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
Heathrow Airport Arrivals Connectivity Module

To be read in conjunction with Master Document

NATS

1. Introduction

1.1 About this document

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

1.1.2 Heathrow is the UK's biggest airport. It is a major international airport, located 14 miles west of central London. It operates two parallel runways and is used by more than 80 operators flying to over 185 destinations.

2. Baseline

2.1.1 This description of the current airspace around Heathrow 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	239,058	239,021	478,079
2020	102,428	102,352	204,780
2021	97,634	97,677	195,311
2022	190,228	190,172	380,400

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

2.1.3 Heathrow has a number of arrival procedures (STARs) which connect with the network, as shown in Figure 1 and described in Table 2. Most arriving aircraft are usually routed to one of four holds (LAM, BIG, OCK and BNN).

Airport	Hold	STARs	Associated ATS Routes
Heathrow[2]	OCK	OTMET 1H, ROXOG 1H, BEDEK 1H, HAZEL 1H	N17, (U)P87, L982, P2, L620
	BIG	ALESO 1H	T420
	BNN	NUGRA 1H, HON 1H	(U)Y53, Q36, Q38, L15, L10, L615
	LAM	BARMI 1H, LOGAN 2H	P7, L608, L980

Table 2 Current arrival connectivity for Heathrow

2.1.4 Heathrow and Northolt currently share arrival structures. The baseline structures are considered at the relative location from each airport.

2.1.5 Heathrow has several SIDs which join with the ATS route network at designated waypoints[3] (Table 3).

Airport	SIDs	Associated ATS Routes
Heathrow	UMLAT (1F/1G)	T418
	ULTIB (1J/1K)	T418
	BPK (7F/7G/6J/5K)	M185, L620
	DET (2F/2G/1J/1K)	L6, Q70
	MODMI (1J/1K)	M185
	MAXIT (1F/1G)	Y803
	GOGSI (2F/2G)	N621
	GASGU (2J/2K)	N866
	CPT (3F/3G/5J/4K)	Q63

Table 3 Current departure connectivity for Heathrow

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

[2] The routes shown also apply to Northolt and Denham.

[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 Heathrow

2.1.6 Figure 2 shows a radar density plot of Heathrow arrival traffic for a typical busy summer week and indicates traffic distribution. About 43% of traffic arrives from the east.

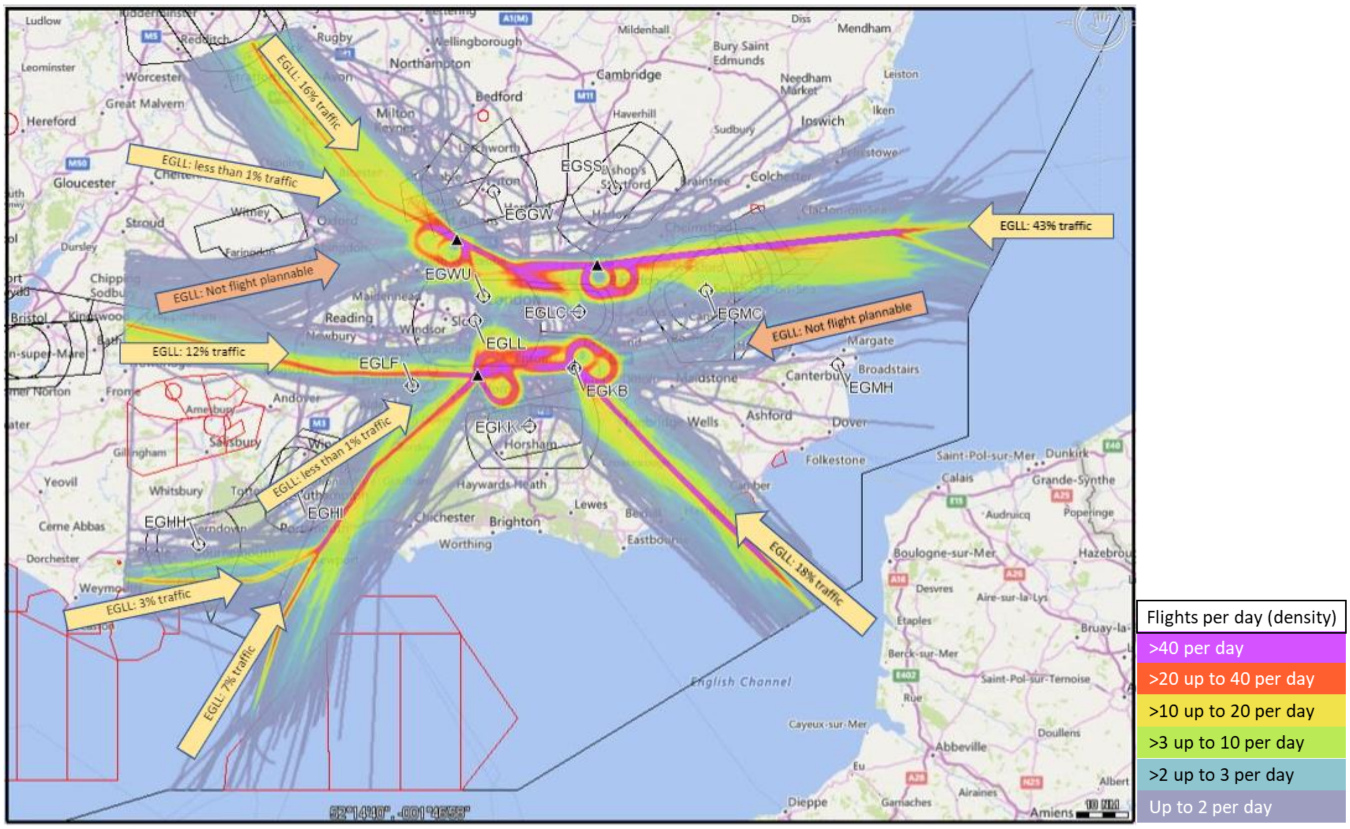

Figure 2 Heathrow traffic density arrivals FL245-FL70 5-11 August 2019

2.1.7 Medium and heavy jets are the most prevalent aircraft type at Heathrow, as shown in Table 4. British Airways was the most prevalent operator in 2019, with approximately 50% of the traffic.

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Heathrow – Aircraft Type		
Aircraft Group	Movements	% traffic
Small Jet	263	<1%
Medium Jet	281,764	59%
Heavy Jet	187,185	39%
Turboprop/Piston/Prop	8,866	2%

Heathrow – Top 4 Aircraft Operator Usage		
Operator	Movements	% traffic
British Airways	238,484	50%
Virgin Atlantic	17,459	4%
Aer Lingus	15,883	3%
American Airlines	14,437	3%

Table 4 Aircraft type and top carriers - Heathrow

3. Design Development

3.1.1 Working with the airport, NERL developed 36 high-level concept options for Heathrow[4]. NERL has assessed that based on required traffic loading, Heathrow would require at least four holds, in distinct geographical regions, either attached to an RMA or attached to systemised arrival structures e.g. two Point Merges. Initial viability assessments were produced for location and structure type 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 11 responses from 11 different stakeholders related to the Heathrow design concepts. Table 5 presents a summary of the feedback and how this has influenced the design.

3.2.2 Feedback recognises Heathrow is the major airport in the LTMA, however there is varying opinion on how this leads to prioritisation. Feedback relating to capacity and efficiency of various design options has been used to inform the Design Principle Evaluation.

3.2.3 New options were developed as a result of the stakeholder engagement and one was removed.

Stakeholder	Feedback ('You said')	Response ('We did')
Airspace4All	Major airports requiring flow management would benefit from PBN approaches and systemised approach structures.	Feedback was used to inform the evaluation of DP1, DP2, DP3 & DP8. The traffic demand is considered when making these assessments so the impact on individual airports is considered.
Biggin Hill	Full engagement is required.	NERL has worked collaboratively with all FASI sponsors throughout the process, including Biggin Hill, and will continue to do so going forward. Biggin Hill attended the formal Stage 2 engagement briefing and received a copy of the briefing presentation and recording.
Boeing	A Point Merge or Trombone airspace feeding into an RNP arrival structure could have multiple benefits. A CDO from merge point to arrival could improve fuel and noise benefits; RNP structured arrivals could increase efficiency.	Feedback was used to inform the evaluation of DP2, DP4, DP8 and DP9.
British Airways	Arrival structures to the north should be enhanced and prioritized over Stansted and Luton. Arrival structures to the east should be enhanced and prioritized over London City. Arrival structures to the south should be enhanced and prioritized over Bournemouth, Farnborough, Gatwick and Southampton. Arrival structures to the west should be enhanced and arrival structures overhead considered.	Structures to the north, east, south and west are all included in the long-list of options. No airport will be prioritised over another as we aim for a network solution. Structures will be evaluated at the DPE stage against the relative expected traffic for the specific airport.
BGA	Conclusions suggest that any new network solutions would not require additional CAS. An opportunity should also be taken to remove legacy CAS segments where possible.	No conclusions have been made at this point. We used this feedback to inform our evaluation of DP5 and DP6.

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

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Stakeholder	Feedback ('You said')	Response ('We did')
Delta Airlines	Capacity is the priority. Flight path efficiency is desired. Using the ability of the controller to align traffic with the minimum spacing may come in the form of Switch Merge or Trombone. A single Trombone offers the most opportunity to reduce track miles, while the Switch Merge may offer the ability to manage workload most efficiently and contain noise to higher flight levels. Holding is the least desired option.	We used this feedback to inform our evaluation of DP2, DP3, and DP4.
Gatwick Airport	Heathrow's design envelope overlaps Southampton, Southend, London City and Gatwick airports (amongst others), whereas none of the other design envelopes overlap Heathrow - we believe this is a limitation which prematurely discounts other design options. Gatwick is specifically concerned with Heathrow's proposed arrival designs to the south, east and west as they will interact with our arrival and departure options.	Heathrow's large design envelope illustrates the area covered by 4 holds (or equivalent) required for their traffic demand. Therefore, the design envelope is much greater than other LTMA airports that require 1 or 2 holds. Interactions with other airports and required deconflictions will be fully considered at Stage 3. Ongoing SME design and development work has revised design envelopes for several airports. See 2.2.11 in Master document for information on Design Envelopes.
Heathrow Airport	Acceptance of the arrival structures with the following comments: Point Merge & Switch Merge options which both have a positive assessment in location and throughput which except for a facility in the overhead we believe have long been assessed as 'airspace hungry' and unlikely to deliver the required throughput. Optimised Inner Holds in the Overhead (assuming this is referring to 4 holds as today). HAL is unsure how a concept of 4 optimised holds in the overhead would be a viable option. If the Point/Switch Merge options are viable across the full compass, why is the Trombone option assessed differently?	Feedback was used to inform the evaluation of DP8. The viability of a Switch Merge has been reassessed and it is not deemed viable for any Heathrow locations. The holds in the overhead have been removed as this option is unlikely to meet the required traffic demand and resilience for the specific airport. Trombones have been removed as a design concept across the LTMA based on ongoing SME development (see paragraph 3.3.1 below). Design matrix updated; this also includes the Northolt table to ensure consistency should the final design require a shared arrival structure with Heathrow.
London City Airport	Altitude gain and deconfliction with London City routes is desirable.	No amendment to design envelope required as a result of this feedback, however the design envelope was subsequently amended as a result of SME development (see paragraph 3.3.1 below). The appropriate deconfliction or colocation of routes will be considered at Stage 3.
Luton Airport	Support widening of design envelope. Important to LLA that Heathrow holds are moved outside of the main LTMA for flexibility for routes below 7,000ft. Holds should also be higher. The arrival envelope is close to Luton TMA; this could restrict Luton traffic.	Design envelope widened, it remains appropriate while retaining flexibility for both Heathrow and Luton traffic. See also paragraph 3.3.1 below. NERL recognises that the Heathrow arrival structures need to be cognisant of the Luton departure track, the aspiration being to improve on the Luton departure profile. The appropriate deconfliction or colocation of specific routes will be considered at Stage 3.
Northolt	Due to proximity of Northolt and Heathrow, it is important any arrival structures for Heathrow make consideration for impacts on RAF Northolt operations.	Feedback was used to inform DP7. No amendment to design envelope required as a result of this feedback, however the design envelope was subsequently amended as a result of SME development (see paragraph 3.3.1 below). The appropriate deconfliction or colocation of routes will be considered at Stage 3.

Table 5 Engagement feedback and NERL response

3.3 Heathrow Design Concepts

3.3.1 Table 6 summarises the high-level qualitative considerations for potential locations for Heathrow arrival structures, and Table 7 summarises the viability assessment for the arrival structures suitable for Heathrow. These have been developed from SME input and stakeholder engagement. SME design development determined that the areas to the north and south of the airfield needed to be extended in the design envelope in order to facilitate potential design options. The design envelope was revised to reflect this. 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, which included the newly developed Trombone options. A detailed description of each structure can be found in Section 5 Appendix 1.

Location	Viability Considerations
North	An arrival structure to the north of the airfield is already in place within the current design, albeit shared with another sponsor. A structure in this area remains possible, subject to deconfliction with Luton, Northolt and Stansted traffic.
Northeast	An arrival structure to the northeast of the airfield is already in place within the current design, albeit shared with another sponsor. A structure in this area remains possible, subject to deconfliction with Biggin Hill, Gatwick, London City, Luton, Northolt, Southend and Stansted traffic.
East	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the east of the airfield, subject to deconfliction with Biggin Hill, London City, Northolt and Southend traffic and the Shoeburyness DA Complex.
Southeast	An arrival structure to the southeast of the airfield is already in place within the current design, albeit shared with another sponsor. A structure in this area remains possible, subject to deconfliction with Biggin Hill, Gatwick, London City, Northolt and Southend traffic.
South	An arrival structure to the south of the airfield is already in place within the current design, albeit shared with another sponsor. A structure in this area remains possible, subject to deconfliction with Farnborough, Gatwick and Northolt traffic and the Portsmouth DA Complex.
Southwest	There is sufficient airspace and arrival connectivity to the southwest to facilitate an arrival structure, subject to deconfliction with Bournemouth, Farnborough, Gatwick, Northolt and Southampton traffic and the Salisbury Plain DA Complex.
West	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the west of the airfield, subject to deconfliction with Bournemouth, Farnborough, Gatwick, Luton, Northolt 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, Farnborough, Gatwick, Luton, Northolt, Southampton and Stansted traffic.
Overhead	It would likely be possible to place an arrival structure overhead the airfield, subject to deconfliction with Gatwick, Luton, Northolt and Stansted traffic.

Table 6 Heathrow 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	There is sufficient airspace for Point Merge, and this would likely meet the runway throughput demands.
Switch Merge	There is insufficient airspace to suitably place a Switch Merge.

Table 7 Heathrow Arrival structures: Viability considerations – post engagement

3.3.2 Figure 3 shows the Heathrow design envelope, developed by SMEs through collaborative workshops and formal engagement with Heathrow and other stakeholders. This design envelope is based on the viability considerations presented above in paragraph 3.3.1 above, 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 Heathrow are the Salisbury Plain, Shoeburyness and Portsmouth Danger Areas as shown.

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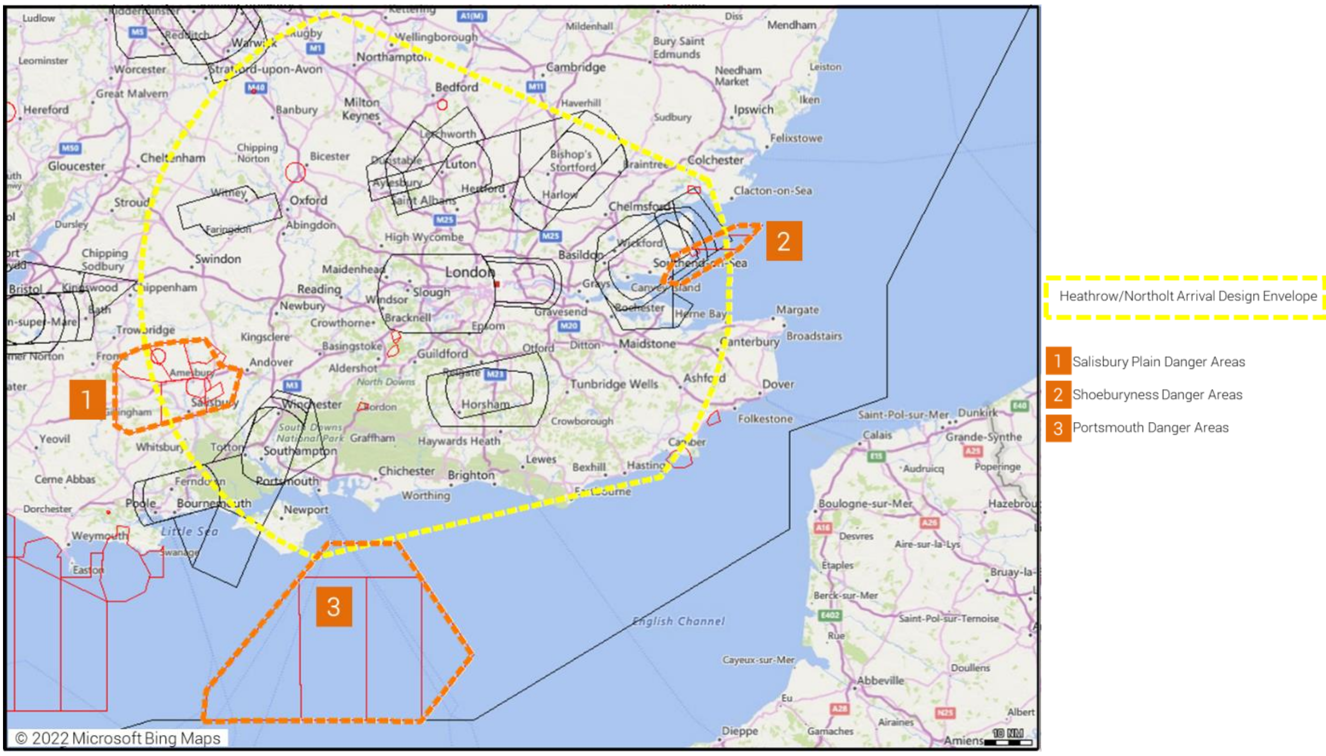

Figure 3 Heathrow Design Envelope and design constraints – post engagement & SME development

3.3.4 The Heathrow Design Concepts which were considered viable at this stage, within the Design Envelope presented, are shown in the Heathrow 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 Heathrow Design Options Viability Matrix

3.3.5 These 17 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	<u>Network</u> Weather avoidance Disruption in neighbouring ANSPs	Reduced resilience and capacity during disruption	Similar resilience and capacity during disruption	Increased resilience and capacity during disruption
			<u>Airport</u> Holding levels Delay absorption between hold and 7,000ft	Reduction in delay absorption	Delay absorption similar to today	Improve delay absorption
			<u>Airport</u> 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 Red 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. LL) - Structure Type (e.g. Inner Hold: IH/Point Merge: PM) - Location (e.g. Northeast: NE). DN = Do Nothing. DM = Do Minimum.

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DP	Priority	LL - DN (Shared)	LL - IH – N (DM) (Maybe shared)	LL - IH - NE (DM) (Maybe shared)
RESULT		REJECT	ACCEPT	ACCEPT
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 aligned with airport traffic flows, therefore improved fuel performance	Optimised concept aligned with airport traffic flows, therefore improved fuel performance
DP3 Environmental (CO_2)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved
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	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
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	Likely to be in current day CAS, no anticipated change in impacts
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. Heathrow currently operates at/near its capacity	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, therefore no change in ATCO workload anticipated
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, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None	Green: DP0, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None

DP	Priority	LL - IH - E (Maybe shared)	LL - IH - SE (DM) (Maybe shared)	LL - IH - S (DM) (Maybe shared)
RESULT		ACCEPT	ACCEPT	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	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	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 similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery
DP2 Economic (Fuel)	B	Optimised concept aligned with airport traffic flows, therefore improved fuel performance	Optimised concept aligned with airport traffic flows, therefore improved fuel performance	Optimised concept aligned with airport traffic flows, therefore improved fuel performance
DP3 Environmental (CO_2)	B AMS	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved
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	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	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	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	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	Similar concept to today's operation, therefore 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, therefore no change in ATCO workload anticipated
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	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, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None	Green: DP0, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None	Green: DP0, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None

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DP	Priority	LL - IH - SW (Maybe shared)	LL - IH - W (Maybe shared)	LL - IH - NW (Maybe shared)
RESULT		ACCEPT	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	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	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 similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery
DP2 Economic (Fuel)	B	Optimised concept aligned with airport traffic flows, therefore improved fuel performance	Does not align with airport traffic flows. Fuel performance worsened	Optimised concept aligned with airport traffic flows, therefore improved fuel performance
DP3 Environmental (CO_2)	B AMS	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved	Does not align with airport traffic flows. CO_2 emissions per flight worsened	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved
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	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	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	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of south and westbound network traffic flows	Aligns with network traffic flows and concept can support the airport required arrival loading
DP8 Operational (Efficiency)	B AMS	Similar concept to today's operation, therefore 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, therefore no change in ATCO workload anticipated
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	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, DP3, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: None	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3	Green: DP0, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None

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DP	Priority	LL - PM - N (Maybe shared)	LL - PM - NE (Maybe shared)	LL - PM - E (Maybe shared)
RESULT		ACCEPT	REJECT	REJECT
DP0 Safety	A AMS	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error
DP1 Operational (Delay Absorption)	B AMS	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today
DP2 Economic (Fuel)	B	Worsened due to extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	PM track miles insufficient for sequencing, would require additional miles. Aligns with airport traffic flows. Net worsened
DP3 Environmental (CO_2)	B AMS	Worsened due to extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	PM track miles insufficient for sequencing, would require additional miles. Aligns with airport traffic flows. Net worsened
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	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	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	Assumes design would not impact Shoeburyness DA Complex. Therefore, no negative impact on current MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows	Aligns with network traffic flows and concept can support the airport required arrival loading
DP8 Operational (Efficiency)	B AMS	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	Reduced controller tactical intervention required, leading to reduced ATCO 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	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, DP9 Amber: DP1, DP1, DP3, DP6, DP8, DP8 Red: None	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3	Green: DP0, DP7, DP8, DP8, DP9 Amber: DP1, DP1, DP6 Red: DP3

DP	Priority	LL - PM - SE (Maybe shared)	LL - PM - S (Maybe shared)	LL - PM - SW (Maybe shared)
RESULT		REJECT	ACCEPT	REJECT
DP0 Safety	A AMS	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error
DP1 Operational (Delay Absorption)	B AMS	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today
DP2 Economic (Fuel)	B	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	Worsened due to extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened
DP3 Environmental (CO_2)	B AMS	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	Worsened due to extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened
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	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	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	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of south and westbound network traffic flows
DP8 Operational (Efficiency)	B AMS	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral
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	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, DP8 Red: None	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3

DP	Priority	LL - PM - W (Maybe shared)	LL - PM - NW (Maybe shared)	LL - PM - OH (Maybe shared)
RESULT		REJECT	REJECT	REJECT
DP0 Safety	A AMS	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error
DP1 Operational (Delay Absorption)	B AMS	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today
DP2 Economic (Fuel)	B	PM track miles insufficient for sequencing, would require additional miles. Aligns with airport traffic flows. Net worsened	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	Worsened due to extended track miles to complete PM structure & routing to the OH then away to lose height on descent
DP3 Environmental (CO_2)	B AMS	PM track miles insufficient for sequencing, would require additional miles. Aligns with airport traffic flows. Net worsened	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened	Worsened due to extended track miles to complete PM structure & routing to the OH then away to lose height on descent
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	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	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	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of south and westbound network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of multiple network traffic flows
DP8 Operational (Efficiency)	B AMS	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral
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	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, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3

Table 11 Design Principle Evaluation

3.4.5 'Do Nothing' and 8 design options were assessed as not meeting the DPs and were rejected at this stage. The remaining 9 design options 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

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LL– 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, subject to constraints of the design • 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 would 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 LL-DN Initial Options Appraisal

LL - IH – N (DM) (Maybe shared) 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
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it may also maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the north would likely be within current day CAS. There is already an arrival structure in this location. 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
As either an independent or shared facility, this option aligns with network traffic flows, which could enable potential capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.	

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AMS	Performance against the vision and parameters/strategic objectives of the AMS

AMS Assessment – Independent Option

- 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 considerations of the design
- Environmental sustainability: could reduce CO_2 emissions

AMS Assessment – Shared Option

- 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 considerations of the design
- Environmental sustainability: could reduce CO_2 emissions

Qualitative Safety Assessment

A high-level safety appraisal for this proposed option indicates that an Inner Hold to the north 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 Luton, Northolt and Stansted traffic.

Conclusion from IOA

Compared to the baseline this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn, CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to the other users, airport capacity, network capacity, and ATCO workload.

Therefore, LL – IH – N (DM) (Maybe shared) is progressed to Stage 3 for further development.

Table 14 LL-IH-N (DM) (Maybe shared) Initial Options Appraisal

LL - IH – NE (DM) (Maybe shared)	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	
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, reduces GHG emissions through improved aircraft trajectories compared with the baseline.		
Wider Society	Capacity / Resilience	
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows and could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it could maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.		
General Aviation (GA)	Access	
As either an independent or shared facility, a holding facility to the northeast would likely be within current day CAS. There is already an arrival structure in this location. 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	
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.		
GA/Commercial Airlines	Fuel Burn	
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.		
Commercial Airlines	Other Costs	
No other operator costs are foreseen, as either an independent or shared facility.		
Airport / ANSP	Infrastructure Costs	
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.		

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AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • 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 reduce CO_2 emissions AMS Assessment – Shared Option • 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 reduce CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the northeast 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 London City arrivals, Luton and Stansted departures and all Biggin Hill, Gatwick, Northolt and Southend traffic.	
Conclusion from IOA	
Compared with the baseline, this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity, network capacity, and ATCO workload. Therefore, LL – IH – NE (DM) (Maybe shared) is progressed to Stage 3 for further development.	

Table 15 LL-IH-NE (DM) (Maybe shared) Initial Options Appraisal

LL – IH – E (Maybe shared)	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
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows and could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it could maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the east 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
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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

AMS Assessment – Independent Option

- 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 reduce CO_2 emissions

AMS Assessment – Shared Option

- 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 reduce CO_2 emissions

Qualitative Safety Assessment

A high-level safety appraisal for this proposed option indicates that an Inner Hold to the east 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 Biggin Hill, London City, Northolt and Southend traffic.

Conclusion from IOA

Compared with the baseline, this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It could maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity, network capacity, and ATCO workload.

Therefore, LL – IH – E (Maybe shared) is progressed to Stage 3 for further development.

Table 16 LL-IH-E (Maybe shared) Initial Options Appraisal

LL - IH – SE (DM) (Maybe shared) 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
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows and could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it may maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the southeast would likely be within current day CAS. There is already an arrival structure in this location. 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
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.	

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AMS	Performance against the vision and parameters/strategic objectives of the AMS

AMS Assessment – Independent Option

- 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 reduce CO_2 emissions

AMS Assessment – Shared Option

- 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 reduce CO_2 emissions

Qualitative Safety Assessment

A high-level safety appraisal for this proposed option indicates that an Inner Hold to the southeast 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 London City arrivals and all Biggin Hill, Gatwick, Northolt and Southend traffic.

Conclusion from IOA

Compared with the baseline, this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity, network capacity, and ATCO workload.

Therefore, LL – IH – SE (DM) (Maybe shared) is progressed to Stage 3 for further development.

Table 17 LL-IH-SE (DM) (Maybe shared) Initial Options Appraisal

LL - IH – S (DM) (Maybe shared) 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
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it may maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the south would likely be within current day CAS. There is already an arrival structure in this location. 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
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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
AMS Assessment – Independent Option • 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 reduce CO_2 emissions AMS Assessment – Shared Option • 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 reduce 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 Farnborough, Gatwick and Northolt traffic.	
Conclusion from IOA	
Compared to the baseline this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to the other users, airport capacity, network capacity, and ATCO workload. Therefore, LL – IH – S (DM) (Maybe shared) is progressed to Stage 3 for further development.	

Table 18 LL-IH-S (DM) (Maybe shared) Initial Options Appraisal

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LL - IH – SW (Maybe shared)	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
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location does not align with network traffic flows and could worsen network capacity. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it may maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the southwest 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
As either an independent or shared facility, this option does not align with network traffic flows, which hinders potential capacity gains across the LTMA from an improved network design. This could impact all LTMA traffic – commercial and GA. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport traffic flows. Overall, could reduce fuel burn for commercial operators compared with the baseline. 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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
AMS Assessment – Independent Option • Safety: maintained • Simplification: could maintain delay absorption, disruption recovery, airport capacity and ATCO workload. Could worsen network capacity. 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 reduce CO_2 emissions AMS Assessment – Shared Option • Safety: maintained • Simplification: could maintain delay absorption, disruption recovery, airport capacity and ATCO workload. Could worsen network capacity. 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 reduce CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the southwest 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, Farnborough, Gatwick, Northolt and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity and ATCO workload. Could worsen network capacity. Therefore, LL – IH – SW (Maybe shared) is progressed to Stage 3 for further development.	

Table 19 LL-IH-SW (Maybe shared) Initial Options Appraisal

LL - IH – NW (Maybe shared)	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	
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.		
Wider Society	Capacity / Resilience	
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. As either an independent or shared facility, this location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: This option, either independent or shared, could maintain disruption recovery. If independent, it may maintain a similar number of holding levels, therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.		
General Aviation (GA)	Access	
As either an independent or shared facility, a holding facility to the northwest 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	
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Heathrow. No impact on GA is expected.		
GA/Commercial Airlines	Fuel Burn	
As either an independent or shared facility, this design option is an optimised version of today. Optimisation could involve improving the approach phase from the hold to 7,000ft, raising the holding height, reorienting, or repositioning the hold. Any of these changes could enable more efficient flight paths. This location aligns with airport and network traffic flows. Overall, could reduce fuel burn for commercial operators compared with the baseline. 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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.		
Commercial Airlines	Other Costs	
No other operator costs are foreseen, as either an independent or shared facility.		
Airport / ANSP	Infrastructure Costs	
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.		

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AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • 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 reduce CO_2 emissions AMS Assessment – Shared Option • 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 reduce 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 Luton and Stansted departures and all Bournemouth, Farnborough, Gatwick, Northolt and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline, this option, either independent or shared with a lower traffic LTMA airport, could improve fuel burn and CO_2 emissions. It would maintain safety any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity, network capacity, and ATCO workload. Therefore, LL – IH – NW (Maybe shared) is progressed to Stage 3 for further development.	

Table 20 LL-IH-NW (Maybe shared) Initial Options Appraisal

LL – PM – N (Maybe shared) 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
As either an independent or shared facility, this design option may result in a change to track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. However, this location does not align with network traffic flows so could worsen network capacity. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: Disruption recovery could be maintained compared with the baseline, with a contingency hold[5] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a Point Merge facility to the north 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
As either an independent or shared facility, this option does not align with network traffic flows, which hinders potential capacity gains across the LTMA from an improved network design. This could negatively impact all LTMA traffic – commercial and GA. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through airport capacity gains; however, non-airspace constraints may hinder overall capacity and economic gains at Heathrow.	
GA/Commercial Airlines	Fuel Burn
This design option, either independent or shared, may result in a change to track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, could maintain fuel burn compared with the baseline. No change in impact is expected for GA.	
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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.	

[5] The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

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AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • Safety: could enhance • Simplification: could maintain delay absorption, disruption recovery, airport capacity, and ATCO workload. Could worsen network capacity. 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 AMS Assessment – Shared Option • Safety: could enhance • Simplification: could maintain delay absorption, disruption recovery, airport capacity, and ATCO workload. Could worsen network capacity. 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 a Point Merge to the north could enhance current safety performance. There is already a Point Merge within current UK airspace which has a proven safety performance and is shared between two airfields. However, traffic volumes at Heathrow are significantly larger which may increase ATCO complexity if the facility is shared. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. However, increases complexity in the area, therefore overall maintaining ATCO workload. An arrival structure in this location would need to deconflict with Luton, Northolt and Stansted traffic.	
Conclusion from IOA	
Compared to the baseline, this option, either independent or shared with a lower traffic LTMA airport, could enhance safety. It would maintain any current MoD access and could maintain fuel burn, CO_2 emissions, delay absorption, disruption recovery, access to other users, airport capacity, and ATCO workload, but may worsen network capacity. Therefore, LL – PM – N (Maybe shared) is progressed to Stage 3 for further development.	

Table 21 LL-PM-N (Maybe shared) Initial Options Appraisal

LL – PM – S (Maybe shared) 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
As either an independent or shared facility, this design option may result in a change to track miles to complete the Point Merge structure. However, this location aligns with airport and network traffic flows. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As either an independent or shared facility, this option could maintain airport capacity, providing the same number of holds as the baseline. This location does not align with network traffic flows so could worsen network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Heathrow. Resilience: Disruption recovery could be maintained compared with the baseline, with a contingency hold[6] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, as either an independent or shared facility, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, Point Merge 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
As either an independent or shared facility, this option does not align with network traffic flows, which hinders potential capacity gains across the LTMA from an improved network design. This could negatively impact all LTMA traffic – commercial and GA. A shared facility with a lower traffic LTMA airport could be similar compared with the baseline. An independent facility could enable positive economic impacts through airport capacity gains; however, other non-airspace constraints may hinder overall capacity gains at Heathrow.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option may result in a change to track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, fuel burn similar compared with the baseline. No change in impact is expected for GA.	
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, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, 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, either shared or independent, 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, either an independent or shared. 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.	

[6] The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • Safety: could enhance • Simplification: could maintain delay absorption, disruption recovery and airport capacity. Reduces ATCO workload. Could worsen network capacity. 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 AMS Assessment – Shared Option • Safety: could enhance • Simplification: could maintain delay absorption, disruption recovery and airport capacity. Reduces ATCO workload. Could worsen network capacity. 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 a Point Merge to the south could enhance current safety performance. There is already a Point Merge within current UK airspace which has a proven safety performance and is shared between two airfields. However, traffic volumes at Heathrow are significantly larger which may increase ATCO complexity if the facility is shared. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. An arrival structure in this location would need to deconflict with Farnborough, Gatwick and Northolt traffic.	
Conclusion from IOA	
Compared to the baseline, this option, either independent or shared with a lower traffic LTMA airport, could enhance safety. It would maintain any current MoD access and could maintain fuel burn, CO_2 emissions, delay absorption, disruption recovery, access to other users and airport capacity. It could reduce ATCO workload and worsen network capacity. Therefore, LL – PM – S (Maybe shared) is progressed to Stage 3 for further development.	

Table 22 LL-PM-S (Maybe shared) 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 design option concepts for Heathrow, 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
Heathrow	36	17	9	9

Table 23 Count of Design Option Concepts for each module through option development stages

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

Heathrow Option Concepts progressed to Stage 3
Inner Holds – North (DM) (Maybe shared)
Inner Holds – Northeast (DM) (Maybe shared)
Inner Holds – East (Maybe shared)
Inner Holds – Southeast (DM) (Maybe shared)
Inner Holds – South (DM) (Maybe shared)
Inner Holds – Southwest (Maybe shared)
Inner Holds – Northwest (Maybe shared)
Point Merge – North (Maybe shared)
Point Merge – South (Maybe shared)

Table 24 Summary of design options progressed to Stage 3

5. APPENDIX 1: Arrival Structure Concepts

Arrival structure types identified as being viable options[7] for potential airspace designs across the LTMA airports:

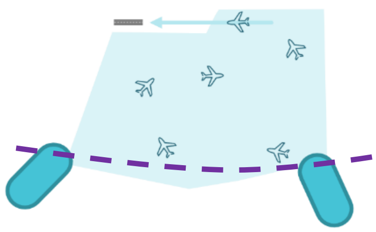
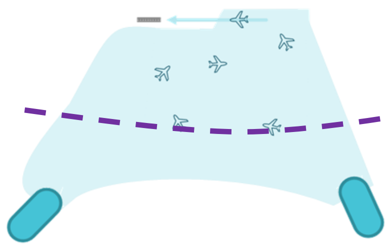
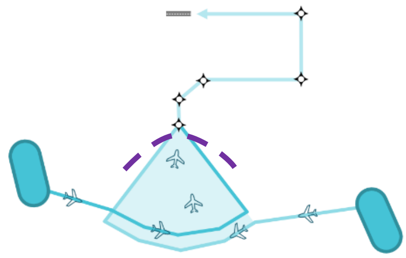
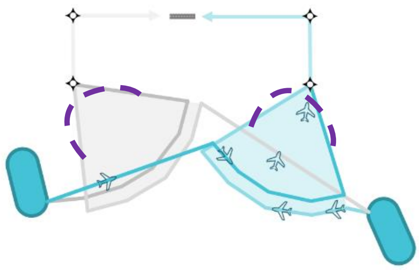
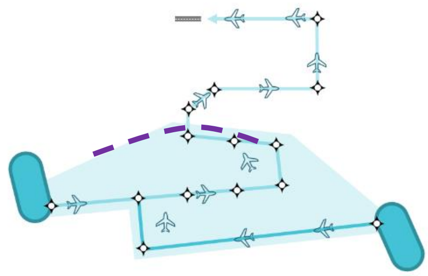
Structure	Diagram	Description
Optimised[8] Holds Illustration of network/airport boundary (indicative c.7,000ft)		A holding pattern is used to delay aircraft from landing, in a vertically separated stack. ATC control entry to, and exit from, the stack; and aircraft are vectored to the runway or may use 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)

End of document

[7] These diagrams are indicative and as per 3.1.1, Heathrow require at least four holds, in distinct geographical regions, either attached to an RMA or attached to systemised arrival structures e.g. two Point Merges.

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