upper section and a smaller lower volume which would be Class D FUA. BAL also submitted a preference for the FUA timings to be: Monday to Friday 1700L to 1000L; and Friday 1700L until Monday 1000L (Option 1B in the Consultation Document, Ref 11).
There was a confliction between BAL's strong preference for 1000L and the MoD's objection to a morning end time of 1000L for the FUA, which NATS assisted in resolving to 0900L – see para 4.9 of Stage 3 Step 3D Collate and Review Responses document (Ref 12), for full details.

Consultation responses were also received from Wellesbourne and Wolverhampton Airfields. Wellesbourne confirmed their understanding of the proposed changes, which they stated would not affect their operations, and noted that they would continue to communicate with all of their stakeholders regarding the consultation. Wolverhampton confirmed that they have no objections.

All consultation feedback is summarised in the Stage 3 Step 3D Collate and Review Responses document (Ref 12) and the action we took on that feedback can be found in the Stage 4 Step 4A Update Design document (Ref 13).

7.3 Military impact and consultation

Design Principle 5 (DP5) stated that the proposed changes should minimise the negative impact on other airspace users, including the MoD.

The MoD was consulted as a key stakeholder via DAATM; specifically, in relation to the impact the proposed changes would have on military traffic. The MoD have been engaged and consulted with, throughout the entire design process.

The MoD responded to the consultation with four specific suggestions which could potentially change the proposal.

- Firstly, the MoD requested that the proposed airspace shown in yellow/ purple (Figure 12) is Class C airspace and control is not delegated from LACC. NATS will progress this suggestion.
- Preference for the proposed block of CAS adjacent to Birmingham to be either a smaller volume, or Class C. As covered in Section 7.2 above, NATS have responded with a compromised solution whereby this airspace would be split vertically (upper large volume, Class C H24/ lower small volume, Class D FUA).
- Consideration of the airspace to the north of RAF Brize Norton which would increase MoD fuel burn. In response to this, the southern block of CAS associated with the Heathrow offload route, which we consulted on, has been removed from this proposal. Additionally, the light blue volume of airspace (shown in the Consultation Document, Ref 11) will have a raised base of FL125, therefore combining it with the yellow block, which will reduce the impact on other airspace users (see Figure 12).
- Finally, the MoD required the proposed timings (listed under Option 1B) to be adjusted by one hour, 0900 instead of 1000 Local. This was against NATS and BAL's preference, however this timing change will be progressed.

All consultation feedback is summarised in the Stage 3 Step 3D Collate and Review Responses document (Ref 12) and the action we took on that feedback can be found in the Stage 4 Step 4A Update Design document (Ref 13).

7.4 General Aviation airspace users impact and consultation

Design Principle 5 (DP5) stated that the proposed changes should minimise the negative impact on other airspace users, including the GA community via the GA Alliance group. The British Gliding Association (BGA) were consulted via NATMAC, agreed to manage the consultation with the gliding community. No responses were received from either the GA Alliance, the organisations they represent, or the gliding communities[1]. Nevertheless, we reduced negative impact on other airspace users by removing one CAS volume entirely, raising the base of another by 2,000ft, and compromising our preferred larger CAS volume near Birmingham by splitting/raising part of it (see Figure 4 and Figure 5). Also, the FUA timing move to end 0900L reduces GA impacts by an hour every weekday.

7.5 Commercial air transport impact and consultation

NATS has engaged and consulted directly with airline operators who were identified as being relevant carriers within the associated area of airspace; these are listed in Annex A of the Stage 3 Step 3A Consultation Strategy document (Ref 9).

Consultation responses were received from the following six airlines: British Airways, Delta Airlines, Flybe, Jet2, Virgin Atlantic Airways and United Airlines. The responses from Delta, Flybe and United all expressed full support for the proposed changes; containing no suggestions which could impact the final proposal.

Jet2 fully support the majority of the proposal but requested for the new CAS around Birmingham to be available H24 to help alleviate congestion and allow more continuous climbs/ departures. NATS cannot progress this suggestion due to the impact on other airspace users.

British Airways submitted a response which was in support of the proposed changes but including a request for the Heathrow offload route to have a CDR1 status assigned, which would allow operators to flight plan the route. NATS will not assign a CDR1 status to the offload route as it must remain entirely tactical and used when appropriate. This is dependent on the live LTMA operation which NATS continuously monitors. The offload route will be RAD restricted and not flight-plannable.

Virgin Atlantic submitted a response which objected to the CDR3 status of the proposed Heathrow offload route. Their preference is predictability from a CDR1 status being assigned. As mentioned above, in relation to the British Airway feedback, NATS must progress this route as tactical only, not flight-plannable.

All consultation feedback is summarised in the Stage 3 Collate and Review Responses document (Ref 12) and the action we took on that feedback can be found in the Stage 4 Step 4A Update Design document (Ref 13).

There is no forecast increase in air transport movements, passenger numbers or cargo carried as an outcome of this proposal.

7.6 CO_2 environmental analysis impact and consultation

This proposal has technically been categorised as a Level 1 airspace change proposal due to the proposed FL65 CAS base close to Birmingham. However, as part of Stage 2, we have assessed that there would not be a discernible noise or visual impact as a consequence of the FL65 base. This assessment is summarised in a compliance paper which was submitted as part of the Stage 2 "Level 1 vs Level 2" Compliance Paper (Ref 8).

The environmental analysis requirements for this proposal have therefore been scaled equivalent to a Level 2 change, CO_2 emissions analysis only. This is due to the reduction of fuel burn and CO_2 emissions being the priority for airspace changes where aircraft operate above 7,000ft. The following data summarises the environmental assessments completed. There has been no further environmental analysis completed.

The NATS Analytics team have completed a final environmental analysis on the proposed changes presented here. Table 13 below shows the forecast fuel burn and CO_2 emission differences for the proposed changes in the first full year of implementation (2020) and ten years after (2030). It describes the same flows previously

[1] Reminder prompts were sent during the consultation to those organisations which had not yet responded

described in the document. This is based on NATS' proposed FUA timings:
Mon-Fri 1700L - 0900L; Fri 1700L - Mon 0900L.

As covered in Section 7.6.1 below, there have been a number of design changes from the design we consulted upon, as a result of consultation and simulation feedback. The fuel burn change from the design we consulted on has been shown in italics/ brackets for each component in Table 13 below.

Traffic Flow (SAIP AD5)	Annual Fuel Burn Change 2020 (T)	Annual CO_2 Change 2020 (T)	Annual Fuel Burn Change 2030 (T)	Annual CO_2 Change 2030 (T)
Birmingham Arrivals and Departures	-465 *(loss 24T)*	-1,479	-523 *(loss 26T)*	-1,663
Heathrow Offload Route	+71 *(no change)*	+226	+80 *(no change)*	+254
Q60 KOPUL - UGNUS	-594 *(gain 282T)*	-1,889	-800 *(gain 357T)*	-2,544
Q60 MORAG – LANON - UGNUS	-82 *(loss 36T)*	-261	-116 *(loss 42T)*	-369
N24 PEMOB - NIGIT	Removed from the proposal			
N24 PEMOB – NIGIT (previously)	*-659*	*-2,096*	*-743*	*-2,363*
P155 MORAG – XXXXX (awaiting a 5LNC) - HON	-299 *(no change)*	-951	-425 *(no change)*	-1,352
All flows	-1,369 *(437T less than predicted)*	-4,353	-1,784 *(454T less than predicted)*	-5,673

Table 13: Fuel burn and CO_2 forecast Changes – ACP

This analysis concluded that there would be an annual saving of 1,369 tonnes fuel and 4,353 tonnes CO_2 in 2020 after implementation, due to the proposed design and forecast route usage. The impact assessment indicates that up to a total of c.124,000 flights would be impacted by 2020. The analysis has also forecast a further annual saving of 1,784 tonnes fuel and 5,673 tonnes CO_2 by 2030, 10 years after implementation. This analysis was based on the Eurocontrol Strategic Forecasting (STRATFOR) data for 2017 grown to future traffic levels; which provides quantitative forecasts by origin and destination. The forecast flows between specific origin and destinations may change to a greater or less extent.

The fuel and CO_2 reduction from the proposed design is due to the Birmingham arrival/ departure and high-level ATS routes offering more direct routings and therefore less track mileage. The proposed changes have been designed to prioritise minimising the environmental extent throughout the whole design. This was one of the key drivers behind the Design Principle Evaluation (Ref 6) which included the environmental Design Principle "avoid low-level changes and reduce CO_2 emissions where possible". The proposed change to L18 (GAVGO – DIKAS) does not have any direct environmental impact as it is an enabler for the other benefits.

Systemising the airspace offers additional benefits such as a reduction in complexity from the systemised flows. It is also difficult to currently account for the fuel used in tactical heading and speed management, tools which controllers employ every day in these sectors of airspace – systemisation would reduce the need for tactical management.

A UK government transport analysis, known as 'WebTAG', has been completed in order to quantify the monetary value of the impact on the environment due to greenhouse gas emissions (specifically using CO_2 as the measure). Details of the WebTAG results are given in the Stage 4 Step 4A Update Design document (Ref 13).

7.6.1 Design differences since consultation

The Stage 4 Step 4A Update Design document [Ref 13] contains full details of all changes to the proposal for submission. The FUA overnight timings have been reduced by one hour (to 0900L, from 1000L) compared with the consulted upon timing. This accounts for the slight reduction in fuel benefit for the proposed Birmingham changes, of c.24t annual fuel burn (2020) and 26t (2030). This hour loss would not change the fuel use for Heathrow arrivals due to the timing dependency on NWMTA.

The proposed ATS Route Q60, westbound KOPUL – UGNUS, would provide a fuel benefit of 594T, which is an increase of 282T from the change we consulted upon. This is due to an additional waypoint for connectivity which has been added to the route; allowing more traffic to use this route.

The proposed change to ATS Route Q60, between MORAG – LANON – UGNUS, would provide a slightly reduced fuel benefit; down 36T from what was consulted upon. This decrease is acceptable in order to improve the connectivity and flows within the wider network.

The N24 ATS route PEMOB NIGIT was originally predicted to provide an annual fuel benefit of 659t (2020), however this environmental calculation unfortunately contained an error. As the fuel benefit cannot be gleaned, this proposed route change has therefore been removed from this proposal.

The P155 MORAG HON route has a formal flightplan level restriction which does not cause a change to the fuel benefit.

This proposal would still provide a fuel usage and CO_2 emissions benefit, and the reduction in benefit from what was consulted upon is acceptable in order for the wider proposal to progress; through fully meeting or compromising on stakeholder's interests and feedback.

7.7 Local environmental impacts and consultation

As explained in Section 7.6 above, the environmental analysis requirements for this proposal have been scaled equivalent to a Level 2 change: CO_2 emissions only. As summarised in the "Level 1 vs Level 2" compliance paper [Ref 8], which the CAA approved, NATS provided evidence to demonstrate that there would be no discernible change to GA traffic below 7,000ft and no change to commercial air traffic at all (Birmingham Airport departures are managed by Birmingham Airport ATC outwith this proposal which aligns with their departure routes).

Asides from the proposed change to the base of CAS close to Birmingham, the changes are all above 7,000ft. Priority has therefore not been given to local environmental impacts such as noise, visual intrusion, tranquillity or local air quality. NATS did not target organisations whose primary interest is environmental impacts.

Detailed analysis of the environmental impact of the proposed changes is given in Section 7.6. This includes analysis of the current vs proposed routes for the impact on fuel burn and CO_2 emissions.

7.8 Economic impacts

The development of this airspace change proposal has not been informed by any economic constraints or opportunities. The likely economic impacts are detailed in the Stage 4 Step 4A Update Design document, Section 5 [Ref 13]. As summarised in this document and the WebTAG spreadsheet provided [Ref 22], the WebTAG analysis concluded a Net Present Value of CO_2 emissions (traded sector) of £601,249. We predict a fuel burn benefit of £706,225 in 2020, predicted to increase to become a saving of £920,311 in 2030, also NPV based on number of tonnes of aviation fuel saved using the IATA jet fuel price of 10th May 2019, at 669.96USD/tonne converted to GBP at 0.77$/£.

8. Analysis of Options

8.1 Airspace Change Design Options

Initially, NATS developed individual design components for the Birmingham and Heathrow CAS/ route designs rather than focussing on the overall combined design. The design components were based on different geographical designs with varying CAS classifications, FUA timings and CDR route statuses. The design components for the TRA 002 and the high-level ATS Routes were considered as "do nothing" or "implement".

These design components were individually evaluated against the Design Principles [Ref 4] before being combined into system-wide designs; this is described in more detail in Section 8.2 below. This process resulted in four final design options which were consulted upon [Ref 11]. These options varied in airspace classifications (C/D); FUA timings; conditional route status applied to the offload route; and the geographical design of the proposed CAS adjacent to Birmingham CTR.

NATS specified a preferred option, termed Option 1B, which included:

- A larger volume of CAS to provide maximum flexibility for Birmingham traffic
- Specific FUA timings: Monday to Friday 1700L to 1000L, and Friday 1700L to Monday 1000L (plus H24 on public holidays)
- A CDR1/3 or CDR3 status for the proposed Heathrow offload route

8.2 Design Options Assessment

NATS evaluated the longlist of individual design components (BB, LL, TRA 002 and ATS Routes) against the seven Design Principles [Ref 4]. This allowed the following components to be assessed and considered in isolation: baselines (do nothing); airspace classifications (A/ C/ D/ E); different FUA timings for routes and CAS (H24/ different time limitations); and different conditional route statuses (CDR1, 1/3, 3).

The best scoring design components were accepted and progressed into four final design options, which were consulted upon. Design components were not progressed if they did not meet any of the seven Design Principles, regardless of how well they were evaluated against the other Design Principles. The four design options contained the same geographical routes and CAS dimensions (except for one mentioned below); the same CDR options for the EGLL offload route; identical high-level ATS Route changes; and the same changes to the TRA 002. The four design options contained the following differences:

- Option 1A – a larger class C/ D CAS volume near Birmingham; airspace and routes available evenings/ overnights/ mornings on weekdays and weekends
- Option 1B – a larger class C/ D CAS volume near Birmingham; airspace and routes available weekday evenings/ overnights/ mornings and H24 weekends
- Option 2A – a smaller class C/ D CAS volume near Birmingham; airspace and routes available evenings/ overnights/ mornings on weekdays and weekends
- Option 2B - a smaller class C/ D CAS volume near Birmingham; airspace and routes available weekday evenings/ overnights/ mornings and H24 weekends

All four options are very similar in concept and all aim to provide a more predictable environment for Birmingham traffic; reduce the complexity for relevant Heathrow inbounds; and where possible, enable fuel and CO_2 savings.

The four design options were also evaluated against the seven Design Principles from Stage 1 [Ref 4]. They all fully met one of the two highest priority Design Principles of obtaining ANSP agreement. The other highest priority Design Principle of avoiding low-level changes and reducing CO_2 emissions was partially met by all four designs. This is due to the proposed FL65 CAS base close to Birmingham, which could potentially cause a slight redistribution of GA flights (covered separately in the Level 1 Compliance Paper, Ref 8). The remaining Design Principles were either fully or partially met.

We then undertook a Full Options Appraisal [Ref 10] which quantified the analyses required by CAP1616. Subsequently we progressed all four design options forward to consultation. The consultation resulted in twelve elements which suggested changes to the design; eight of which were either fully or partially progressed (where compromises were appropriate). A full summary of the consultation [Ref 11], the feedback received [Ref 12] and how the design changed as a consequence of the feedback [Ref 13] and other technical/administrative amendments are described in the associated references.

The final design is hereby submitted because it best meets the design principles and takes account of consultation feedback.

9. Airspace Description Requirements

	The proposal should provide a full description of the proposed change including the following:	Description for this proposal
a	The type of route or structure; for example, airway, UAR, Conditional Route, Advisory Route, CTR, SIDs/STARs, holding patterns, etc	ATS Routes, CAS volumes, STARs (Section 6) See Figure 12 and Figure 13 for proposal schematics
b	The hours of operation of the airspace and any seasonal variations	FUA timings covered in Section 7.2. Others as described in Section 6.
c	Interaction with domestic and international en-route structures, TMAs or CTAs with an explanation of how connectivity is to be achieved. Connectivity to aerodromes not connected to CAS should be covered	See Section 6 for ATS route schematics. See ADD Ref 16.
d	Airspace buffer requirements (if any). Where applicable describe how the CAA policy statement on 'Special Use Airspace – Safety Buffer Policy for Airspace Design Purposes' has been applied.	See RSAD (Ref 18) for one request to reduce CAS-ATS route buffer from 3nm to 2nm
e	Supporting information on traffic data including statistics and forecasts for the various categories of aircraft movements (passenger, freight, test and training, aero club, other) and terminal passenger numbers	See Section 4.2.1 and Stage 4 Step 4A doc Ref 13
f	Analysis of the impact of the traffic mix on complexity and workload of operations	The design concept is to flow the traffic as shown in Figure 12 and Figure 13, in order to reduce complexity and workload. Further covered in Section 4.3.
g	Evidence of relevant draft Letters of Agreement, including any arising out of consultation and/or airspace management requirements	See Draft LoAs Ref 17
h	Evidence that the airspace design is compliant with ICAO Standards and Recommended Practices (SARPs) and any other UK policy or filed differences, and UK policy on the Flexible Use of Airspace (or evidence of mitigation where it is not)	See Figure 12 for ATS route schematics. FUA was a major thread in this proposal and is covered throughout the project. See RSAD Ref 18 for evidence of CAP1385 compliance. STARs and holds will comply with relevant PANS-OPS.
i	The proposed airspace classification with justification for that classification	All new CAS is proposed as Class C or D. See Section 6.2 Further justification can be found in the Stage 4 Update Design document (Ref 13). No changes to existing CAS volumes or classifications.
j	Demonstration of commitment to provide airspace users equitable access to the airspace as per the classification and where necessary indicate resources to be applied or a commitment to provide them in line with forecast traffic growth. 'Management by exclusion' would not be acceptable	Proposed CAS volumes are Class C or D. NATS commits to provide the same level of access post-implementation in line with forecast growth.
k	Details of and justification for any delegation of ATS	See Section 7.3. See References Update Design (Ref 13) and HAZID summary (Ref 19) for summary of ATS delegations.

10. Safety Assessment

NATS has a dedicated safety manager for the SAIP project. Their role is to assess the scale of each airspace change, to ensure the CAA-compliant NATS Safety Management System is followed. Also their role is to submit safety arguments with supporting evidence to the CAA's en-route safety regulator, to clearly demonstrate each airspace change is acceptably safe for implementation and the right assurances are in place.

The NATS safety manager has assessed the SAIP AD5 proposed change. Due to the impacted sectors being of high complexity, and the high capacity of traffic throughput of the combined sector group, along with the changes to ATC routes and procedures, the assessment resulted in a High Impact Change that require full Safety Assurance in accordance with the NATS Safety Management Manual (SMM).

Any change assessed as 'high impact' triggers a greater depth of safety analysis and mitigation work, it does not mean there is any particular safety risk in the region caused by the proposal. As part of the ongoing safety work for SAIP AD5, a full safety analysis occurred which will result in the production of a Project Safety Assurance Report (PSAR). These documents are technical in nature and are designed to be read by experts in the field of aviation safety with full contextual awareness of the contents. These documents are confidential and would not be published as part of the airspace change process. A high-level summary of the hazards is supplied as Ref 19, this fulfils the ACP requirement in advance of the wider safety evidence work directly coordinated between SARG and NATS.

The post-consultation design changes (described in this document) would have no impact on this subject. The following text is the same as that submitted for Stage 3:

Birmingham Arrivals and Departures

The flows proposed would provide a modernisation and partial systemisation of the region, whereby the handling of flights would be much more predictable.

The proposal aims to provide more systemised, predictable flightplanning options for Birmingham arrivals and departures which would be fully contained within the proposed CAS volumes thus reducing overall controller and cockpit workload.

The proposed volumes of CAS would contain Birmingham arrivals and departures within CAS. This is a more predictable air traffic environment during the hours of operation, and logically flights within CAS are safer than those outside CAS.

This would cause a reduction in the complexity of the region's airspace for the same amount of traffic, for both ATC and pilots. There would be less coordination and fewer tactical actions required, thus reducing the number of controller interactions. This would also result in a lower RT loading.

NATS' first priority is safety (and transparently demonstrating its commitment to safety). NATS will construct an appropriate safety case to show that an appropriate containment buffer for ATS Routes is applied to the proposed volumes of CAS.

Heathrow Offload Routes

The flows proposed would provide a more predictable method for the tactical balancing of flows by reducing the need for late tactical stack swaps. This would lead to a more modernised and partially systemised environment.

This would consequently reduce the operational complexity currently experienced within this region, and potential associated safety risks linked to this.

The proposed offload route and CAS could be used by pre-selected flights. This would increase the overall environmental efficiency.

A decrease in coordination and controller interactions would reduce ATC complexity. A reduction in late-notice stack-swaps would reduce cockpit workload.

NATS' first priority is safety (and transparently demonstrating its commitment to safety). NATS will construct an appropriate safety case in accordance with standard practice.

ATS routes and TRA 002

There is no particular safety consideration to be addressed by the implementation of new/revised high level ATS routes. However, some items are commonly used tactical-directs which would become formal ATS routes, logically these have better aeronautical data definitions (e.g. AIP publication, defined RNAV status etc).
Addendum post-consultation: The changes to the ATS routes described in this document do not change the safety concepts evaluated under the formal safety assessment.

There is no particular safety consideration to be addressed by the implementation of a revised TRA 002 boundary. The MoD are content that this would not cause a safety issue for their operation.

NATS is similarly content and appreciates the MoD's acceptance of this item.

11. Operational Impact

	An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:	Evidence of compliance/ proposed mitigation
a	Impact on IFR general air traffic and operational air traffic or on VFR General Aviation (GA) traffic flow in or through the area	IFR GAT as per Figure 1and Figure 2 flow schematics, also in Figure 12 and Figure 13 summarises. Impacts on VFR GA covered in Stage 2 compliance paper (Ref 8) and para 7.4. Impacts on MoD operations see para 7.3.
b	Impact on VFR operations (including VFR routes where applicable);	Impacts on VFR GA covered in Stage 2 compliance paper (Ref 8). Impact on VFR operations covered in para 7.4.
c	Consequential effects on procedures and capacity, i.e. on SIDs, STARs, and/or holding patterns. Details of existing or planned routes and holds	Section 6 for full description. See Figure 12 flow schematics. The aim of this project is not to improve upon capacity or delay, as covered in Section 4.3.
d	Impact on aerodromes and other specific activities within or adjacent to the proposed airspace	Impacts on units can be found in Section 7.2 and GA users, Section 7.4. See Draft LoAs with relevant aerodromes, Ref 17.
e	Any flight planning restrictions and/or route requirements	See Figure 12 for flow schematics. See ADD (Ref 16) for flightplanning restrictions and route requirements.

12. Supporting Infrastructure/ Resources

	General requirements	Evidence of compliance/ proposed mitigation
a	Evidence to support RNAV and conventional navigation as appropriate with details of planned availability and contingency procedures	See RNAV Coverage Exec Summary Report and Full Report (Ref 20, 21)
b	Evidence to support primary and secondary surveillance radar (SSR) with details of planned availability and contingency procedures	Traffic uses the same regions as today in a similar manner from a surveillance point of view. Demonstrably adequate for the region.
c	Evidence of communications infrastructure including R/T coverage, with availability and contingency procedures	Traffic uses the same regions as today in a similar manner from a comms infrastructure point of view. Demonstrably adequate for the region.
d	The effects of failure of equipment, procedures and/or personnel with respect to the overall management of the airspace must be considered	Existing contingency procedures and management protocol will continue to apply as today.
e	Effective responses to the failure modes that will enable the functions associated with airspace to be carried out including details of navigation aid coverage, unit personnel levels, separation standards and the design of the airspace in respect of existing international standards or guidance material	As above (12d)
f	A clear statement on SSR code assignment requirements	No change
g	Evidence of sufficient numbers of suitably qualified staff required to provide air traffic services following the implementation of a change	See Stage 4 Step 4A Update Design (Ref 13) where we described the need to train c.140 NATS LAC/ LTC controllers, presuming the approval and implementation of this proposal. This training will be complete in good time for the planned implementation date.

13. Airspace and Infrastructure

	General requirements	Evidence of compliance/ proposed mitigation
a	The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments	See Figure 12 for flow schematics and RSAD (Ref 18) for CAS buffer and route separation considerations.
b	Where an additional airspace structure is required for radar control purposes, the dimensions shall be such that radar control manoeuvres can be contained within the structure, allowing a safety buffer. This safety buffer shall be in accordance with agreed parameters as set down in CAA policy statement 'Safety Buffer Policy for Airspace Design Purposes Segregated Airspace'. Describe how the safety buffer is applied, show how the safety buffer is portrayed to the relevant parties, and provide the required agreements between the relevant ANSPs/ airspace users detailing procedures on how the airspace will be used. This may be in the form of Letters of Agreement with the appropriate level of diagrammatic explanatory detail.	Request for reduced CAS buffer of 2NM on the northern edge of the FUA boundary – see RSAD (Ref 18) and LoAs (Ref 17)
c	The Air Traffic Management system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures	See Section 6.2 for ATS route schematics. See RSAD Ref 18 for evidence of CAP1385 compliance.
d	Air traffic control procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures	See Section 6.2 for ATS route schematics. See RSAD Ref 18 for evidence of CAP1385 compliance. See item b above.
e	Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable	The classification of new proposed CAS has taken into consideration feedback from stakeholders/ airspace users. See Updated Design, Ref 13. All new CAS volumes are either Class C or D, both of which allow for VFR flight. No changes to existing CAS classification.
f	There must be assurance, as far as practicable, against unauthorised incursions. This is usually done through the classification and promulgation	Appropriate classifications have been chosen, which require ATC clearance. See Updated Design, Ref 13. No change to existing CAS volumes or classification. Promulgation via the normal AIRAC cycle.
g	Pilots shall be notified of any failure of navigational facilities and of any suitable alternative facilities available and the method of identifying failure and notification should be specified	Existing contingency procedures would continue to apply.
h	The notification of the implementation of new airspace structures or withdrawal of redundant airspace structures shall be adequate to allow interested parties sufficient time to comply with user requirements. This is normally done through the AIRAC cycle	This change will be promulgated by AIRAC as per the typical cycle schedule.
i	There must be sufficient R/T coverage to support the Air Traffic Management system within the totality of proposed controlled airspace	Traffic uses the same regions as today in a similar manner from a comms infrastructure point of view. Demonstrably adequate for the region. See item 12 c.
j	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	See Draft LoAs Ref 17 for agreements between ANSPs and units. Other procedures and operating agreements will be implemented as per CAA-approved MATS Part 2.
k	Should there be any other aviation activity (low flying, gliding, parachuting, microlight site, etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests	Should this occur, we would act appropriately and expeditiously.

	Section 13 Continued - ATS route requirements	Evidence
a	There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources, to contain the aircraft within the route to the published RNP value in accordance with ICAO/ Eurocontrol standards	See RNAV Coverage Documents (Ref 20, 21) Primarily we would expect flights to use GNSS navigation.
b	Where ATS routes adjoin terminal airspace there shall be suitable link routes as necessary for the ATM task	See Figure 12 for ATS route schematic. See ADD (Ref 16) for more details.
c	All new routes should be designed to accommodate P-RNAV navigational requirements	Proposed new routes serving BB/LL are all RNAV1. Proposed changes to high level ATS Routes are all RNAV5. See ADD (Ref 16) for more details.
	Terminal airspace requirements	**Evidence**
	Changes to link with proposed terminal structures are illustrated in Figure 12 route schematics & described in the associated text from Section 6.2. For full details see ADD Ref 16.	
	Off-route airspace requirements	**Evidence**
	The lateral dimensions of TRA 002 will be modified in agreement with the MoD. NATS will progress the AIP changes with the MoD's permission – this will include the definition of a new CTA to "replace" that portion of TRA 002.	

14. Environmental Assessment

	Theme	Content	Evidence of compliance/ proposed mitigation
a	WebTAG analysis	Output and conclusions of the analysis (if not already provided elsewhere in the proposal)	See para 15.4, Stage 4 Step 4A Ref 13 and Webtag Excel file Ref 22.
b	Assessment of noise impacts (Level 1/M1 proposals only)	Consideration of noise impacts, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no noise impacts, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2 change, see Section 7.6.
c	Assessment of CO_2 emissions	Consideration of the impacts on CO_2 emissions, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no impact on CO_2 emissions impacts, the rationale must be explained	See Section 7.6 and Stage 4 Step 4A, Ref 13.
d	Assessment of local air quality (Level 1/M1 proposals only)	Consideration of the impacts on local air quality, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no impact on local air quality, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2 change, see Section 7.6.
e	Assessment of impacts upon tranquillity (Level 1/M1 proposals only)	Consideration of any impact upon tranquillity, notably on Areas of Outstanding Natural Beauty or National Parks, and where appropriate the related qualitative and/or quantitative analysis If the change sponsor expects that there will be no tranquillity impacts, the rationale must be explained	N/A - environmental analysis requirements scaled equivalent to a Level 2 change, see Section 7.6.
f	Operational diagrams	Any operational diagrams that have been used in the consultation to illustrate and aid understanding of environmental impacts must be provided	N/A
g	Traffic forecasts	10-year traffic forecasts, from the anticipated date of implementation, must be provided (if not already provided elsewhere in the proposal)	See Section 7.6 and Stage 4 Step 4A, Ref 13.
h	Summary of environmental impacts and conclusions	A summary of all of the environmental impacts detailed above plus the change sponsor's conclusions on those impacts	See Section 7.1

15. Annexe

15.1 References – supplied as separate documents from Ref 14 - Ref 22.

Ref No	Description	Notes
1	SAIP AD4 CAA web page – progress through CAP1616	(link)
2	Stage 1 Step 1A Assessment Meeting Presentation	(link)
3	Stage 1 Step 1A Assessment Meeting Minutes	(link)
4	Stage 1 Step 1B Design Principles	(link)
5	Stage 2 Step 2A Design Options	(link)
6	Stage 2 Step 2A Design Principle Evaluation	(link)
7	Stage 2 Step 2B Initial Options Safety Appraisal	(link)
8	Stage 2 Level 1 vs Level 2 Compliance Paper	(link)
9	Stage 3 Step 3A Consultation Strategy	(link)
10	Stage 3 Step 3A Full Options Appraisal	(link)
11	Stage 3 Step 3C 3 Consultation Website and Document	(link)
12	Stage 3 Step 3D Collate and Review Responses	(link)
13	Stage 4 Step 4A Update Design	(link)
14abcdef	Technical definition documents x6	Supplied separately (NO PUBLISH)
15	Draft AIP changes	Uploaded to CAA portal
16	Airspace Design Definition (ADD)	Supplied separately (NO PUBLISH)
17ab	List of Letters of Agreement (LoAs) requiring update Draft LoA between NATS Swanwick, Cardiff Airport, Birmingham Airport and RAF(U) Swanwick Military	Supplied separately (NO PUBLISH)
18	Route Spacing Analysis Document (RSAD)	Supplied separately (NO PUBLISH)
19	Safety Management Hazard Identification (HAZID) Summary	Supplied separately (NO PUBLISH)
20	RNAV1 Coverage via DME-DME analysis - Exec Summary	Uploaded to CAA portal
21	RNAV1 Coverage via DME-DME analysis – Full Report	Supplied separately (NO PUBLISH)
22	WebTAG greenhouse gas workbook, all traffic flows	Uploaded to CAA portal

15.2 List of Consultation Stakeholders

Links to the consultation were placed on the NATS Customer Website and the CAA public airspace change website. The consultation was most relevant to the stakeholders listed below, but not exclusively. One member of the public responded.

Key Stakeholders:

A4A	Airspace 4 all (formally FASVIG)
BAATL	Birmingham Airport Air Traffic Limited
BAL	Birmingham Airport Limited
GAA	General Aviation Alliance representing a partnership of GA organisations
HAL	Heathrow Airport Limited
IAG GBS	International Airlines Group Global Business Services
MoD	Ministry of Defence via Defence Airspace & Air Traffic Management (DAATM)
	MoD RAF Brize Norton
	MoD RAF (U) Swanwick

The following air operators were targeted:

AAL	American Airlines
ACA	Air Canada
BAW	British Airways
BEE	Flybe
DAL	Delta Airlines
EXS	Jet2
RYR	Ryanair
STK	Stobart Air
TCX	Thomas Cook
TOM	Thomson
TUI	TUI Group
UAL	United Airlines
VIR	Virgin Atlantic

Other Stakeholders:

Members and organisations of the NATMAC (National Air Traffic Management Advisory Committee):
AOA, AOPA, ARPAS-UK, AEF, BA, BAE Systems, BALPA, Airlines UK, BBAC, BBGA, BGA, BHPA, BMAA, BMFA, BPA, BHA, GAA, GATCO, HCGB, Heavy Airlines, Honourable Company of Air Pilots, LAA, Light Airlines, Low Fares Airlines, PPL/ IR (Europe)

GA Airfields:

EGBE	Coventry
EGBJ	Gloucester
EGBO	Halfpenny Green
EGBP	Cotswold Kemble
EGBS	Shobdon
EGTK	Oxford
EGBW	Wellesbourne

Local Airfields: EGNX East Midlands

15.3 Analysis modelling methodology and assumptions

Three fuel burn modelling methodologies were used for the environmental calculations in this document.

Birmingham Arrivals and Departures

This airspace change has been modelled using the fast-time simulation software AirTOp.
The traffic sample days used were the 6th & 8th July 2016 grown to 2019 traffic.
Annualised traffic figures are based on the 2017 NATS base case forecast.
The traffic sample contained all aircraft which arrived or departed at EGBB.
The AirTOp Model was run once each for easterly and westerly operations and then weighted 30%/70% in accordance with typical runway use.
Fuel burn modelling has been undertaken using the KERMIT emissions model. The KERMIT model uses Base of Aircraft Data (BADA) data which has been made available by the European Organisation for the Safety of Air Navigation (EUROCONTROL) all rights reserved. The AirTOp simulation model also uses BADA aircraft performance data.
Fuel uplift is included in the assessment.
AirTOp version 2.3.112 was used.

The Baseline traffic data was based on flight plan data and not actual flown data. This ensured that network constraints associated with excessive demand did not mask underlying demand requirements on the airspace. When undertaking comparative analysis between the scenarios, the traffic samples remained the same as that in the Baseline (do-nothing) scenario. This was to ensure any observed differences were due to the airspace design, not due to changes in the traffic sample.

No conflict resolution was applied Controller tasks were completed instantaneously with each controller able to control multiple aircraft simultaneously (no workload constraints or response limitations applied). For the fuel burn analysis, the models were run once only, using the scheduled aircraft departure times as per the flight plan. Holding and arrival separation was not turned on within the baseline and scenario. The average fuel burn benefit per aircraft is calculated using only the traffic and aircraft types observed on the particular traffic flows relevant to the scenario.

Heathrow Offload Route

Flights were modelled using the NATS Analytics profile generator.

Comparisons were made to show the difference in total fuel burn and total CO2 emissions for the route change. The fuel burn and CO2 emissions were calculated using the NATS Analytics tool KERMIT (Kerosene Emissions Research Model in the TMA), using Eurocontrol BADA data.

For each aircraft type the average fuel uplift percentage was calculated using the equation detailed in Fuel Uplift: Methodology for Application, 2013.

The traffic sample used was from 2017 NEST data grown to 2020/2030 traffic levels using the 2017 NATS traffic base forecast.

High-level ATS Routes

As there is no level change for traffic using the ATS routes, the fuel saving was calculated for each flight by multiplying the distance saving (NM) by the fuel burn (per NM) for that aircraft type at their RFL (using Eurocontrol's BADA data).

Fuel uplift was then applied using the Fuel Uplift: Methodology for Application, 2013 to give the overall change in fuel used.

15.4 WebTAG - 10 year greenhouse gas results, all traffic flows

Greenhouse Gases Workbook - Worksheet 1

Scheme Name: NATS SAIP AD5 Stage 4 ACP

Present Value Base Year	2010
Current Year	2018
Proposal Opening year:	2020
Project (Road/Rail or Road and Rail):	road

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£): £601,249

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 60 year appraisal period (tonnes): -55,146
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded -39760.24437

Change in carbon dioxide equivalent emissions in opening year (tonnes): -4,353
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£): £871,126
(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a **net benefit** (i.e. CO2E emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	-9701.89857	-18072.83835
Non-traded sector	0	0	-3754.27143	-6993.51165

Qualitative Comments:

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £901,874

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£): £300,625

Data Sources:

See Ref 22 for full Excel workbook. For consistency with the Stage 2 and 3 documentation, the "current year" was left as 2018 which is when work was started on this proposal. It has no effect on the calculations.

End of document