Free Route Airspace Deployment 3

Airspace Change Proposal (ACP)
ACP-2021-071

Gateway documentation:
Stage 3 Consult

Step 3A Options Appraisal
(Phase II - Full)
including Safety Assessment

NATS

Roles

Action	Role	Date
Produced	**Airspace Change Specialist** NATS Airspace & Future Operations	April 2023
Reviewed Approved	**Manager Airspace Evolution & Planning** NATS Airspace & Future Operations	April 2023
Reviewed Approved	**Airspace Development Consultant** NATS Airspace & Future Operations	April 2023
Reviewed Approved	**FRA Project Manager** Operations & Airspace Programme Delivery	April 2023

Drafting and Publication History

Issue	Month/Year	Changes this issue
1.0	April 2023	Submitted to CAA

Contents

1. Introduction

This document forms part of the document set in required for the CAP1616 airspace change process.

This document aims to provide adequate evidence to satisfy Stage 3 Consult; Step 3A Consultation Preparation: Options Appraisal (Phase II Full), including a Safety Assessment and a full analysis of the viable option.

Its purpose is to provide a more detailed quantitative assessment on the design option which progressed through the Step 2B Initial Options Appraisal, which was based around a qualitative assessment. This document will include a quantitative assessment of all reasonable costs and benefits of the design options, other costs and benefits described qualitatively and reasons why they could not be quantified.

2. Change Level and Scaling

The changes proposed in this ACP impact flights above FL255. Hence in accordance with the Levels as defined in CAP1616, this proposal is categorised as a scaled Level 2B change.

In line with the requirements for a Level 2B change the environmental impact assessment has been conducted on the basis of CO_2e emissions. There would be no perceptible change to noise impacts to stakeholders on the ground, so no noise analysis has been conducted.

The anticipated environmental impacts for this change are positive, so the environmental impact assessment is primarily qualitative. The CO_2 and fuel burn benefit is provided, but a WebTAG analysis is not, in line with CAP1616 requirements.

3. Options Appraisal (Phase II Full)

There is one viable design option for this proposal, which is compared to the baseline do-nothing scenario:

- FRA Option 1. In which all ATS routes are removed, and RAD restrictions are introduced in order to manage the flow of traffic transitioning into and out of FRA.

The baseline do-nothing option would not meet the AMS requirements or meet the mandated legal requirement to introduce FRA in the UK UIR, so was discounted at Stage 2 as a viable option. It should be noted that the implementation of Free Route Airspace (FRA) was mandated in EU law via the SESAR PCP Implementing Regulation EU716/2014[1], and as such is not benefits driven.

The proposed option is for deployment of FRA in the deployment area from FL255.

There is a fixed correlation between fuel burnt and greenhouse gases emitted. For every 1kg of fuel that is burnt 3.18kg of CO2 equivalent (CO2e) is emitted.

[1] EU716/2014 has been superseded within the EU. However, the UK has retained the requirements under UK (EU) 716/2014.

3.1 Baseline 'Do Nothing'

This presents the impact assessment of the baseline scenario.

<table>
<tr><th colspan="4">Option 0: BASELINE (Do Nothing)</th></tr>
<tr><th>Group</th><th>Impact</th><th>Level of Analysis</th><th>Description</th></tr>
<tr><td>Communities</td><td>Noise impact on health and quality of life</td><td>Qualitative</td><td>The proposed changes to air traffic patterns are all above FL255 (circa 25,500ft). This is well above the 7,000ft threshold below which CAP1616 states noise impacts are considered significant and analysis is required. The potential noise or tranquillity impacts are neither measurable nor describable.</td></tr>
<tr><td>Communities</td><td>Air quality</td><td>N/A</td><td>ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". No change in airspace design below 1,000ft – no changes to impacts.</td></tr>
<tr><td>Wider society</td><td>Greenhouse gas (GHG) impact</td><td>Qualitative / Quantitative</td><td>No changes to airspace; no change to GHG impacts. CO_2 emissions analysis has been performed using computer simulations which modelled the current operation of the FRA D3 airspace. Extrapolating the baseline using traffic forecast figures presents the 'do nothing' option, shown in this table:
<table><tr><th>Year</th><th>Traffic (forecast)</th><th>CO_2 (KT)</th></tr><tr><td>2022</td><td>447,283</td><td>21,821</td></tr><tr><td>2024</td><td>549,206</td><td>26,794</td></tr><tr><td>2034</td><td>665,083</td><td>32,447</td></tr></table>This modelling is based on EUROCONTROL flight plan data for a 6-day 2022 traffic sample using BADA 4.2 and the NATS STATFOR OCT 2022 forecast.</td></tr>
<tr><td>Wider society</td><td>Capacity/ resilience</td><td>Qualitative</td><td>No changes to airspace; no changes to airspace capacity / resilience.</td></tr>
<tr><td>General Aviation</td><td>Access</td><td>Qualitative</td><td>GA access to the higher-level airspace above FL255 would be unchanged.</td></tr>
<tr><td>General Aviation/ commercial airlines</td><td>Economic impact from increased effective capacity</td><td>Qualitative</td><td>No changes to airspace; no impact on capacity.</td></tr>
<tr><td>General Aviation/ commercial airlines</td><td>Fuel burn</td><td>Qualitative / Quantitative</td><td>No changes to airspace; no change to fuel burn. CO_2 emissions analysis has been performed using computer simulations which modelled the current operation of the FRA D3 airspace. Extrapolating the baseline using traffic forecast figures presents the 'do nothing' option, shown in this table:
<table><tr><th>Year</th><th>Traffic (forecast)</th><th>Fuel (KT)</th></tr><tr><td>2022</td><td>447,283</td><td>6,862</td></tr><tr><td>2024</td><td>549,206</td><td>8,426</td></tr><tr><td>2034</td><td>665,083</td><td>10,203</td></tr></table>This modelling is based on EUROCONTROL flight plan data for a 6-day 2022 traffic sample using BADA 4.2 and the NATS STATFOR OCT 2022 forecast.</td></tr>
</table>

Commercial airlines	Training cost	Qualitative	No changes to airspace; no training cost impact.
Commercial airlines	Other costs	Qualitative	No changes to airspace, no impacts
Airport/ Air navigation service provider	Infrastructure costs	Qualitative	No changes to airspace, no impacts
Airport/ Air navigation service provider	Operational costs	Qualitative	No changes to airspace, no change in operational costs.
Airport/ Air navigation service provider	Deployment costs	Qualitative	No changes to airspace, no impacts

Table 1 Initial Option Appraisal: Baseline

3.2 FRA Option 1 – ATS Routes Removed

FRA Option 1 would implement FRA across the Deployment 3 area with all ATS routes removed and RAD restrictions introduced in order to manage the flow of traffic in complex areas and transitioning into and out of FRA. The CAP1616 Full Options Appraisal analysis is given below.

<table>
<tr><td colspan="4">Option 1: FRA WITH ALL ATS ROUTES REMOVED: This would implement FRA across the Deployment 3 area with all ATS routes removed. RAD restrictions would be introduced in order to manage the flow of traffic in complex areas and transitioning into and out of FRA.</td></tr>
<tr><td>Group</td><td>Impact</td><td>Level of Analysis</td><td>Description</td></tr>
<tr><td>Communities</td><td>Noise impact on health and quality of life</td><td>Qualitative</td><td>The proposed changes to air traffic patterns are all above FL255 (circa 25,500ft). This is well above the 7,000ft threshold below which CAP1616 states noise impacts are considered significant and analysis is required. The potential noise or tranquillity impacts are neither measurable nor describable.</td></tr>
<tr><td>Communities</td><td>Air quality</td><td>N/A</td><td>ANG (2017) states “emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality”. No change in airspace design below 1,000ft – no changes to impacts.</td></tr>
<tr><td>Wider society</td><td>Greenhouse gas (GHG) impact</td><td>Qualitative /Quantitative</td><td>The introduction of FRA would enable a benefit of reduced GHG emissions. Flights would be able to plan the most direct route through the airspace (subject to structural limitations where required to maintain capacity) without the need to plan the existing routes. This enables individual flights to adapt their trajectories to consider not only distance and direction, but meteorological conditions and other factors which could improve efficiency.
Computer simulations have modelled the operation of the FRA D3 airspace, forecasting an enabled reduction in track mileage, and CO2 emissions. The extent and impact of structural limitations is not fully determined at this stage so the benefit for this change is presented as a range, as shown below.
The range presents 50% (lower) to 100% (upper) range of the modelled benefit. This also reflects the uncertainty on how airline operators will utilise FRA.

This modelling is based on EUROCONTROL flight plan data for a 6-day 2022 traffic sample using BADA 4.2 and the NATS STATFOR OCT 2022 forecast.

<table>
<tr><td>Year</td><td>Forecast Traffic</td><td>Annual average Track mileage saving</td><td>Annual average CO_2 saving</td></tr>
<tr><td>2024</td><td>549,206</td><td>Between 236,402 – 472,803 NM</td><td>Between 7.6 – 15.2KT</td></tr>
<tr><td>2034</td><td>665,083</td><td>Between 286,280 – 572,560 NM</td><td>Between 9.2 – 18.4KT</td></tr>
</table>
</td></tr>
<tr><td>Wider society</td><td>Capacity/ resilience</td><td>Qualitative</td><td>Increased flight planning flexibility would allow aircraft operators to flight plan more efficiently and would give them the option of avoiding capacity constrained areas.
The ability to avoid restrictions by utilising alternative flight plan trajectories would reduce the likelihood of delay, thus improving the resilience of the wider network.</td></tr>
<tr><td>General Aviation</td><td>Access</td><td>Qualitative</td><td>GA access to the higher-level airspace above FL255 would be unchanged.</td></tr>
<tr><td>General Aviation/ commercial</td><td>Economic impact from increased</td><td>Qualitative</td><td>The introduction of FRA would not increase air transport movements, passenger numbers or cargo carried as an outcome of this proposal.
The flight plan options this proposal would introduce could allow airlines</td></tr>
</table>

<table>
<tr><td>airlines</td><td>effective capacity</td><td></td><td>to avoid capacity constrained areas and avoid consequential delay and cost.
However, this is not quantifiable, and no specific capacity increase is assumed or claimed by this proposal.</td></tr>
<tr><td>General Aviation/ commercial airlines</td><td>Fuel burn</td><td>Qualitative /Quantitative</td><td>The introduction of FRA would enable a benefit of reduced fuel burn. Flights would be able to plan the most direct route through the airspace (subject to structural limitations where required to maintain capacity) without the need to plan the existing routes. This enables individual flights to adapt their trajectories to consider not only distance and direction, but meteorological conditions and other factors which could improve efficiency.
Computer simulations have modelled the operation of the FRA D3 airspace, forecasting an enabled reduction in track mileage, and fuel burn. The extent and impact of structural limitations is not fully determined at this stage so the benefit for this change is presented as a range, as shown below:
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<tr><th>Year</th><th>Forecast Traffic</th><th>Annual average Track mileage saving</th><th>Annual average fuel burn saving</th></tr>
<tr><td>2024</td><td>549,206</td><td>Between 236,402 – 472,803 NM</td><td>Between 2.4 - 4.8KT</td></tr>
<tr><td>2034</td><td>665,083</td><td>Between 286,280 – 572,560 NM</td><td>Between 2.9 – 5.8KT</td></tr>
</table>
This modelling is based on EUROCONTROL flight plan data for a 6-day 2022 traffic sample using BADA 4.2 and the NATS STATFOR OCT 2022 forecast.</td></tr>
<tr><td>Commercial airlines</td><td>Training cost</td><td>Qualitative</td><td>There is not expected to be any airline training cost associated with FRA implementation.</td></tr>
<tr><td>Commercial airlines</td><td>Other costs</td><td>Qualitative</td><td>Updates to FMS and flight planning systems will be by the routine AIRAC updates. There are no other known costs which would be imposed on commercial aviation.</td></tr>
<tr><td>Airport/ Air navigation service provider</td><td>Infrastructure costs</td><td>Qualitative</td><td>The implementation of this FRA deployment is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering amendments.</td></tr>
<tr><td>Airport/ Air navigation service provider</td><td>Operational costs</td><td>Qualitative</td><td>This proposal would not lead to changes in operational costs.</td></tr>
<tr><td>Airport/ Air navigation service provider</td><td>Deployment costs</td><td>Qualitative</td><td>Approximately 100 controllers would require training using the NATS simulator facility.
Support staff are required to run the simulator – data preparation, testing, simulator setup, pseudo pilots, feed sector controllers, training staff, safety analysts, output to be collated into a sim report.
Some operational support staff may require briefings.
The reduced availability of operational controllers during their conversion training means that operational rostering becomes a factor when considering continuous service delivery.
NB NATS cannot quantify training costs for other ANSPs; however, their acceptance of this proposal is a high-priority design principle. It is assumed that any such training costs are acceptable to these agencies.</td></tr>
</table>

4. Safety Assessment

Note: the safety assessment below is unchanged from the Stage 2 assessment

4.1 Options Appraisal Safety Assessment - Baseline

The proposed deployment area is adjacent to current Free Route Airspace (D1). The current operation uses a published route structure and airline operators flight-plan to follow available ATS routes or flight plannable Directs (DCT) as published in the Route Availability Document (RAD).

The published routes are supportive of strategic de-confliction between flights against active Special Use Airspace volumes (such as Danger Areas) and airspace with constrained radiotelephony or surveillance coverage. The routes also provide an operational framework that is conducive to Air Traffic Controllers' familiarity with traffic patterns, potential conflict points and practices for conflict avoidance/resolution. Flights into and out of the airspace volume (i.e. across boundaries with other Sectors and Air Traffic Control Units) are nominally managed via published waypoints.

In addition to flights following routes, some may be instructed to take a more direct path through the airspace. This is done in a tactical manner by Air Traffic Controllers based on their judgement that a different path can be followed safely.

Air Traffic Controllers are supported in their task by equipment functionality (tools) that includes prediction of the trajectories that aircraft will follow. Predicted trajectories can be viewed by Controllers, and the tools use the former to identify potential areas of conflict between aircraft for Controllers' attention. The tools also monitor the conformance of aircraft to their expected trajectories and highlight deviations. The tools support the Controllers in ensuring that the aircraft pass through the airspace safely separated from other aircraft, Danger Areas etc.

4.2 Options Appraisal Safety Assessment – Current Position

Project activities so far have included a Key Assurance Risk review and a Pre-Simulation Hazard review prior to the planned Real Time Development Simulation (planned for April 2023).

The initial work[2] that has been done has indicated that the Air Traffic Controllers regard the FRA mode of operation as being similar to that experienced today, in particular similar with the current FRA D1 already in operation since December 2021. Key factors underlying this are that direct routings that are (tactically) provided today are expected to be reflected in flight plans and that the tools will continue to support Controllers in foreseeing and resolving potential conflicts. Although reduced familiarity as to where conflicts may occur is a possibility (due to the ability to flight plan user-preferred trajectories) the tools are designed to provide adequate support in discerning and managing changes in this aspect.

It is expected that the existing level of safety performance undertaken within the current operation would be maintained. This would be verified, and assurance provided in further stages of the project.

[2] It has not yet been possible to fully involve all ATC parties (such as the Military) or to exercise the final form of equipment functionality.

5. Conclusion and Next Steps

This proposal has been developed following the submission of the Statement of Need to the CAA: Airspace Regulation:

> *In response to the CAP1711 Airspace Modernisation Strategy, NATS is progressing to implement Free Route Airspace (FRA) in a phased manner across UK airspace. This ACP proposes the introduction of the third deployment of FRA and associated changes to the underlying structure.*
>
> *The boundary of FRA D3 will align with the current Area of Responsibility of our Prestwick Centre Upper operation. This will produce a single FRA volume north of 54N extending into the North Sea to encompass our Humber sector. (Statement of Need v2; FRA D3)*

This document describes options which address the Statement of Need by the proposed introduction of Free Route Airspace within the deployment area. This will meet AMS requirements and the legal requirements for the implementation of FRA.

The FRA programme has been developed thus far with assistance, input, feedback and effort from senior MoD staff, senior representatives of all bordering ANSPs, representatives from airlines and flight planning service providers. NATS thanks all these stakeholders and looks forward to continuing the development of this proposal.

A single option has been appraised and feedback on this will be requested from stakeholders during consultation.

Subject to CAA approval at the Stage 3 Gateway Assessment, this proposal will then move on to Stage 3C - Consultation.

6. Appendix A: Analysis Modelling assumptions

- The fuel impact of this change would happen at cruise
- Flight distance has been taken from a simulation created by EUROCONTROL
- Traffic sample included was 11/07/2022, 15/07/2022, 23/07/2022, 29/07/2022, 23/08/2022, 06/09/2022 based on the AIRAC 2210.
- The traffic sample from these 6 days (7,353) was then used to get an annual 2022 figure.
- Flights that had an RFL higher than the maximum BADA Flight level used the fuel burn rate from the maximum BADA Flight level for that type.
- The track distance flown (NM) was taken from the Baseline and Scenario models and used to calculate the change in distance flown.
- 20 flights were excluded from these results as they could not be matched to a BADA Aircraft type.
- Traffic levels were grown as per the October 22 STATFOR extended forecast and assumed the growth rate from the last year of the STATFOR forecast continues, to estimate the annual impact to 2034.