



# ***AIRSPACE MODERNISATION AIRSPACE CHANGE PROPOSAL***

## ***STEP 2B INITIAL OPTIONS APPRAISAL***

### ***APPENDIX B***

#### ***PBN ARRIVALS Runway 09R - Part 10***



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All airspace design options in this document are subject to change throughout the airspace change process, as options are matured in detail and refined in accordance with safety requirements, design principles, appraisals and stakeholder engagement and consultation.



# **Initial Options Appraisal**

## **PBN Arrivals**

### **Runway 09R**



All airspace design options in this document are subject to change throughout the airspace change process, as options are matured in detail and refined in accordance with safety requirements, design principles, appraisals and stakeholder engagement and consultation.

Version 1.0 (July 2023)

PBN Arrivals – Runway (RWY) 09R Baseline  
‘Do Nothing’

Option Description

This represents the baseline for Doing Nothing with 09R arrivals in the 0430-0600 period. The image represents the areas overflowed at least once per day on average by 09R arrivals in 2019, 0430-0600.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	5,800	N/A
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	0	N/A

Communities - Air Quality

As this is the Baseline ‘Do Nothing’, there is no change to Air Quality.

Wider Society – Greenhouse Gas Impact

Metric	Option Value	Difference to Baseline
Overall Track Miles (nm) of all routes	403	N/A

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflowed between 0-7000ft once a day on average (night-time)	0km <sup>2</sup>	N/A
Total Area of AONBs/NPs overflowed experiencing at least one event of N60 on average (night-time)	0km <sup>2</sup>	N/A
Total Area of Richmond Park overflowed between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	N/A
Number of sites (RAMSAR, SAC, SPA, SSSI) overflowed between 0-1640ft which observe a potential change in location overflowed	N/A	N/A
Number of sites (RAMSAR, SAC, SPA, SSSI) overflowed between 0-3000ft which observe a potential change in location overflowed	N/A	N/A

Wider Society – Capacity/Resilience

Arrival throughput is not a concern 0430-0600.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation (GA) – Access

No additional Controlled Airspace (CAS) required.  
Option would not facilitate the release of CAS.  
Option not expected to impact existing helicopter routes.



**General Aviation / Commercial Airlines – Economic impact from increased effective capacity**

As this is the Baseline ‘Do Nothing’ there is no economic effect expected on GA or Commercial Airline operations.  
  
Arrival delay is not an issue during the 0430-0600 period.

**Commercial Airlines – Training costs**

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

**Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs**

Doing nothing means no changes to infrastructure costs.

**Airport/ANSP – Deployment costs**

Doing nothing mean no deployment costs.

**Safety**

Doing nothing means no Instrument Flight Procedure (IFP) design considerations.

**Interdependencies, Conflicts & Trade-Offs**

Option may result in conflicts/interdependencies with Gatwick Airport’s options.

**General Aviation / Commercial Airlines – Fuel Burn**

Change in Fuel Burn (annual - tonnes)	No change
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**Commercial Airlines – Other costs**

None identified.

**Airport/ANSP – Operational costs**

Doing nothing means no change to operational costs.

**Adherence to Airspace Modernisation Strategy (AMS)**

Doing nothing with Easterly arrivals will not align with the AMS. It will not enable environmental benefits, increase airspace capacity, reduce noise impacts or maximise benefits from NERL’s re-design of the London Terminal Manoeuvring Area (LTMA). No change and therefore no ACP submission will not enable enhancements to safety, enhanced integration or reductions in the volume of CAS.

**Outcome of PBN Arrival RWY09R Baseline ‘Do Nothing’**

The Baseline (Do Nothing) Option was discontinued during the Design Principles Evaluation (DPE) phase of Stage 2, owing to the option not meeting the objectives set by the Airspace Modernisation Strategy (AMS).

**OPTION DISCONTINUED (During DPE)**

# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Do Nothing (Night)



23:00 - 07:00

### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Do Nothing	
≥ 1	0	0	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Do Nothing	
≥ 1	0	0	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Do Nothing	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	16,300	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	5,800	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (0 brought out of Partial LOAEL by Option)	0	0 (0 brought into Partial LOAEL by Option)	

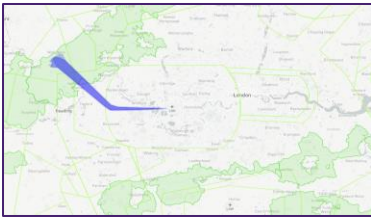




PBN Arrivals – RWY 09R Option A

Option Description

This option was developed to address DP2. This option assumes a single PBN arrival track used for all RWY09R arrivals during the 0430-0600 period from BEDEK, TOBID & BEGTO.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,100	+2,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	36,300	+36,300

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+10

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	28km <sup>2</sup>	+28km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	35km <sup>2</sup>	+35km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	4	+4
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	8	+8

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



**General Aviation / Commercial Airlines – Economic impact from increased effective capacity**

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

**Commercial Airlines – Training costs**

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

**Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs**

Option may require re-location and/or addition of Noise Monitoring Terminals.

**Airport/ANSP – Deployment costs**

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

**Safety**

There are already PBN to ILS procedures published in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

**Interdependencies, Conflicts & Trade-Offs**

Option not expected to interact with other airports’ options.

**General Aviation / Commercial Airlines – Fuel Burn**

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

**Commercial Airlines – Other costs**

None identified.

**Airport/ANSP – Operational costs**

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

**Adherence to AMS**

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

**Outcome of PBN Arrival RWY09R Option A**

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

**OPTION CARRIED FORWARD TO STAGE 3**



# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option A (Night)



23:00 - 07:00

### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option A	
≥ 1	0	6,500	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option A	
≥ 1	0	36,300	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option A	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	24,100	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,100	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (of which 0 brought out of Partial LOAEL by Option)	0	8,100 (of which 2,300 brought into Partial LOAEL by Option)	



PBN Arrivals – RWY 09R Option B

Option Description

This option was developed to address DP2. This option assumes a single PBN arrival track used for all RWY09R arrivals during the 0430-0600 period from ALESO & LOGAN.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,100	+2,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	51,300	+51,300

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+15

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	47km <sup>2</sup>	+47km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	38km <sup>2</sup>	+38km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	0	No change

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.





**General Aviation / Commercial Airlines – Economic impact from increased effective capacity**

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

**General Aviation / Commercial Airlines – Fuel Burn**

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

**Commercial Airlines – Other costs**

None identified.

**Commercial Airlines – Training costs**

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

**Airport/ANSP – Operational costs**

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

**Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs**

Option may require re-location and/or addition of Noise Monitoring Terminals.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

**Airport/ANSP – Deployment costs**

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

**Safety**

There are already PBN to ILS procedures published in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

**Adherence to AMS**

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

**Interdependencies, Conflicts & Trade-Offs**

Option not expected to interact with other airports' options.

**Outcome of PBN Arrival RWY09R Option B**

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

**OPTION CARRIED FORWARD TO STAGE 3**



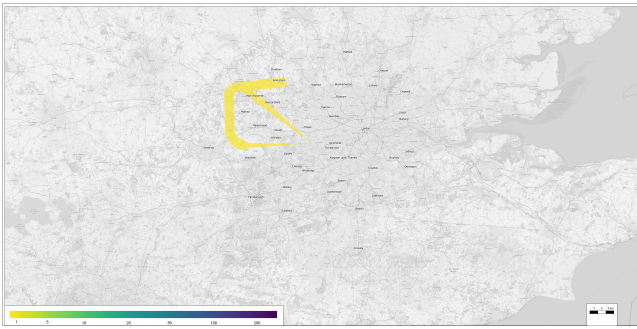
# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option B (Night)

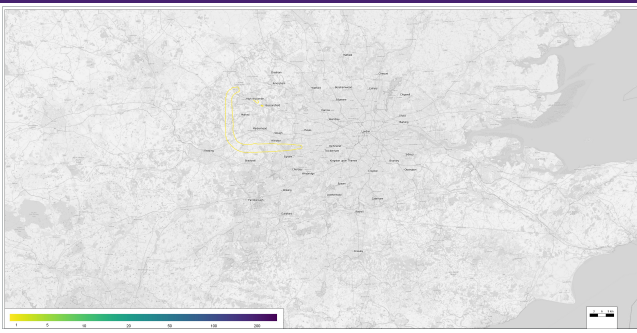


23:00 - 07:00

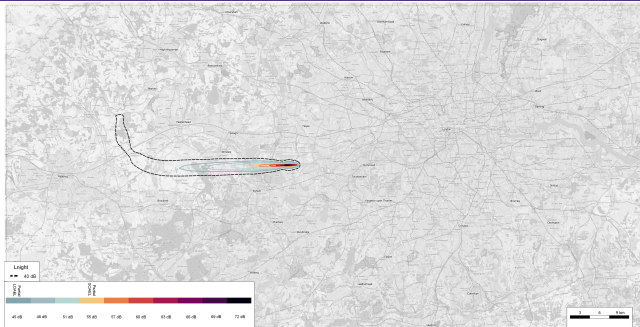
### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option B	
≥ 1	0	10,700	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	


### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option B	
≥ 1	0	51,300	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option B	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	23,800	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,100	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (of which 0 brought out of Partial LOAEL by Option)	0	8,100 (of which 2,300 brought into Partial LOAEL by Option)	
				



PBN Arrivals – RWY 09R Option C

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals during the 0430-0600 period from BEDEK.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	7,800	+2000
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	100,800	+100,800

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-1

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	14km <sup>2</sup>	+14km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	3km <sup>2</sup>	+3km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	6	+6
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	11	+11

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



## General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

## General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

## Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

## Commercial Airlines – Other costs

None identified.

## Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

## Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

## Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

## Safety

There are already PBN to ILS procedures published in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

## Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

## Interdependencies, Conflicts & Trade-Offs

Option not expected to interact with other airports' options.

## Outcome of PBN Arrival RWY09R Option C

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

## OPTION CARRIED FORWARD TO STAGE 3





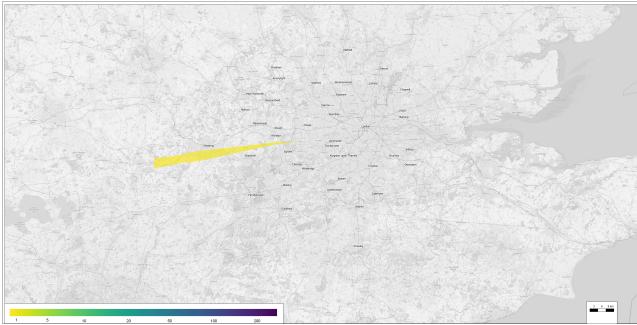
# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option C (Night)

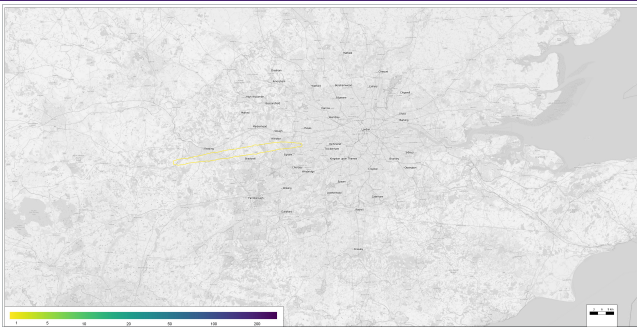


23:00 - 07:00

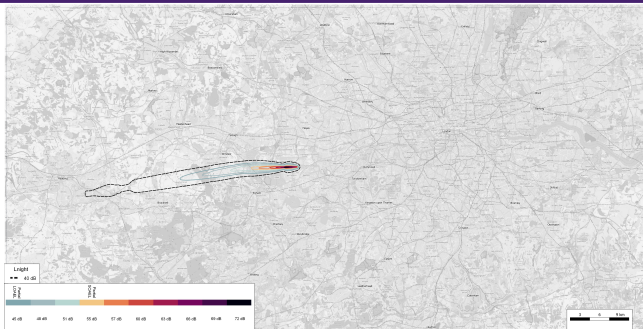
### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option C	
≥ 1	0	82,700	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	


### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option C	
≥ 1	0	100,800	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option C	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	27,400	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	7,700	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	600 (of which 500 brought out of Partial LOAEL by Option)	100	7,600 (of which 2,400 brought into Partial LOAEL by Option)	
				



PBN Arrivals – RWY 09R Option D

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals capable of RNP-AR during the 0430-0600 period from BEDEK.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,000	+2,200
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	125,500	+125,500

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric <sup>1</sup>	Difference to Baseline
Track Miles of the routes used (nm)	-1

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	20km <sup>2</sup>	+20km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	4km <sup>2</sup>	+4km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	4	+4
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	8	+8

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



**General Aviation / Commercial Airlines – Economic impact from increased effective capacity**

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

**General Aviation / Commercial Airlines – Fuel Burn**

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

**Commercial Airlines – Training costs**

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

**Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs**

Option may require re-location and/or addition of Noise Monitoring Terminals.

**Commercial Airlines – Other costs**

None identified.

**Airport/ANSP – Operational costs**

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

**Airport/ANSP – Deployment costs**

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

**Safety**

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

**Adherence to AMS**

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

**Interdependencies, Conflicts & Trade-Offs**

Option not expected to interact with other airports' options.

**Outcome of PBN Arrival RWY09R Option D**

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

**OPTION CARRIED FORWARD TO STAGE 3**





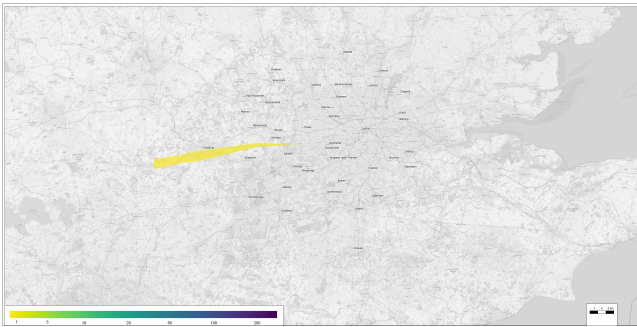
# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option D (Night)

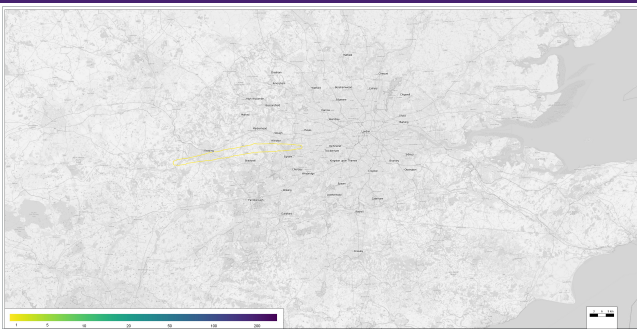


23:00 - 07:00

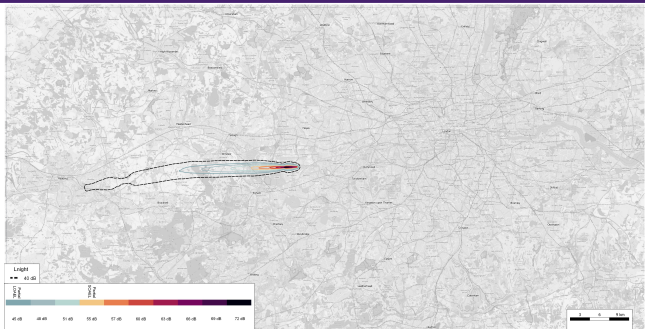
### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option D	
≥ 1	0	98,400	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	


### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option D	
≥ 1	0	125,500	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option D	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	34,500	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,000	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (of which 0 brought out of Partial LOAEL by Option)	0	8,000 (of which 2,200 brought into Partial LOAEL by Option)	
				





PBN Arrivals – RWY 09R Option E

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals during the 0430-0600 period from BEGTO.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,000	+2,200
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	112,900	+112,900

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-4

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	0km <sup>2</sup>	No change
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km <sup>2</sup>	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	4	+4
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	9	+9

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



## General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

## General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

## Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

## Commercial Airlines – Other costs

None identified.

## Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

## Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

## Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

## Safety

There are already PBN to ILS procedures published in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

## Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

## Interdependencies, Conflicts & Trade-Offs

Option not expected to interact with other airports' options.

## Outcome of PBN Arrival RWY09R Option E

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

## OPTION CARRIED FORWARD TO STAGE 3



# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option E (Night)



23:00 - 07:00

### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option E	
≥ 1	0	96,200	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option E	
≥ 1	0	112,900	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option E	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	55,800	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,000	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (of which 0 brought out of Partial LOAEL by Option)	0	8,000 (of which 2,200 brought into Partial LOAEL by Option)	



PBN Arrivals – RWY 09R Option F

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals capable of RNP-AR during the 0430-0600 period from BEGTO.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	9,100	+3,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	102,800	+102,800

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-7

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	0km <sup>2</sup>	No change
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km <sup>2</sup>	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	6	+6
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	10	+10

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.





**General Aviation / Commercial Airlines – Economic impact from increased effective capacity**

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

**General Aviation / Commercial Airlines – Fuel Burn**

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

**Commercial Airlines – Training costs**

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

**Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs**

Option may require re-location and/or addition of Noise Monitoring Terminals.

**Commercial Airlines – Other costs**

None identified.

**Airport/ANSP – Operational costs**

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

**Airport/ANSP – Deployment costs**

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

**Safety**

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

**Adherence to AMS**

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

**Interdependencies, Conflicts & Trade-Offs**

Option may result in conflicts/interdependencies with Gatwick's options.

**Outcome of PBN Arrival RWY09R Option F**

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

**OPTION CARRIED FORWARD TO STAGE 3**



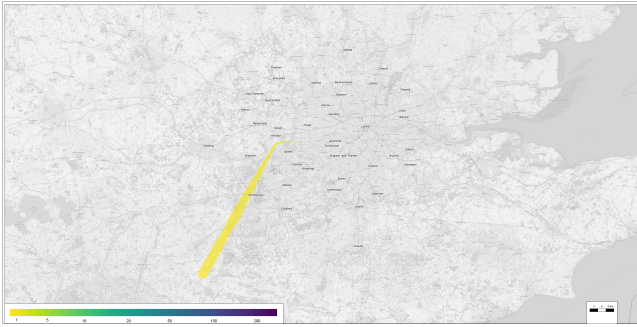
# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option F (Night)

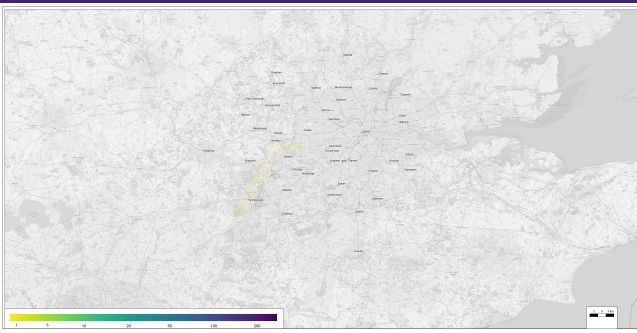


23:00 - 07:00

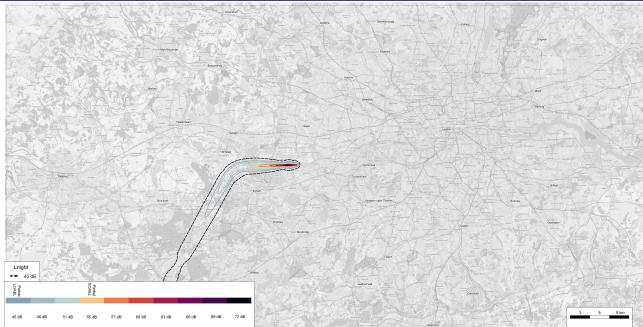
### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option F	
≥ 1	0	91,500	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	


### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option F	
≥ 1	0	102,800	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option F	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	56,000	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	9,100	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	600 (of which 600 brought out of Partial LOAEL by Option)	400	8,700 (of which 3,000 brought into Partial LOAEL by Option)	



PBN Arrivals – RWY 09R Option G

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals during the 0430-0600 period from ALESO.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,100	+2,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	136,900	+136,900

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-10

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	21km <sup>2</sup>	+21km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	3km <sup>2</sup>	+3km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	4	+4
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	9	+9

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



## General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

## General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

## Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

## Commercial Airlines – Other costs

None identified.

## Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

## Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

## Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

## Safety

There are already PBN to ILS procedures in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

## Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

## Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

## Outcome of PBN Arrival RWY09R Option G

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

## OPTION CARRIED FORWARD TO STAGE 3





# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option G (Night)



23:00 - 07:00

### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option G	
≥ 1	0	139,700	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option G	
≥ 1	0	136,900	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option G	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	57,900	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,100	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	0 (of which 0 brought out of Partial LOAEL by Option)	0	8,100 (of which 2,300 brought into Partial LOAEL by Option)	



PBN Arrivals – RWY 09R Option H

Option Description

This option was developed to address DP4. This option assumes a single PBN arrival track used for all RWY09R arrivals capable of RNP-AR during the 0430-0600 period from ALESO.



Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA <sub>eq</sub> , 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA <sub>eq</sub> , 8h)	8,000	+2,200
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	84,200	+84,200

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-20

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	13km <sup>2</sup>	+13km <sup>2</sup>
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	11km <sup>2</sup>	+11km <sup>2</sup>
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km <sup>2</sup>	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	6	+6
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	10	+10

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.



## General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

## General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)

Not able to quantify at this time, owing to uncertainty in new stack locations

## Commercial Airlines – Training costs

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

## Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

## Commercial Airlines – Other costs

None identified.

## Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

## Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

## Safety

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

## Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

## Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

## Outcome of PBN Arrival RWY09R Option H

All 09R PBN arrivals perform worse than the Baseline for noise metrics, since this runway is not routinely used for arrivals today.

Options that perform relatively well (i.e. when compared with each other) have been retained for further development at Stage 3.

## OPTION CARRIED FORWARD TO STAGE 3





# CAP1616 - INITIAL OPTIONS APPRAISAL – SUPPLEMENTARY METRICS

## PBN Arrivals – RWY 09R Option H (Night)



23:00 - 07:00

### Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option H	
≥ 1	0	102,800	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option H	
≥ 1	0	84,200	
≥ 5	0	0	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

### Noise Exposures

Population count	Baseline	Option H	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	16,300	35,900	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$ )	5,800	8,000	

### Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	600 (of which 600 brought out of Partial LOAEL by Option)	400	7,500 (of which 2,600 brought into Partial LOAEL by Option)	

