

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

Northolt Airport Arrivals Connectivity Module

Issue 1.3

To be read in conjunction with Master Document



**NATS**

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# 1. Introduction

## 1.1 About this document

- 1.1.1 This document describes the arrival connectivity options for Northolt Airport, which have been developed using the methodology described in Section 2 of the Master document.
- 1.1.2 RAF Northolt is a military airport approximately 6 miles north of Heathrow. It operates a single runway and handles private civil flights in addition to Royal Air Force flights.

## 2. Baseline

- 2.1.1 This description of the current airspace around Northolt should be considered the ‘Do Nothing’ option if no airspace change was to take place.
- 2.1.2 Table 1 shows actual<sup>1</sup> 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	988	969	1,957
2020	1,229	1,226	2,455
2021	1,923	1,911	3,834
2022	3,543	3,532	7,075

**Table 1 Actual air traffic movements: Northolt Airport 2019-2022**

- 2.1.3 Northolt currently utilises the Heathrow arrival procedures (STARs), to one of four holds (LAM, BIG, OCK and BNN), as shown in Figure 1 and described in Table 2.

Airport	Hold	STARs	Associated ATS Routes
Northolt	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, L612
	LAM	BARMI 1H, LOGAN 2H	P7, L608, L980

**Table 2 Current arrival connectivity for Northolt**

- 2.1.4 Northolt and Heathrow currently share arrival structures. The baseline structures are considered at the relative location from each airport.
- 2.1.5 Northolt has independent departure procedures (SIDs) which connect with the network<sup>2</sup> (Table 3).

Airport	SIDs	Associated ATS Routes
Northolt	BUZAD 1Y/3X	T420 / LAM-CPT
	CPT 4Y/5X	N859, Y321, Q63
	DET 4X/4Y	M189 / DET-CLN
	MATCH 1Y	Q295

**Table 3 Current departure connectivity for Northolt**

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

<sup>2</sup> SIDs are all below 7,000ft and will be subject to Airport ACP. NERL will ensure network connectivity.



Key:  
 STARs including en-route holds  
 SIDs  
 Terminal Holds

Figure 1 Current arrival and departure procedures for Northolt

2.1.6

Figure 2 shows the traffic flows for arrivals to Northolt for January – August 2022<sup>3</sup> and indicates traffic distribution. The majority of traffic arrives from the east/ southeast.

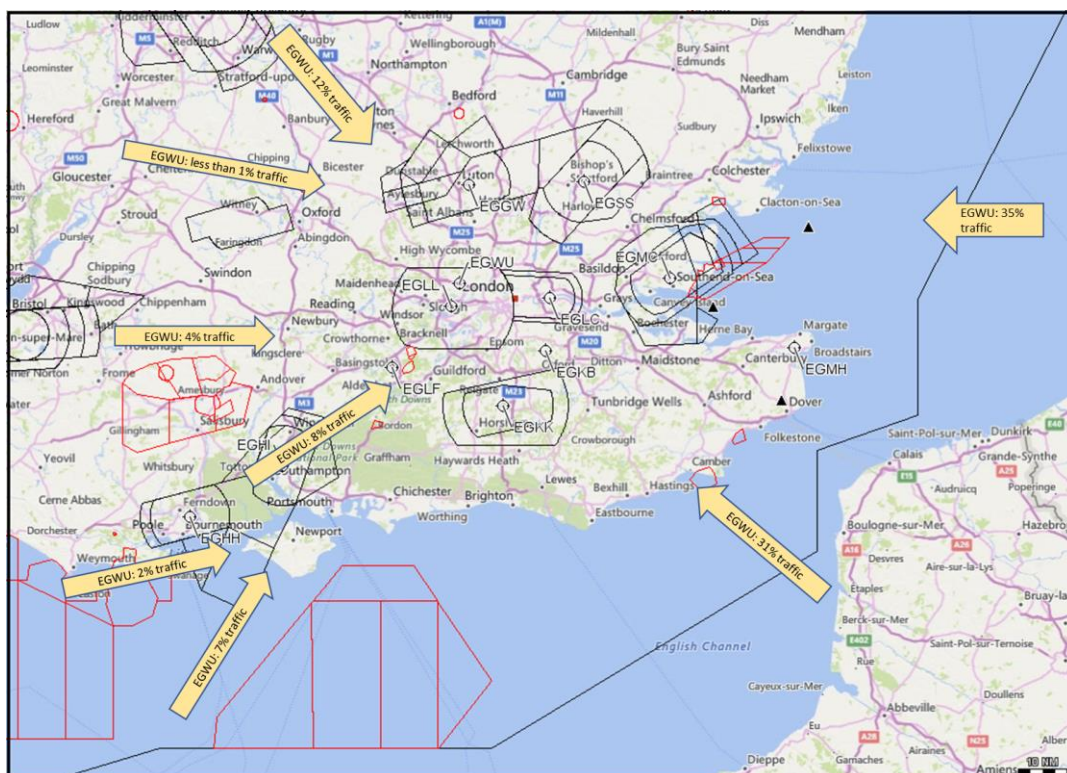


Figure 2 Northolt traffic arrival flows FL245-FL70 Jan-Aug 2022

<sup>3</sup> For this diagram, traffic proportions are taken from 1<sup>st</sup> January 2022 to 31 August 2022 due to the runway closure at Northolt April-November 2019 so there is insufficient data for the baseline period. Radar data was not available for Northolt, flow arrows are based on shared Heathrow arrival flows. Northolt had around 2,200 arrivals during this period.

2.1.7 Small and medium jets are the most prevalent aircraft type at Northolt, as shown in Table 4. In 2022 NetJets was the most prevalent operator and they made up approximately 24% of the traffic.

Northolt – Aircraft Type			Northolt – Top 4 Aircraft Operator Usage		
Aircraft Group	Movements	% traffic	Operator	Movements	% traffic
Small Jet	1,187	61%	NetJets	1,542	24%
Medium Jet	672	34%	VistaJet	575	9%
Heavy Jet	9	<1%	Air Hamburg	295	5%
Turboprop/Piston/Prop	78	4%	Jetfly	199	3%

Table 4 Aircraft type and top carriers<sup>4</sup> - Northolt

### 3. Design Development

3.1.1 Working with the airport, NERL developed 34 high-level concept options for Northolt<sup>5</sup>. NERL has assessed that based on required traffic loading, Northolt would require at least one hold, either attached to an RMA or attached to a systemised arrival structure. Initial viability assessments were produced for location and structure type (Figure 3) and presented to stakeholders in formal engagement (Ref 7). Feedback was requested through the engagement response questionnaire.

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

Viable Option: taken forward to engagement

Not considered a viable option: eliminated at this point

Figure 3 Engagement Initial Viability Matrix

### 3.2 Stakeholder engagement

- 3.2.1 We received 6 responses from 6 different stakeholders related to the Northolt design concepts. Table 5 presents a summary of the feedback and how this has influenced the design.
- 3.2.2 Feedback recognises Northolt is near Heathrow, and that traffic movements are relatively low.
- 3.2.3 No new options were developed as a result of the stakeholder engagement, however additional design concepts were considered, and revision made to the design envelope in line with feedback for Heathrow options (see Heathrow document), to ensure consistency should the overall arrival concept require a shared arrival structure with Heathrow. Additionally, engaged-upon options were removed due to SME development (see paragraph 3.3.3 and 3.3.4).

<sup>4</sup> Due to the 6-month runway closure in 2019, the most representative data for Northolt is 2022.

<sup>5</sup> See Master document Section 2.2 for a detailed description of this work.

Stakeholder	Feedback ('You said')	Response ('We did')
<b>Airspace4All</b>	Supports holds at minor airports, with direct routings, to keep track miles minimal.	Feedback was used to inform the evaluation of DP1, DP2, DP3 & DP8 for each airport. However, the conceptual nature of the design options means that specific design decisions as a result of this feedback cannot be made until more detailed options are developed in Stage 3.
<b>British Airways</b>	Considering the number of movements at Northolt, this must be deprioritized to facilitate Heathrow efficiencies, although mindful that this needs military priority at certain times.	At this stage, no airport will be prioritised over another, as we strive for a balanced network-wide design. Stage 3 work will identify prioritisation needs.
<b>BGA</b>	With such dependency and compatibility with Heathrow and very low movement rates any network supporting structure should be commensurate with such demand/dependency.	We used this feedback to inform our evaluation of DP1, DP6, and DP8. However, the conceptual nature of the design options means that specific design decisions as a result of this feedback cannot be made until more detailed options are developed in Stage 3.
<b>Heathrow Airport</b>	Request that 'standalone' or 'shared with another TMA airfield' options are also considered as concepts move to design. Alternatively, clarification added to the viability comments in the RAF Northolt section of the material. Request clarification of the intention for a shared arrival structure via the DPE with evidence that Heathrow, community, and Northolt requirements would still be met or exceeded by any joint structures.	Where options are described as 'maybe shared', DPEs have been assessed assuming they are an independent facility. Any options progressed to IOA are appraised both independently and shared. At this stage, the shared assessment makes no assumption with whom. See Master document 2.2.12. NERL will collaborate with all sponsors to understand how best to either integrate or separate operations at a network level throughout the Stage 3 development work.
<b>Luton Airport</b>	Support widening of design envelope. Important to LLA that any Northolt 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 Northolt and Luton traffic. See also paragraph 3.3.1. NERL recognises that the Northolt 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.
<b>Northolt</b>	Supportive of the approach this ACP is developing and will continue to work closely to ensure that Northolt's requirements are met. It will continue to cooperate to integrate interdependent airports arrival structures to ensure the best solution is developed.	No amendment to design envelope or options required as a result of this feedback, however the design envelope was subsequently amended as a result of SME development (see paragraph 3.3.1).

**Table 5 Engagement feedback and NERL response**

### 3.3 Northolt Design Concepts

- 3.3.1 Table 6 summarises the high-level qualitative considerations for potential locations for Northolt arrival structures, and Table 7 summarises the viability assessment for the arrival structures suitable for Northolt. These have been developed from SME input and stakeholder engagement.
- 3.3.2 Not every arrival structure concept may be viable in every location; the Viability Matrix (Figure 5) illustrates the possible combinations.
- 3.3.3 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.
- 3.3.4 As described in the Master document paras 2.4.2 & 2.4.3, the concepts Holds Further Out and Trombones were removed as viable concepts at this stage. A detailed description of each structure can be found in 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, Heathrow, 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, Heathrow, London City, Luton, 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, Heathrow, London City 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, Heathrow, London City 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 Heathrow 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, Heathrow, 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, Heathrow, Luton, 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, Heathrow, Luton, Southampton, and Stansted traffic.
Overhead		It would likely be possible to place an arrival structure overhead the airfield, subject to deconfliction with Gatwick, Heathrow, Luton, and Stansted traffic.

**Table 6 Northolt Arrivals: Location viability considerations – post engagement**

Structure	Viability Considerations	
Optimised (inner) holds		Optimisation of current day structures. There is sufficient airspace to suitably place optimised hold(s). Based on traffic throughput, this may need to be a shared facility.
Point Merge		There is sufficient airspace to suitably place a Point Merge. Based on traffic throughput, this will need to be a shared facility.
Switch Merge		There is insufficient airspace to suitably place a Switch Merge.

**Table 7 Northolt Arrival structures: Viability considerations – post engagement**

- 3.3.5 Figure 4 shows the Northolt design envelope, developed by SMEs through collaborative workshops and formal engagement with Northolt and other stakeholders, and revised in line with Heathrow engagement feedback. This design envelope is based on the viability considerations presented above in Table 6 & Table 7, developed through two-way engagement as shown in Table 5.
- 3.3.6 Airspace design constraints, as described in the Master document Section 3.5, are highlighted in orange. Considerations for Northolt are the Salisbury Plain, Shoeburyness and Portsmouth Danger Areas as shown.

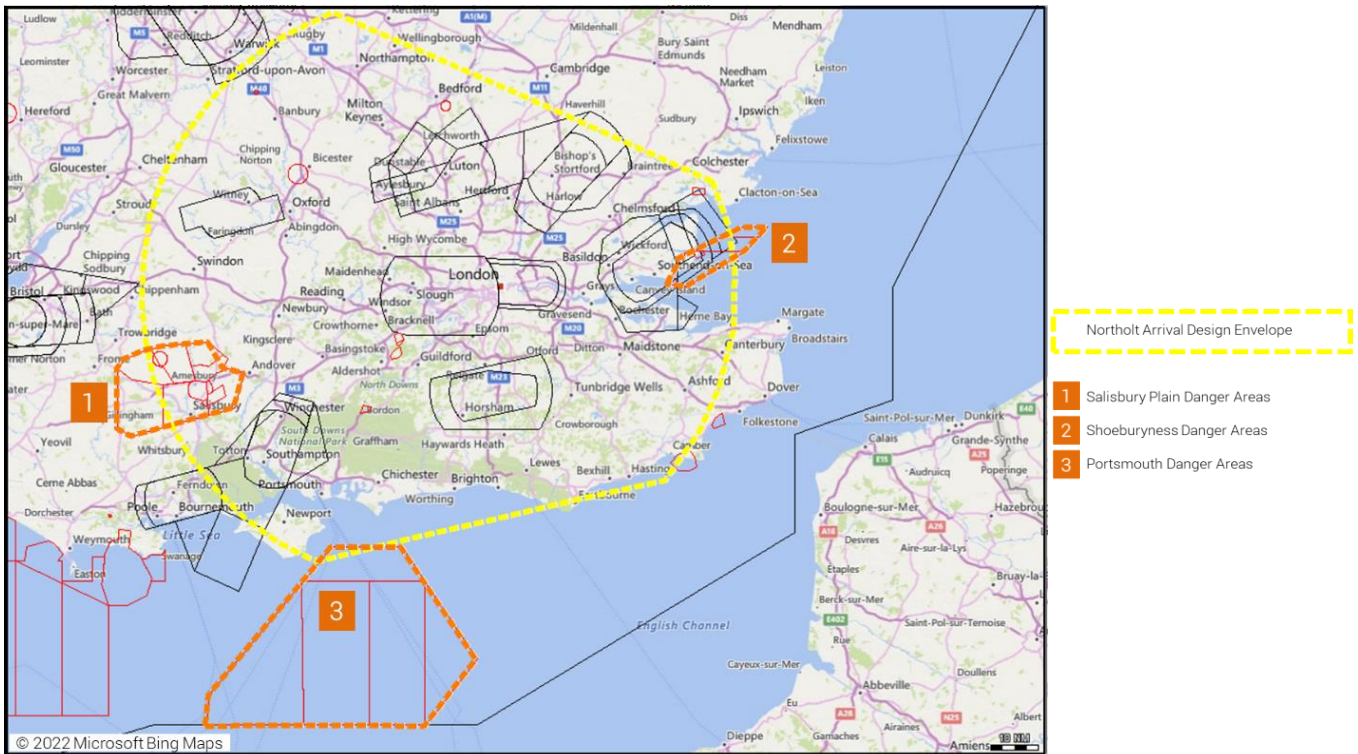


Figure 4 Northolt Design Envelope and design constraints – post engagement & SME development

3.3.7 The Northolt Design Concepts which were considered viable at this stage, within the Design Envelope presented, are shown in the Northolt Arrival Structure Viability Assessment below (Figure 5).

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 5 Northolt Design Options Comprehensive Viability Matrix

3.3.8 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<sup>6</sup>, 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	<b>Safety</b> 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	<b>Operational</b> 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	<b>Economic</b> 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	<b>Environmental</b> Optimise CO <sub>2</sub> emissions per flight	Track mileage GHG performance Aircraft height Method of delay absorption	CO <sub>2</sub> emissions worsened	CO <sub>2</sub> emissions similar to today	CO <sub>2</sub> emissions improved

<sup>6</sup> Where the Stakeholder Engagement Feedback tables state that feedback was used to inform the evaluation of one or more DPs, our SMEs take that feedback, add it to their wider knowledge and experience, and apply their combined judgment to the DPE for each option. The conceptual nature of the design options means that design decisions on each subject may not be possible at this stage. However, all feedback is considered by the SMEs in the round, and will also be carried forward into later stages as the concepts develop into more detailed options.



DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
4	C	<b>Environmental</b> 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	<b>Technical</b> 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 Or Similar CAS to today	Airspace required the minimum necessary to deliver an efficient design
6	C AMS	<b>Technical</b> 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 Or Similar impacts to today	Positive impacts to other airspace users' current activities
7	C AMS	<b>Technical</b> 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	<b>Operational</b> 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	<p><b>Technical</b> 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</p> <p>(Note: The main route network is considered as FL70 - FL245. Approach structures are not considered as 'the main route network').</p>	Airspace requirement vs. RNAV rating Required aircraft equipage standards	PBN standard applied to route spacing would maintain or decrease efficiency and maintain 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	<p><b>Policy</b> Must accord with the CAA's published Airspace Modernisation Strategy (CAP1711) and any current or future plans associated with it.</p>	<p><u>AMS "Ends" Strategic Objectives</u> Safety (DP0) Integration of diverse users (DP6 and DP7) Simplification (DP1, DP8 and DP9) Environmental sustainability (DP3)</p>	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
<b>Red</b>	DP0 (Safety) is red OR 2 other DPs are red
<b>Amber</b>	All other colour combinations not covered by Red or Green
<b>Green</b>	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
<b>A</b>	1 red OR 1 amber
<b>B</b>	2 reds
<b>C</b>	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. WU) - Structure Type (e.g. Inner Hold: IH/Point Merge: PM) - Location (e.g. Northeast: NE). DN = Do Nothing. DM = Do Minimum.

DP	Priority	WU - DN (Shared)	WU - IH - N (Maybe shared)	WU - IH - NE (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 <sub>2</sub> )	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> 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 non-Northolt MoD currently, therefore no change in impact	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations
DP8 Operational (Capacity)	B AMS	Aligns with network traffic flows but does not support forecast network loading. Can support the airport required arrival loading	Aligns with network traffic flows and concept can support the airport required arrival loading	Aligns with network traffic flows and concept can support the airport required arrival loading
DP8 Operational (Efficiency)	B AMS	Today's operation, no change in ATCO workload anticipated	Similar concept to today's operation, therefore no change in ATCO workload anticipated	Similar concept to today's operation, 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	WU - IH - E (DM) (Maybe shared)	WU - IH - SE (DM) (Maybe shared)	WU - 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 <sub>2</sub> )	B AMS	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> 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 non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt 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

DP	Priority	WU - IH - SW (Maybe shared)	WU - IH - W (Maybe shared)	WU - IH - NW (DM) (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 <sub>2</sub> )	B AMS	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> emissions per flight improved	Does not align with airport traffic flows. CO <sub>2</sub> emissions per flight worsened	Optimised concept of current day operation aligned with airport traffic flows, therefore CO <sub>2</sub> 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 non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt 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, DP7, DP9 Amber: DP1, DP1, DP6, DP8, DP8 Red: DP3	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

DP	Priority	WU - PM - N (Shared)	WU - PM - NE (Shared)	WU - PM - E (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	A shared PM could result aircraft being held when there is a disruption at another airport	A shared PM could result aircraft being held when there is a disruption at another airport	A shared PM could result aircraft being held when there is a disruption at another airport
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 <sub>2</sub> )	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 non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	Assumes design would not impact Shoeburyness DA Complex. Therefore, no negative impact on current non-Northolt MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of westbound and northbound network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound 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, DP3, DP6, DP8, DP8 Red: DP1	Green: DP0, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: DP1, DP3	Green: DP0, DP7, DP8, DP8, DP9 Amber: DP1, DP6 Red: DP1, DP3

DP	Priority	WU - PM - SE (Shared)	WU - PM - S (Shared)	WU - PM - SW (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	A shared PM could result in aircraft being held when there is a disruption at another airport	A shared PM could result in aircraft being held when there is a disruption at another airport	A shared PM could result in aircraft being held when there is a disruption at another airport
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 <sub>2</sub> )	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 non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt 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. Negative impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negative impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negative 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, DP6, DP8, DP8 Red: DP1, DP3	Green: DP0, DP7, DP9 Amber: DP1, DP3, DP6, DP8 Red: DP1	Green: DP0, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: DP1, DP3

DP	Priority	WU - PM - W (Shared)	WU - PM - NW (Shared)	WU - PM - OH (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	A shared PM could result in aircraft being held when there is a disruption at another airport	A shared PM could result in aircraft being held when there is a disruption at another airport	A shared PM could result in aircraft being held when there is a disruption at another airport
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 <sub>2</sub> )	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 non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt MoD operations	No non-Northolt military-use areas in the vicinity, therefore, would not require a change to non-Northolt 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. Negative impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negative impacts on network traffic flows; increases ATCO workload. Net neutral	PM structure require less tactical intervention. Negative 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, DP6, DP8, DP8 Red: DP1, DP3	Green: DP0, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: DP1, DP3	Green: DP0, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: DP1, DP3

Table 11 Design Principle Evaluation

3.4.5 'Do Nothing' and a further 8 design options were assessed as not meeting the DPs and were rejected at this stage. The remaining 9 viable option concepts progress to Step 2B Options Appraisal.



### 3.5 Initial Options Appraisal

3.5.1 The following viable options have been progressed to IOA:

Northolt Option Concepts progressed to IOA
Inner Holds – North (Maybe shared)
Inner Holds – Northeast (Maybe shared)
Inner Holds – East (DM) (Maybe shared)
Inner Holds – Southeast (DM) (Maybe shared)
Inner Holds – South (DM) (Maybe shared)
Inner Holds – Southwest (Maybe shared)
Inner Holds – Northwest (DM) (Maybe shared)
Point Merge – North (Shared)
Point Merge – South (Shared)

**Table 12 Summary of design options progressed from DPE to IOA**

Table 13 shows the assessment criteria used to complete the initial appraisal of each shortlisted option.

Group	Impact
<b>Communities</b>	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.
<b>Communities</b>	Air Quality
	A qualitative assessment of changes to local air quality compared with the 'Do Nothing' baseline.
<b>Wider Society</b>	Greenhouse Gas Impacts
	A qualitative assessment of changes to greenhouse gas impacts compared with the 'Do Nothing' baseline.
<b>Wider Society</b>	Capacity / Resilience
	A qualitative assessment of changes to airspace capacity and resilience compared with the 'Do Nothing' baseline.
<b>General Aviation (GA)</b>	Access
	A qualitative assessment of changes to GA access compared with the 'Do Nothing' baseline.
<b>GA/Commercial Airlines</b>	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.
<b>GA/Commercial Airlines</b>	Fuel Burn
	A qualitative assessment of changes to GA and commercial operator fuel burn impacts compared with the 'Do Nothing' baseline.
<b>Commercial Airlines</b>	Training Costs
	A qualitative assessment of changes to commercial operator training costs compared with the 'Do Nothing' baseline.
<b>Commercial Airlines</b>	Other Costs
	A qualitative assessment of changes to other relevant commercial operator costs compared with the 'Do Nothing' baseline.
<b>Airport / ANSP</b>	Infrastructure Costs
	A qualitative assessment of changes to airport and ANSP infrastructure costs compared with the 'Do Nothing' baseline.
<b>Airport / ANSP</b>	Operational Costs
	A qualitative assessment of changes to airport and ANSP operational costs compared with the 'Do Nothing' baseline.
<b>Airport / ANSP</b>	Deployment Costs
	A qualitative assessment of changes to airport and ANSP deployment costs compared with the 'Do Nothing' baseline.
<b>All</b>	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 <sub>2</sub> , minimal impact on other users, maintaining or enhancing safety, and facilitation of defence and security objectives, compared with the 'Do Nothing' baseline.

**Table 13 Initial Options Appraisal Assessment Criteria**

3.5.2 The baseline 'Do Nothing' is described in Section 2. It did not progress through the DPE however, in line with CAP1616, it must be included in the IOA for comparison purposes. Each option is described in Section 3.3 and Section 5 Appendix 1.

WU– DN Qualitative Initial Impacts Assessment		REJECTED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	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.	
<b>General Aviation (GA)</b>	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.	
<b>GA/Commercial Airlines</b>	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.	
<b>GA/Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No change in airspace design – no changes to other commercial operator costs.	
<b>Airport / ANSP</b>	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.	
<b>Airport / ANSP</b>	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.	
<b>Airport / ANSP</b>	Deployment Costs	
	If this baseline system was retained, there would be no deployment, hence no associated costs.	
<b>AMS</b>	Performance against the vision and parameters/strategic objectives of the AMS	
	<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: worsens delay absorption, disruption recovery, airport capacity, network capacity, and ATCO workload. Does not utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA</li> <li>• Environmental sustainability: worsens CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>		
	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.	
<b>Conclusion from IOA</b>		
	This option was rejected during the DPE stage. It has been included for comparison purposes only.	

**Table 14 WU-DN Initial Options Appraisal**

WU - IH – N (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, it could maintain airport capacity compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	As either an independent or shared facility, a holding 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.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit airport capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	
<b>Airport / ANSP</b>	Operational Costs	
	This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	

Airport / ANSP	Deployment Costs
<p>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.</p>	
AMS	
<p>Performance against the vision and parameters/strategic objectives of the AMS</p>	
<p>AMS Assessment – Independent Option</p>	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity. Could Maintain disruption recovery, delay absorption, network capacity, and ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
<p>AMS Assessment – Shared Option</p>	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
Qualitative Safety Assessment	
<p>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 Heathrow traffic and Luton, and Stansted departures.</p>	
Conclusion from IOA	
<p>Compared to the baseline, an independent facility could improve fuel burn, CO<sub>2</sub> emissions, and enable airport capacity. Either an independent or shared facility, would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same.</p>	
<p><b>Therefore, WU – IH – N (Maybe shared) is progressed to Stage 3 for further development.</b></p>	

Table 15 WU-IH-N (Maybe shared) Initial Options Appraisal

WU - IH – NE (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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, it could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, it could maintain airport capacity compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	As either an independent or shared facility, a holding facility to the northeast would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	
<b>Airport / ANSP</b>	Operational Costs	
	This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	

Airport / ANSP	Deployment Costs
<p>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.</p>	
AMS	
<p>Performance against the vision and parameters/strategic objectives of the AMS</p>	
<p>AMS Assessment – Independent Option</p>	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity. Could maintain disruption recovery, delay absorption, network capacity, and ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
<p>AMS Assessment – Shared Option</p>	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
Qualitative Safety Assessment	
<p>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 all Gatwick, Heathrow traffic and Biggin Hill, London City, Luton, Southend and Stansted departures.</p>	
Conclusion from IOA	
<p>Compared to the baseline, an independent facility could enable airport capacity. Either an independent or shared facility, could improve fuel burn and CO<sub>2</sub> emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity, and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same.</p>	
<p><b>Therefore, WU – IH – NE (Maybe shared) is progressed to Stage 3 for further development.</b></p>	

Table 16 WU-IH-NE (Maybe shared) Initial Options Appraisal

WU - IH – E (DM) (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, it could maintain airport capacity compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	As either an independent or shared facility, a holding facility to the east 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.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	

<b>Airport / ANSP</b>	<b>Operational Costs</b>
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	<b>Deployment Costs</b>
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.	
<b>AMS</b>	<b>Performance against the vision and parameters/strategic objectives of the AMS</b>
AMS Assessment – Independent Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity. Could maintain disruption recovery, delay absorption, network capacity, and ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
AMS Assessment – Shared Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>	
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, Heathrow, London City and Southend traffic.	
<b>Conclusion from IOA</b>	
Compared to the baseline, an independent facility could enable airport capacity. Either an independent facility or shared facility, could improve fuel burn and CO <sub>2</sub> emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same. <b>Therefore, WU – IH – E (DM) (Maybe shared) is progressed to Stage 3 for further development.</b>	

**Table 17 WU-IH-E (DM) (Maybe shared) Initial Options Appraisal**



WU - IH – SE (DM) (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, it could maintain airport capacity could be compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	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.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	

<b>Airport / ANSP</b>	<b>Operational Costs</b>
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	<b>Deployment Costs</b>
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.	
<b>AMS</b>	<b>Performance against the vision and parameters/strategic objectives of the AMS</b>
AMS Assessment – Independent Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity. Could maintain disruption recovery, delay absorption, network capacity, and ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
AMS Assessment – Shared Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>	
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 all Heathrow traffic and Biggin Hill, Gatwick, London City and Southend departures.	
<b>Conclusion from IOA</b>	
Compared to the baseline, an independent facility could enable airport capacity. Either an independent facility or shared facility, could improve fuel burn and CO <sub>2</sub> emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same. <b>Therefore, WU – IH – SE (DM) (Maybe shared) is progressed to Stage 3 for further development.</b>	

Table 18 WU-IH-SE (DM) (Maybe shared)

WU - IH – S (DM) (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, there could be no change compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	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.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	

<b>Airport / ANSP</b>	<b>Operational Costs</b>
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	<b>Deployment Costs</b>
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.	
<b>AMS</b>	<b>Performance against the vision and parameters/strategic objectives of the AMS</b>
AMS Assessment – Independent Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity. Could maintain disruption recovery, delay absorption, network capacity, and ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
AMS Assessment – Shared Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the south would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. An arrival structure in this location would need to deconflict with all Farnborough, Gatwick and Heathrow traffic.	
<b>Conclusion from IOA</b>	
Compared to the baseline, an independent facility could enable airport capacity. Either an independent or shared facility, could improve fuel burn and CO <sub>2</sub> emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity, and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same.	
<b>Therefore, WU – IH – S (DM) (Maybe shared) is progressed to Stage 3 for further development.</b>	

**Table 19 WU-IH-S (DM) (Maybe shared) Initial Options Appraisal**

WU - IH – SW (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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 traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. However, as either an independent or shared facility, this location does not align with network traffic flows so could worsen network capacity. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, there could be no change compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	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.	
<b>GA/Commercial Airlines</b>	Economic Impact from Increased Effective Capacity	
	As either an independent or shared facility, this option does not align with network traffic flows, which could hinder any potential capacity gains across the LTMA from an improved network design. A shared facility with Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	
<b>Airport / ANSP</b>	Operational Costs	
	This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	

<b>Airport / ANSP</b>	<b>Deployment Costs</b>
<p>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.</p>	
<b>AMS</b>	<b>Performance against the vision and parameters/strategic objectives of the AMS</b>
<p>AMS Assessment – Independent Option</p> <ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity, maintain disruption recovery, maintain delay absorption, and maintain ATCO workload. Could worsen network capacity. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul> <p>AMS Assessment – Shared Option</p> <ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity and ATCO workload. Could worsen network capacity. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>	
<p>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, Heathrow, and Southampton traffic.</p>	
<b>Conclusion from IOA</b>	
<p>Compared to the baseline, an independent facility could enable airport capacity. Either an independent or shared facility could improve fuel burn and CO<sub>2</sub> emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, and ATCO workload. Could negatively impact network capacity. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same.</p> <p><b>Therefore, WU – IH – SW (Maybe shared) is progressed to Stage 3 for further development.</b></p>	

**Table 20 WU-IH-SW (Maybe shared) Initial Options Appraisal**

WU - IH – NW (DM) (Maybe shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	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.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: If this is an independent facility, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. If the Inner Hold is a shared facility with Heathrow, it could maintain airport capacity compared with the baseline. A shared facility with a different LTMA airfield, may lead to a reduced number of holding levels for Northolt. Resilience: As either an independent or shared facility, optimised holds could maintain disruption recovery resulting from unplanned runway closure. This option, either independent or shared, could maintain a similar number of holding levels, therefore could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	As either an independent or shared facility, a holding facility to the northwest 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.	
<b>GA/Commercial Airlines</b>	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 Heathrow could be similar compared with the baseline. A shared facility with a different LTMA airfield may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at Northolt. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
<b>GA/Commercial Airlines</b>	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. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
<b>Commercial Airlines</b>	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.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen, as either an independent or shared facility.	
<b>Airport / ANSP</b>	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.	

<b>Airport / ANSP</b>	<b>Operational Costs</b>
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	<b>Deployment Costs</b>
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.	
<b>AMS</b>	<b>Performance against the vision and parameters/strategic objectives of the AMS</b>
AMS Assessment – Independent Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could enable airport capacity, maintain disruption recovery, maintain delay absorption, maintain network capacity and maintain ATCO workload. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions. Could result in network inefficiencies</li> </ul>	
AMS Assessment – Shared Option	
<ul style="list-style-type: none"> <li>• Safety: maintained</li> <li>• Simplification: could maintain disruption recovery, delay absorption, airport capacity, network capacity, and ATCO workload. Potential to worsen delay absorption depending on airport. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could reduce CO<sub>2</sub> emissions</li> </ul>	
<b>Qualitative Safety Assessment</b>	
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 all Bournemouth, Farnborough, Gatwick, Heathrow and Southampton traffic and Luton and Stansted departures.	
<b>Conclusion from IOA</b>	
Compared to the baseline, an independent facility could enable airport capacity. Either an independent or shared facility, could improve fuel burn and CO <sub>2</sub> . It would maintain safety and any current MoD access. It could maintain disruption recovery, delay absorption, access to other users, network capacity, and ATCO workload. Depending on the airport, a shared facility may have worse delay absorption than the baseline, whilst other factors are the same.	
<b>Therefore, WU – IH – NW (DM) (Maybe shared) is progressed to Stage 3 for further development.</b>	

Table 21 WU-IH-NW (DM)(Maybe shared) Initial Options Appraisal



WU – PM – N (Shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	Greenhouse Gas Impacts	
	This design option may result in extended track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, it could maintain GHG emissions compared with the baseline.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: This option could maintain airport capacity, providing the same number of shared 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 and economic gains at Northolt. Resilience: This option includes a contingency hold <sup>7</sup> utilised in the event of unplanned runway closure. However, as a shared structure, any unplanned runway closure at the other airfield could negatively impact Northolt operations. Overall, disruption recovery could be worse compared with the baseline. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	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.	
<b>GA/Commercial Airlines</b>	Economic Impact from Increased Effective Capacity	
	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 Heathrow could be similar compared with the baseline; however, other non-airspace constraints may hinder overall capacity and economic gains at Northolt. A shared facility with a different LTMA airfield may limit airport capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators.	
<b>GA/Commercial Airlines</b>	Fuel Burn	
	This design option may result in extended track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, it could maintain fuel burn compared with the baseline. No change in impact is expected for GA.	
<b>Commercial Airlines</b>	Training Costs	
	Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen.	
<b>Airport / ANSP</b>	Infrastructure Costs	
	This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
<b>Airport / ANSP</b>	Operational Costs	
	This design option is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	Deployment Costs	
	At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	
<b>AMS</b>	Performance against the vision and parameters/strategic objectives of the AMS	
	<ul style="list-style-type: none"> <li>• Safety: could enhance</li> <li>• Simplification: could maintain delay absorption, airport capacity, and ATCO workload. Could worsen disruption recovery, and network capacity. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could maintain CO<sub>2</sub> emissions</li> </ul>	

<sup>7</sup> The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

Qualitative Safety Assessment
<p>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 than either of the airports currently sharing a PM, this could increase ATCO complexity if this facility is shared with Heathrow. However, 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 maintaining overall ATCO workload. Therefore, will be progressed for further analysis. An arrival structure in this location would need to deconflict with all Heathrow and Luton traffic and Stansted departures.</p>
Conclusion from IOA
<p>Compared to the baseline, this option could enhance safety. It would maintain MoD access and could maintain delay absorption, fuel burn, CO<sub>2</sub> emissions, access to other users, airport capacity, and ATCO workload. This location could have a negative impact on network capacity and disruption recovery compared with the baseline. If the facility is shared with a different LTMA airfield, airport capacity and disruption recovery could be worse than the baseline.</p> <p><b>Therefore, WU – PM – N (Shared) is progressed to Stage 3 for further development.</b></p>

Table 22 WU-PM-N (Shared) Initial Options Appraisal

WU – PM – S (Shared) Qualitative Initial Impacts Assessment		PROGRESSED
Group	Impact	
<b>Communities</b>	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.	
<b>Communities</b>	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.	
<b>Wider Society</b>	Greenhouse Gas Impacts	
	This design option may result in extended track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, it could maintain GHG emissions compared with the baseline.	
<b>Wider Society</b>	Capacity / Resilience	
	Capacity: This option could maintain airport capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity and economic gains at Northolt. This location does not align with network traffic flows so could worsen network capacity. Resilience: This option includes a contingency hold <sup>8</sup> utilised in the event of unplanned runway closure. However, as a shared structure, any unplanned runway closure at the other airfield could negatively impact Northolt operations. Overall, disruption recovery could be worse compared with the baseline. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
<b>General Aviation (GA)</b>	Access	
	A 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.	
<b>GA/Commercial Airlines</b>	Economic Impact from Increased Effective Capacity	
	This option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. This could positively impact all LTMA traffic – commercial and GA. A shared facility with Heathrow could be similar compared with the baseline; however, other non-airspace constraints may hinder overall capacity and economic gains at Northolt. A shared facility with a different LTMA airfield may limit airport capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators.	
<b>GA/Commercial Airlines</b>	Fuel Burn	
	This design option may result in extended track miles to complete the Point Merge structure. However, this location aligns with airport traffic flows. Overall, it could maintain fuel burn compared with the baseline. No change in impact is expected for GA.	
<b>Commercial Airlines</b>	Training Costs	
	Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
<b>Commercial Airlines</b>	Other Costs	
	No other operator costs are foreseen.	
<b>Airport / ANSP</b>	Infrastructure Costs	
	This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
<b>Airport / ANSP</b>	Operational Costs	
	This design option is not expected to change airport or ANSP operational cost impacts.	
<b>Airport / ANSP</b>	Deployment Costs	
	At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	
<b>AMS</b>	Performance against the vision and parameters/strategic objectives of the AMS	
	<ul style="list-style-type: none"> <li>• Safety: could enhance</li> <li>• Simplification: could reduce ATCO workload, maintain delay absorption and maintain airport capacity. Could worsen disruption recovery, and network capacity. Will utilise aircraft performance capabilities</li> <li>• Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design</li> <li>• Environmental sustainability: could maintain CO<sub>2</sub> emissions</li> </ul>	

<sup>8</sup> The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

Qualitative Safety Assessment
<p>A high-level safety appraisal for this proposed option indicates that a Point Merge to the south would 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, than either of the airports currently sharing a PM, this could increase ATCO complexity if this facility is shared with Heathrow. However, a Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. Therefore, will be progressed for further analysis. An arrival structure in this location would need to deconflict with all Farnborough, Gatwick and Heathrow traffic.</p>
Conclusion from IOA
<p>Compared to the baseline, this option could enhance safety and improve ATCO workload. It would maintain MoD access and could maintain delay absorption, fuel burn, CO<sub>2</sub> emissions, access to other users, and airport capacity. This location could have a negative impact on network capacity and disruption recovery compared with the baseline. If the facility is shared with a different LTMA airfield, airport capacity and disruption recovery could be worse than the baseline.</p> <p><b>Therefore, WU – PM – S (Shared) is progressed to Stage 3 for further development.</b></p>

Table 23 WU-PM-S (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 Northolt, 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
Northolt	34	17	9	9

**Table 24 Count of Design Option Concepts for each module through option development stages**

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

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

**Table 25 Summary of design options progressed to Stage 3**

## 5. APPENDIX 1: Arrival Structure Concepts

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

Structure	Diagram	Description
<b>Optimised<sup>9</sup> Holds</b>  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.
<b>Holds Further Out</b>  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.
<b>Point Merge</b>  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.
<b>Switch Merge</b>  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.
<b>Trombone</b>  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 6 Arrival structure concepts (at and above 7,000ft)

End of document

<sup>9</sup> See paragraph 2.2.10 of Master document for explanation of 'Optimised'