Future Airspace Strategy Implementation (FASI)

London Terminal Manoeuvring Area (LTMA)

Airspace Change Proposal (ACP)
ACP-2020-043
ACP-2020-044
ACP-2020-045

Stage 2 Develop and Assess
Farnborough Airport Arrivals Connectivity Module

To be read in conjunction with Master Document

1. Introduction

1.1 About this document

1.1.1 This document describes the arrival connectivity options for Farnborough Airport, which have been developed using the methodology described in Section 2 of the Master document.

1.1.2 Farnborough is a single runway airport sited 30 miles southwest of London. The airport is dedicated to business aviation. Only private business operations are permitted under the Airport's Planning Agreement. The vast majority of traffic is business jets, with some private scheduled services.

1.1.3 NERL acknowledges that Farnborough joined FASI slightly later than the other airports and is still in Stage 1 of the CAP1616 airspace change process. Therefore, Farnborough has not yet developed design concepts. This document remains compatible with Farnborough's aspirations.

2. Baseline

2.1.1 This description of the current airspace around Farnborough should be considered the 'Do Nothing' option if no airspace change was to take place.

2.1.2 Table 1 shows actual[1] airport traffic counts from the 2019 baseline traffic year to 2022. The NERL forecast for network traffic levels is shown in the Master document Section 3.9. Airport forecasts are independent of the network and will be included within airport ACPs.

Year	Arrivals	Departures	Total Movements
2019	15,408	15,435	30,843
2020	9,609	9,659	19,268
2021	12,593	12,621	25,214
2022	16,043	16,095	32,138

Table 1 Actual air traffic movements: Farnborough Airport 2019-2022

2.1.3 Farnborough implemented an Airspace Change in 2020 which introduced controlled airspace and new arrival and departure procedures, shown in Figure 1 and described in Table 2 & Table 3. Two holds, RUDMO and PEPIS, provide for network delay absorption, albeit are not utilised routinely in the operation and are there for contingency purposes should the airport be unable to accept inbound traffic. VEXUB is a low altitude hold, also used for contingency purposes, below network levels.

Airport	Hold	STARs	Associated ATS Routes
Farnborough[2]	PEPIS	CPT 1P, NOTGI 1P, ABSAV 1P	Q63, N859, L179, L980, N20
	VEXUB	SOKDU 1V, KATHY 1V, ELDAX1V, CPT 1V	Q63, N859, L179, L980, P83, N20, M8, N17

Table 2 Current arrival connectivity for Farnborough

2.1.4 Farnborough has two SIDs which join with the ATS route network at designated waypoints[3] (Table 3).

Airport	SIDs	Associated ATS Routes
Farnborough	GWC (2L/2F)	N859
	HAZEL (2L/2F)	L620

Table 3 Current departure connectivity for Farnborough

1 This is based on CFMU actual data for 2019; this may vary from airport data.

2 The STARs shown also apply to Blackbushe, Dunsfold, Fairoaks, Lasham and Odiham.

3 SIDs are all below 7,000ft and will be subject to Airport ACP. NERL will ensure network connectivity.

Figure 1 Current arrival and departure procedures for Farnborough

2.1.5 Figure 2 shows a radar density plot of Farnborough arrival traffic for a typical busy summer week[4] and indicates traffic distribution. About 50% arrives from the south and southeast.

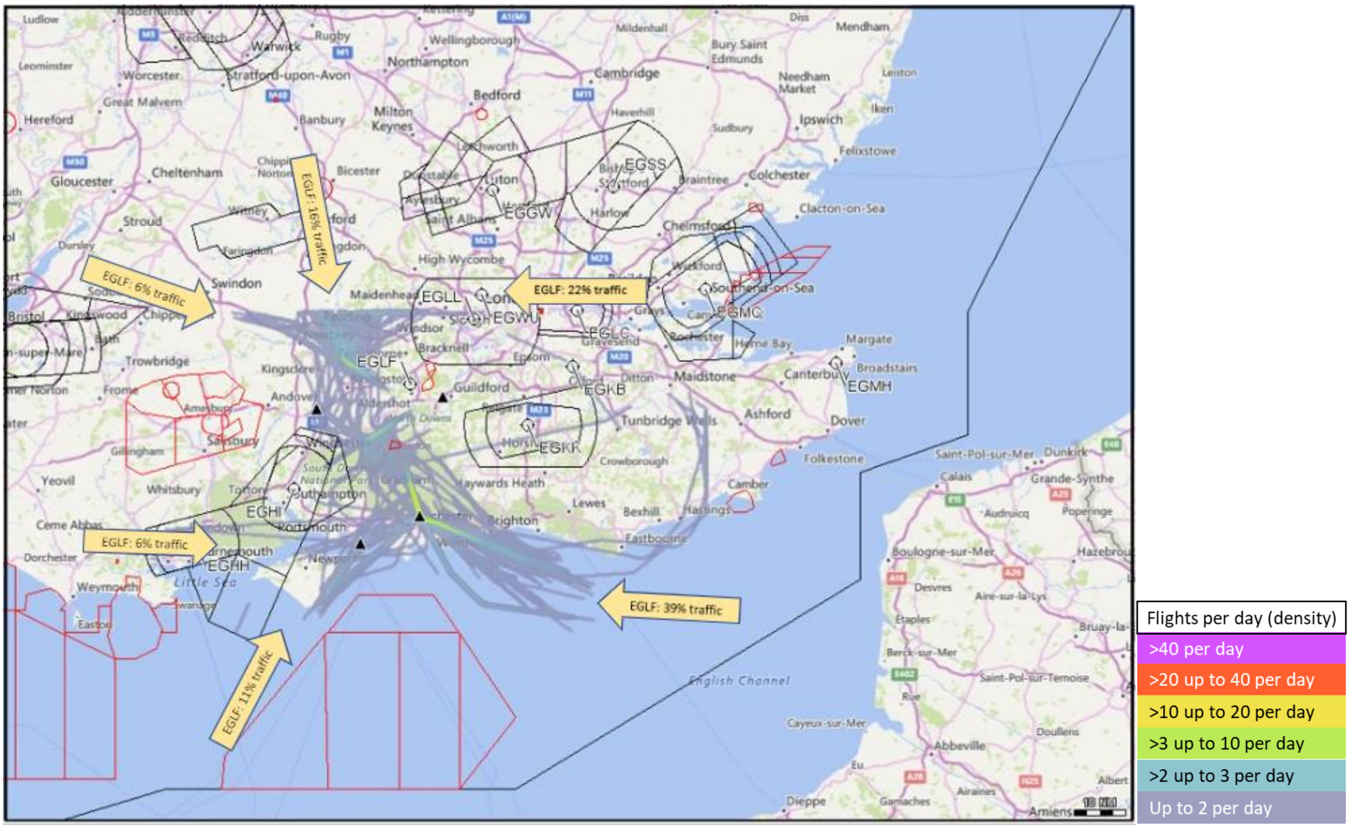


Figure 2 Farnborough traffic density arrivals FL110-FL70 5-11 August 2022

2.1.6 Small jets are the most prevalent aircraft type at Farnborough, as shown in Table 4. NetJets was the most prevalent operator in 2019, with approximately 17% of the traffic.

[4] For this diagram, traffic proportions are taken from 1st January 2022 to 31 August 2022 due to the changes made to Farnborough airspace in 2020, so the 2019 baseline is not representative of current traffic flows. This data is 12,000-7,000ft only.

Farnborough – Aircraft Type		
Aircraft Group	Movements	% traffic
Small Jet	20,566	66%
Medium Jet	8,466	28%
Heavy Jet	-	-
Turboprop/Piston/Prop	1,810	6%

Farnborough – Top 4 Aircraft Operator Usage		
Operator	Movements	% traffic
NetJets	5,310	17%
Vistajet	2,558	8%
Air Hamburg	1,082	4%
Vickers	908	3%

Table 4 Aircraft type and top carriers - Farnborough

3. Design Development

3.1.1 Working with the airport, NATS developed 11 high-level concept options for Farnborough[5]. NERL has assessed that based on required traffic loading, Farnborough would require at least one hold, either attached to an RMA or attached to a systemised arrival structure. Initial viability assessments were produced for location and structure type (see Appendix 1 for details) and presented to stakeholders in formal engagement (Ref 7). Feedback was requested through the engagement response questionnaire.

3.2 Stakeholder engagement

3.2.1 We received 5 responses from 5 different stakeholders related to the Farnborough design concepts. Table 5 presents a summary of the feedback and how this has influenced the design.

3.2.2 Feedback recognises that Farnborough is an airport with lower traffic demand compared to others in the LTMA and suggests this should be a consideration in the design development. This feedback has been used to inform the Design Principle Evaluation.

3.2.3 No new options were developed as a result of the stakeholder engagement.

Stakeholder	Feedback ('You said')	Response ('We did')
Airspace4All	Supports holds at minor airports, with direct routings, to keep track miles minimal.	Feedback was used to inform the evaluation of DP1, DP2, DP3 & DP8 for each airport.
British Airways	Considering the number of movements at Farnborough, this must be deprioritized to facilitate LHR and LGW efficiencies.	At this stage, no airport will be prioritised over another, as we strive for a balanced network-wide design. Stage 3 development will identify prioritisation needs.
BGA	This ACP has an opportunity to present Farnborough traffic more efficiently to reduce the complex and inefficient network of lower airspace currently in place. Demand is low. Holds to the south and west with tromboning routes onto final approach are concerning if this is associated with imposition of new CAS with difficult access requirements for GA operators. The BGA sees an opportunity to better integrate Farnborough traffic above 7000ft allowing steeper arrivals and departures and release of some CAS below 7000ft.	NERL will be working collaboratively with the FASI sponsors throughout Stage 3 to deconflict routes and refine the overall designs to be as efficient as possible for the relative traffic demands of any given airport. The long list of options includes options to the south and west however, there have been no conclusions made at this point. We used this feedback to inform our evaluation of DP5 and DP6.
Farnborough Airport	No current revisions requested to the design envelope or the design options.	No amendment to design envelope or design options required as a result of this feedback, however the design envelope was subsequently amended as a result of SME development (see paragraph 3.3.2 below).
Southampton Airport	Southampton's aspiration is to remove the requirement for Solent Approach Control to work Farnborough traffic, ideally with Farnborough traffic avoiding Solent airspace.	Appropriate deconfliction /colocation of specific routes will be determined at Stage 3.

Table 5 Engagement feedback and NERL response

[5] See Master document Section 2.2 for a detailed description of this work.

3.3 Farnborough Design Concepts

3.3.1 Table 6 summarises the high-level qualitative considerations for potential locations for Farnborough arrival structures, and Table 7 summarises the viability assessment for the arrival structures suitable for Farnborough. These have been developed from SME input and stakeholder engagement. As described in the Master document paras 2.4.2 & 2.4.3, the concepts Holds Further Out and Trombones were removed as viable concepts at this stage. A detailed description of each structure can be found in Section 5 Appendix 1.

Location	Viability Considerations
North	An arrival structure, and associated connectivity, to the north of the airfield would likely conflict with Gatwick, Heathrow, Luton, Northolt and Stansted traffic
Northeast	An arrival structure, and associated connectivity, to the northeast of the airfield would likely conflict with Heathrow, Luton, Northolt and Stansted traffic.
East	An arrival structure, and associated connectivity, to the east of the airfield would likely conflict with Biggin Hill, Gatwick, Heathrow, London City and Northolt traffic.
Southeast	An arrival structure, and associated connectivity, to the southeast of the airfield would likely conflict with Gatwick, Heathrow and Northolt traffic
South	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the south of the airfield, subject to deconfliction with Bournemouth, Gatwick and Southampton traffic.
Southwest	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the southwest of the airfield, subject to deconfliction with Bournemouth, Gatwick, Heathrow, and Southampton traffic.
West	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the west of the airfield, subject to deconfliction with Bournemouth and Southampton traffic and the Salisbury Plain DA Complex.
Northwest	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the northwest of the airfield, subject to deconfliction with Bournemouth, Heathrow, Luton, Northolt and Southampton traffic.
Overhead	An arrival structure, and associated connectivity, overhead the airfield would likely conflict with Bournemouth, Gatwick, Heathrow, Luton, Northolt and Southampton traffic.

Table 6 Farnborough Arrivals: Location viability considerations – post engagement

Structure	Viability Considerations
Optimised (inner) holds	Optimisation of current day structures. There is sufficient airspace for optimised hold(s), and this would likely meet the runway throughput demands.
Point Merge	A Point Merge structure would likely interact with predominant traffic flows within the LTMA. It would not be suitable for the runway throughput requirement as the airspace required for such a structure is disproportionate to the traffic volumes.
Switch Merge	There is insufficient airspace to suitably place a Switch Merge.

Table 7 Farnborough Arrival structures: Viability considerations – post engagement

3.3.2 Figure 3 shows the Farnborough design envelope, developed by SMEs through collaborative workshops and formal engagement with Farnborough and other stakeholders. This design envelope is based on the viability considerations presented in section 3.3 above, including Table 6 & Table 7, developed through two-way engagement as shown in Table 5.

3.3.3 Airspace design constraints, as described in the Master document Section 3.5, are highlighted in orange. Considerations for Farnborough are the Salisbury Plain Danger Areas as shown.

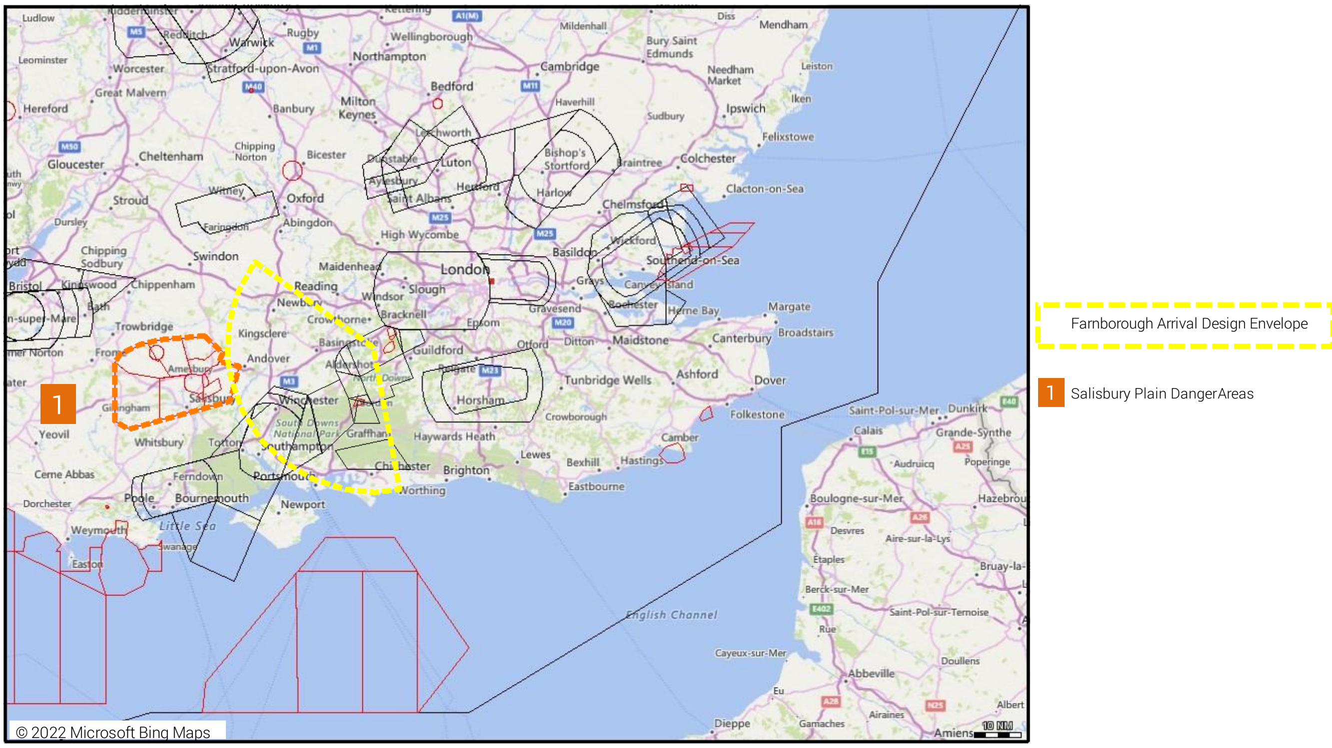


Figure 3 Farnborough Design Envelope & design constraints – post engagement and SME development

3.3.4 The Farnborough Design Concepts which were considered viable at this stage, within the Design Envelope presented, are shown in the Farnborough Arrival Structure Viability Assessment (Figure 4).

Arrival Structure Viability Assessment									
Arrival Structure Type	Location								
	N	NE	E	SE	S	SW	W	NW	OH
Do nothing	✗	✗	✗	✗	✗	✗	✗	✗	✗
Optimised (inner) hold(s)	✗	✗	✗	✗	✓	✓	✓	✓	✗
Point merge	✗	✗	✗	✗	✗	✗	✗	✗	✗
Switch merge	✗	✗	✗	✗	✗	✗	✗	✗	✗

✓ Viable Option: taken forward to DPE

✗ Not considered a viable option: eliminated at this point

Figure 4 Farnborough Design Options Viability Matrix

3.3.5 These 4 viable options were taken forward as the comprehensive list to Design Principle Evaluation, along with 'Do Nothing'.

3.4 Design Principle Evaluation

3.4.1 Table 8 shows the DPE assessment criteria. SMEs, in this case air traffic control experts and airspace change experts, list topics associated with each DP and qualitatively test how each option would react to those topics, describing how a red/amber/green outcome is reached.

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
0	A AMS	Safety Safety is always the highest priority (Note: Red could not be solved by mitigation, amber may be able to be solved by mitigation).	Human performance (ATCO control-ability) Human performance (pilot fly-ability) IFP (fly-ability) Surrounding airspace users (inside/outside of CAS) Impact if ATM tools fail	Unacceptable level of safety risk	Diminished - Issue(s) identified could result in an elevated level of safety risk when compared to today's operation	Enhanced - improvement over today's level of safety. Maintained - safety risk could be maintained within acceptable levels of today's operation
1	B AMS	Operational The airspace will enable increased operational resilience	Network Weather avoidance Disruption in neighbouring ANSPs	Reduced resilience and capacity during disruption	Similar resilience and capacity during disruption	Increased resilience and capacity during disruption
			Airport Holding levels Delay absorption between hold and 7,000ft	Reduction in delay absorption	Delay absorption similar to today	Improve delay absorption
			Airport Time to restart after runway closure Number of aircraft off the hold	Reduction in disruption recovery	Disruption recovery similar to today	Improve disruption recovery
2	B	Economic Optimise network fuel performance	Track mileage Economic performance Aircraft height Method of delay absorption	Fuel performance worsened	Fuel performance similar to today	Fuel performance improved
3	B AMS	Environmental Optimise CO_2 emissions per flight	Track mileage GHG performance Aircraft height Method of delay absorption	CO_2 emissions worsened	CO_2 emissions similar to today	CO_2 emissions improved

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
4	C	**Environmental** Minimising of noise impacts due to LAMP influence will take place in accordance with local needs	Overall environmental impact Environmental impact below 7,000ft Impact on tranquillity (or visual intrusion)	LAMP influence not aligned with local ACP sponsors' needs	Extent of alignment not yet known	LAMP influence fully aligned with local ACP sponsors' needs
5	C	**Technical** The volume of controlled airspace required for LAMP should be the minimum necessary to deliver an efficient airspace design, taking into account the needs of the UK airspace users	Lateral footprint of CAS Vertical footprint of CAS Proportional to airport traffic levels	Airspace required not the minimum necessary to deliver an efficient design	Extent of airspace required not yet known	Airspace required the minimum necessary to deliver an efficient design
6	C AMS	**Technical** The impacts on GA and other civilian airspace users due to LAMP will be minimised	Change to boundaries of CAS Changes to CAS classification Safety based impacts	Excessive negative impacts	Negative impacts minimised but requires changes to other airspace users' activities	Negative impacts minimised, no impact, or positive impacts to other airspace users' current activities
7	C AMS	**Technical** The impacts on MoD users due to LAMP will be minimised	Overall amount of danger area available Amount of time for danger area available Flexible use airspace provision Change to access between danger areas Safety based impacts Radar corridor access	Negative impacts not minimised or would require excessive changes to current MoD operations	Negative impacts minimised but requires changes to current MoD operations Or Extent of impact not yet known	Negative impacts minimised or no negative impact on current MoD operations
8	B AMS	**Operational** Systemisation will deliver the optimal capacity and efficiency benefits (Note: This is about airspace capacity, not ground infrastructure capacity which could be the limiting factor to overall airport capacity).	Traffic throughput Sectorisation Effect on overall network capacity Effect on airports' arrival flow	Design option unable to support the forecast traffic loading for the airport and the network	Design option supports the forecast traffic loading for the airport or the network	Design option supports the forecast traffic loading beyond the reference period for both the airport and the network
			Overall ATCO workload Levels of tactical intervention (radio transmissions per flight) No increase to operations requirements Balancing out of hot spots	Design option increases ATCO workload	ATCO workload similar to today	Design option decreases ATCO workload

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
9	B AMS	Technical The main route network linking airport procedures with the En Route phase of flight will be spaced to yield maximum safety and efficiency benefits by using an appropriate standard of PBN (Note: The main route network is considered as FL70 - FL245. Approach structures are not considered as 'the main route network').	Airspace requirement vs. RNAV rating Required aircraft equipage standards	PBN standard applied to route spacing would decrease efficiency and safety	PBN standard applied to route spacing would limit efficiency and safety benefits	PBN standard applied to route spacing is likely to maximise efficiency and safety benefits
10	A	Policy Must accord with the CAA's published Airspace Modernisation Strategy (CAP1711) and any current or future plans associated with it.	AMS "Ends" Strategic Objectives Safety (DP0) Integration of diverse users (DP6 and DP7) Simplification (DP1, DP8 and DP9) Environmental sustainability (DP3)	No or limited alignment with the AMS	Partial alignment with the AMS	Aligned with the AMS

Table 8 Design Principle Evaluation Assessment Criteria

3.4.2 Table 9 shows the AMS assessment criteria which are used to determine the overall RAG status for DP10.

DP10 outcome	Criteria for DP0, DP1, DP3, DP6, DP7, DP8 and DP9
Red	DP0 (Safety) is red OR 2 other DPs are red
Amber	All other colour combinations not covered by Ref or Green
Green	2 DPs are green and 0 are red OR 3 DPs are green and 1 is red

Table 9 - AMS Assessment Criteria

3.4.3 The criteria in Table 10 describe how each option's overall combination of reds/ambers/greens lead to the option progressing to the next step or to rejection and discounting from further development.

DP Priority	Criteria for Rejection Status
A	1 red OR 1 amber
B	2 reds
C	2 reds

Table 10 - Accept / Reject Criteria

3.4.4 Each design option has been assessed against the Design Principles. The following code is used for each design option. Airport (e.g. LF) - Structure Type (e.g. Inner Hold: IH/Point Merge: PM) - Location (e.g. Northeast: NE). DN = Do Nothing. DM = Do Minimum.

DP	Priority	LF - DN	LF - IH - S (DM)	LF - IH - SW
RESULT		REJECT	ACCEPT	REJECT
DP0 Safety	A AMS	Maintained: Similar operation to today	Maintained: Holds are used in current day operations and are known to be safe	Maintained: Holds are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation, which provides similar delay absorption	Optimised concept of current day operation, which provides similar delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation, which provides similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery
DP2 Economic (Fuel)	B	Today's operation, no change from baseline	Optimised concept, partially aligned with airport traffic flows, therefore fuel performance neutral	Does not align with airport traffic flows. Fuel performance worse than today
DP3 Environmental (CO_2)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation, partially aligned with airport traffic flows, therefore CO_2 emissions per flight neutral	Does not align with airport traffic flows. CO_2 emissions per flight worsened
DP4 Environmental (Noise)	C	Today's operation, no change from baseline	Impact on routes (and noise distribution) below 7,000ft not known at this point	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Today's operation, no change from baseline	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	A design to the southwest may require additional CAS, depending on location. Therefore, extent not yet known
DP6 Technical (Other Users)	C AMS	Today's operation, no change from baseline	Likely to be in current day CAS, no anticipated change in impacts	Potential additional CAS may require changes to other airspace users' activities
DP7 Technical (MoD)	C AMS	Operation is known not to impact MoD currently, therefore no change in impact	No military-use areas in the vicinity, therefore, would not require a change to MoD operations	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Aligns with network traffic flows but does not support forecast network loading. Can support the airport required arrival loading	Aligns with network traffic flows and concept can support the airport required arrival loading	Aligns with network traffic flows and concept can support the airport required arrival loading
DP8 Operational (Efficiency)	B AMS	Today's operation, no change in ATCO workload anticipated	Similar concept to today's operation, therefore no change in ATCO workload anticipated	Similar concept to today's operation. Negative impact on network traffic flows. Net increase in TMA workload
DP9 Technical (Route Spacing)	B AMS	Does not fully utilise the performance capabilities of modern aircraft	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes
DP10 Policy (AMS)	A	Green: DP0, DP7 Amber: DP1, DP1, DP3, DP6, DP8, DP8 Red: DP9	Green: DP0, DP7, DP8, DP9 Amber: DP1, DP1, DP3, DP6, DP8 Red: None	Green: DP0, DP7, DP8, DP9 Amber: DP1, DP1, DP6 Red: DP3, DP8

DP	Priority	LF - IH - W	LF - IH - NW
RESULT		REJECT	ACCEPT
DP0 Safety	A AMS	Maintained: Holds are used in current day operations and are known to be safe	Maintained: Holds are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Optimised concept of current day operation, which provides similar delay absorption	Optimised concept of current day operation, which provides similar delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Optimised concept of current day operation, which provides similar disruption recovery	Optimised concept of current day operation, which provides improved disruption recovery
DP2 Economic (Fuel)	B	Does not align with airport traffic flows. Fuel performance worse than today	Optimised concept, partially aligned with airport traffic flows, therefore fuel performance neutral
DP3 Environmental (CO_2)	B AMS	Does not align with airport traffic flows. CO_2 emissions per flight worsened	Optimised concept of current day operation, partially aligned with airport traffic flows, therefore CO_2 emissions per flight neutral
DP4 Environmental (Noise)	C	Impact on routes (and noise distribution) below 7,000ft not known at this point	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	A design to the west may require additional CAS, depending on location. Therefore, extent not yet known	A design to the northwest may require additional CAS, depending on location. Therefore, extent not yet known
DP6 Technical (Other Users)	C AMS	Potential additional CAS may require changes to other airspace users' activities	Potential additional CAS may require changes to other airspace users' activities
DP7 Technical (MoD)	C AMS	Assumes design would not impact Salisbury Plain DA Complex. Therefore, no negative impact on current MoD operations	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Aligns with network traffic flows and concept can support the airport required arrival loading	Supports the required airport arrival loading, however, negatively impacts capacity of south and westbound network traffic flows
DP8 Operational (Efficiency)	B AMS	Assumes CAS is agreed if required, therefore workload similar as today	Similar concept to today's operation. Negatively impact on network traffic flows. Net increase in TMA workload
DP9 Technical (Route Spacing)	B AMS	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes
DP10 Policy (AMS)	A	Green: DP0, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: DP3	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP3, DP6, DP8 Red: DP8

Table 11 Design Principle Evaluation

3.4.5 'Do Nothing' and a further 2 design options were assessed as not meeting the DPs and were rejected at this stage. The remaining 2 option concepts progress to Step 2B, Options Appraisal.

3.5 Initial Options Appraisal

Table 12 shows the assessment criteria used to complete the initial appraisal of each shortlisted option.

Group	Impact
Communities	Noise impact on health and quality of life
A qualitative assessment of changes to noise impacts compared with the 'Do Nothing' baseline. A qualitative assessment of changes to tranquillity impacts compared with the 'Do Nothing' baseline.	
Communities	Air Quality
A qualitative assessment of changes to local air quality compared with the 'Do Nothing' baseline.	
Wider Society	Greenhouse Gas Impacts
A qualitative assessment of changes to greenhouse gas impacts compared with the 'Do Nothing' baseline.	
Wider Society	Capacity / Resilience
A qualitative assessment of changes to airspace capacity and resilience compared with the 'Do Nothing' baseline.	
General Aviation (GA)	Access
A qualitative assessment of changes to GA access compared with the 'Do Nothing' baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
A qualitative assessment of changes to GA and commercial operator economic impacts from increased effective capacity compared with the 'Do Nothing' baseline.	
GA/Commercial Airlines	Fuel Burn
A qualitative assessment of changes to GA and commercial operator fuel burn impacts compared with the 'Do Nothing' baseline.	
Commercial Airlines	Training Costs
A qualitative assessment of changes to commercial operator training costs compared with the 'Do Nothing' baseline.	
Commercial Airlines	Other Costs
A qualitative assessment of changes to other relevant commercial operator costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Infrastructure Costs
A qualitative assessment of changes to airport and ANSP infrastructure costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Operational Costs
A qualitative assessment of changes to airport and ANSP operational costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Deployment Costs
A qualitative assessment of changes to airport and ANSP deployment costs compared with the 'Do Nothing' baseline.	
All	Performance against the vision and parameters/strategic objectives of the AMS
A qualitative assessment of how the design option performs, considering the AMS objectives of improved capacity, reduced CO_2, minimal impact on other users, maintaining or enhancing safety, and facilitation of defence and security objectives, compared with the 'Do Nothing' baseline.	

Table 12 Initial Options Appraisal Assessment Criteria

LF – DN Qualitative Initial Impacts Assessment	REJECTED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. No change in airspace design – no changes to impacts.	
Communities	Air Quality
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 – no changes to impacts.	
Wider Society	Greenhouse Gas Impacts
In the short term, there would be no change. In the long term, failure to modernise the airspace would have a negative impact on GHG emissions due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
Wider Society	Capacity / Resilience
In the short term, there would be no change. In the long term, failure to modernise the airspace would have a negative impact on capacity and resilience due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
General Aviation (GA)	Access
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would lead to increased likelihood of commercial aircraft delays and holding in an unchanged design as traffic is forecast to increase. This may lead to negative impacts on GA access due to the busier airspace, however as GA access is currently relatively infrequent at network levels, this may not be a major impact.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would have a negative impact on capacity due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase. This would lead to a negative economic impact.	
GA/Commercial Airlines	Fuel Burn
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would have a negative impact on fuel burn due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. If this baseline system was retained, the same flight procedures would be used, and training cost impacts would not change.	
Commercial Airlines	Other Costs
No change in airspace design – no changes to other commercial operator costs.	
Airport / ANSP	Infrastructure Costs
No change in airspace design – no changes to infrastructure costs. If this baseline system was retained, the same infrastructure would continue to be used in the same way, with no additional costs.	
Airport / ANSP	Operational Costs
No change in airspace design – no changes to infrastructure costs. If this baseline system was retained, the same infrastructure would continue to be used in the same way, with no additional operational costs.	
Airport / ANSP	Deployment Costs
If this baseline system was retained, there would be no deployment, hence no associated costs.	
AMS	Performance against the vision and parameters/strategic objectives of the AMS
• Safety: maintained • Simplification: worsens delay absorption, disruption recovery, airport capacity, network capacity, and ATCO workload. Does not utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA • Environmental sustainability: worsens CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that if the baseline system was retained, the existing level of safety performance undertaken within the current operation would be at least maintained. However, if there was no change to the current operation the potential increase in traffic as forecast could begin to constrain capacity, which in turn, could increase controller workload and traffic complexity within the LTMA leading to potential safety issues in the future. In order to mitigate any reduction in safety margins it is likely that increased flow management measures would be required, resulting in additional delay.	
Conclusion from IOA	
This option was rejected during the DPE stage. It has been included for comparison purposes only.	

Table 13 LF-DN Initial Options Appraisal

LF - IH – S (DM) Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
This design option is an optimised version of today which may reposition the current hold to better align with the traffic flows. However, this location only partially aligns with airport traffic flows. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Farnborough. This location aligns with network traffic flows so network capacity could be maintained. Resilience: This option could maintain disruption recovery resulting from unplanned runway closure. This option could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A holding facility to the south would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
Aligns with network traffic flows, which enables potential capacity gains across the LTMA from an improved network design. Could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Farnborough. This could positively impact all LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option is an optimised version of today which may reposition the current hold to better align with the traffic flows. However, this location only partially aligns with airport traffic flows. Overall, maintains fuel burn compared with the baseline. There are currently structures in this location so no change in impact is expected for GA traffic.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen.	
Airport / ANSP	Infrastructure Costs
This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option is not expected to change airport or ANSP operational cost impacts.	
Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	
AMS	Performance against the vision and parameters/strategic objectives of the AMS
• Safety: maintained • Simplification: could maintain delay absorption, disruption recovery, airport capacity, network capacity, and ATCO workload. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could maintain CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the south would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. An arrival structure in this location would need to deconflict with all Bournemouth, Gatwick and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline, this option would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, fuel burn, CO_2 emissions, access to other users, airport capacity, network capacity, and ATCO workload. Therefore, LF – IH – S (DM) is progressed to Stage 3 for further development.	

Table 14 LF-IH-S (DM) Initial Options Appraisal

LF - IH – NW Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000 ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
This design option is an optimised version of today which may reposition the current hold to better align with the traffic flows. However, this location only partially aligns with airport traffic flows. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Farnborough. This location does not align with network traffic flows so network capacity could be worse compared with the baseline. Resilience: This option could maintain disruption recovery resulting from unplanned runway closure. This option could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A holding facility to the northwest may require additional CAS, the extent is not yet known. As a result, the access impact on GA traffic may be worse compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
This location does not align with network traffic flows, which hinders potential capacity gains across the LTMA from an improved network design. Could enable positive economic impacts through airport capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Farnborough. This could positively impact all LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option is an optimised version of today which may reposition the current hold to better align with the traffic flows. However, this location only partially aligns with airport traffic flows. Overall, maintains GHG emissions compared with the baseline. Depending on the location, may increase track miles and fuel burn for transiting GA traffic.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen.	
Airport / ANSP	Infrastructure Costs
This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option is not expected to change airport or ANSP operational cost impacts.	
Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	
AMS	Performance against the vision and parameters/strategic objectives of the AMS
• Safety: maintained • Simplification: could maintain delay absorption, disruption recovery and airport capacity. Could worsen network capacity and ATCO workload. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could maintain CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the northwest would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. An arrival structure in this location would need to deconflict with Heathrow, Luton and Northolt departures and all Bournemouth and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline, this option would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, fuel burn, CO_2 emissions, and airport capacity. Network capacity and ATCO workload could be worsened. There may be negative impacts on other users, but this is not yet known. **Therefore, LF – IH – NW is progressed to Stage 3 for further development.**	

Table 15 LF-IH-NW Initial Options Appraisal

4. Step 2B Conclusion and Next Steps

4.1.1 There is not yet enough detailed quantified data to make a statement on preferred option(s). Compromises and trade-offs may be necessary between airports taking part in the FASI regional airspace change. Appropriate quantitative assessments and trade-offs will be carried out as part of Stage 3 to allow a preferred option to be selected prior to consultation.

4.1.2 This table provides a summary of the Stage 2 design work undertaken for Farnborough, showing how the number of design options has changed through the design development stages as described above.

Module	Initial Long List	Comprehensive List	Progress to IOA	Progress to Stage 3
Farnborough	11	4	2	2

Table 16 Count of Design Options for each module through option development stages

4.1.3 These shortlisted options have been carried forward to Stage 3:

Farnborough Design Options progressed to Stage 3
Inner Holds – South (DM)
Inner Holds – Northwest

Table 17 Summary of design options progressed to Stage 3

5. APPENDIX 1: Arrival Structure Concepts

5.1.1 Arrival structure types identified as being viable options for potential airspace designs across the LTMA airports:

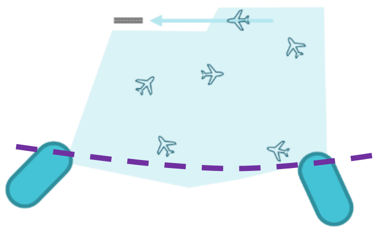
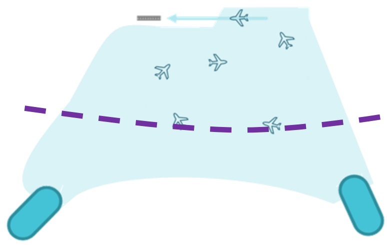
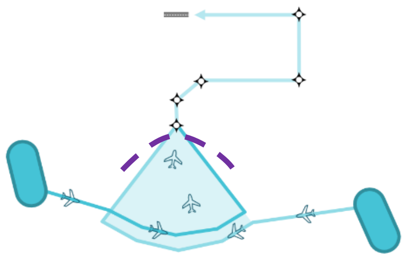
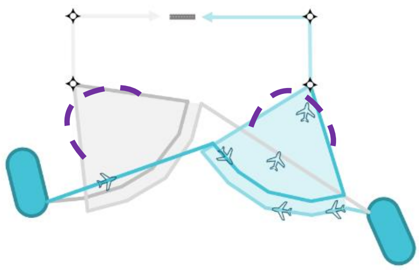
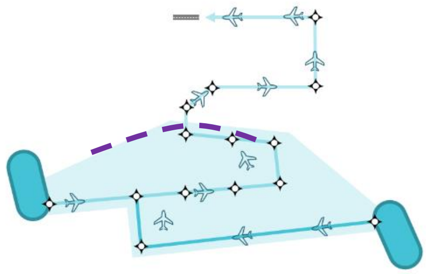
Structure	Diagram	Description
Optimised[6] Holds Illustration of network/airport boundary (indicative c.7,000ft)		A holding pattern is used to delay aircraft from landing, in a vertically separated stack. ATC control entry to, and exit from, the stack; and aircraft are vectored to the runway or may use a transition. Linked with either a traditional Radar Manoeuvring Area (RMA) or Transitions. This design is for holds within c.30nm of the airport.
Holds Further Out Illustration of network/airport boundary (indicative c.7,000ft)		As above but would typically be higher. This design is for holds c.30nm-60nm from the airport.
Point Merge Illustration of network/airport boundary (indicative c.7,000ft)		Point Merge (PM) is a systemised method for sequencing arrival flows, allowing controllers to sequence and merge arrivals without vectoring, whilst enabling continuous descent operations and maintaining runway throughput. This design has a fixed location regarding the merge legs and merge point.
Switch Merge Illustration of network/airport boundary (indicative c.7,000ft)		SM is a concept not currently in UK operation, whereby two separate PM structures exist within a given airspace volume to serve different runway directions for the same airport. The merge legs and merge point (the tip of each triangle) is angled to favour the runway in use, but only one of the merge structures is in operation at any time; they are 'switched' when the runway direction changes. The holds do not change.
Trombone Illustration of network/airport boundary (indicative c.7,000ft)		A 'snake-like' PBN transition which can be closed (fixed) which aircraft must fly; or open, whereby tactical flexibility is retained with defined short cuts.

Figure 5 Arrival structure concepts (at and above 7,000ft)

[6] See paragraph 2.2.10 of Master document for explanation of 'Optimised'

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