YOUR LONDON AIRPORT Gatwick

Redesign of Gatwick Route 4 RNAV SIDs

Design Principles Evaluation

CAA Ref: ACP-2018-86

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1 Introduction

1.1 Background

London Gatwick Airport (LGW) is the UK's second largest airport, handling over 100k metric tons of cargo and 46 million passengers annually. Destinations serviced by LGW include other UK regions, Europe, Canada, the Americas, Africa and the Far East.

The introduction of RNAV SIDs (Area Navigation Standard Instrument Departure) for Route 4 has been subject to regulatory and legal challenge since its original approval in 2013, when the CAA approved the introduction of RNAV procedures for all nine LGW departure routes. In 2015 the CAA conducted a Post Implementation Review and approved most of the routes for continued use but found that Route 4 had not delivered the aim of the airspace change and required the route to be modified. This work was completed, and LGW submitted an amended Route 4 proposal which was ratified by the CAA.

Subsequently, the community group 'Plane Justice' sought a judicial review to challenge the CAA's Post Implementation Review decision. Following a further detailed investigation, the CAA asked the court to quash their previous decision. As a result, Route 4 RNAV SIDs assumed a temporary status.

The purpose of this project is to submit a new application for RNAV1 performance-based navigation (PBN) Standard Instrument Departure (SID) Procedures for Route 4 departures at Gatwick Airport under the guidance and requirements of the CAA's new Airspace Change Process, CAP1616. This project is not connected in process to any previous airspace changes.

Route 4 is a departure route for aircraft taking off in a westerly direction from Runway 26 and then turning approximately 180° to track east just to the south of Reigate and Redhill in Surrey.

The objectives of this Airspace Change Proposal (ACP) are to design and implement new RNAV SIDs for Route 4 that:

- Improve further, where practicable, aircraft and passenger safety
- Limit and seek to reduce, where possible, the environmental impact on local communities in the vicinity of the Route 4 SIDs
- Enable further improvements in safety and noise reduction through the application of more efficient FASI-South[1] operating procedures and opportunities
- Provide long term predictability of flight paths.

This document aims to:

- Briefly explain the process followed in order to evaluate the design principles in accordance with CAP 1616
- Describe how the options have responded to the design principles

[1] FASI-South is the umbrella name for the programme to modernise the airspace structure and route network in Southern England. The programme is a collaborative initiative between 17 airports, and NATS as the UK's en route air navigation services provider (ANSP).

- Demonstrate the evaluation of the technical criteria of the design principles, and
- Forms part of the document set required as evidence by the CAA to satisfy the Stage 2 Develop & Assess Gateway.

1.2 Progress to Date- Stage 1

The CAP 1616 Stage 1 'Define Gateway' was successfully achieved on 27 September 2019. Stage 1 required us to engage with our stakeholders to identify a set of Design Principles that would guide the development of our design options for Route 4. Full details of Stage 1 and the documented output of that stage can be found on the CAA portal via this link https://airspacechange.caa.co.uk/PublicProposalArea?pID=111

Successful completion of the Define Gateway allowed LGW to progress to Stage 2 of the CAP1616 process, details of which can be found below in Section 2.

In order to develop the design principles, LGW engaged with a group of aviation and non-aviation stakeholders in order to ascertain their views using questionnaires and focus groups. Responses to the questionnaires were analysed and considered alongside all comments received during the focus groups. A document entitled Design Principles - Stakeholder Review was then sent to a large selection of stakeholders, including those who returned questionnaires and attended the focus groups.

The purpose of the stakeholder review document was to share the comprehensive list of design principles and propose a shortlist of design principles. The document also explained how the shortlist was initially prioritised, in accordance with the volume of comments received and requested stakeholder responses to 7 questions, including a question that asked if stakeholders agreed with the prioritisation. Stakeholders were asked to apply their own preference to the prioritisation of the design principle shortlist if they did not agree with the prioritisation.

The responses received were fewer and narrower than expected and, as such, the further prioritisation of design principles was considered to be a time-consuming exercise with extremely limited validity, even if a representative sample of all stakeholders were simultaneously available to participate in some of the more detailed methodologies available.

Full details of the process followed can be seen in in our Design Principles Report at Stage 1B on the CAA Airspace Portal via this link:
https://airspacechange.caa.co.uk/umbraco/Surface/PublicSurface/DownloadDocument/999

The work undertaken during Stage 1, and described above, helped to establish a shortlist of design principles to act as a framework against which design options have been developed. The list of design principles is shown in Table 1 below.

The option that is ultimately proposed must also be compliant with the relevant technical criteria as detailed in Appendix F to CAP 1616. Included in this document is an initial evaluation of how each developed option responds to the technical criteria, identifying where plans will need to be established to resolve any issues that may arise. This can be found at Section 6.

	Design Principle
1	Route 4 options will be designed safely with full regulatory compliance
2	Designs should be built to facilitate dispersion below 7000 ft
3	New Route 4 designs options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012
4	Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown
5	Designs should seek to minimise the impact of noise on particularly sensitive areas
6	Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes
7	Designs that seek to provide respite should not overfly previously unaffected populations
8	Route 4 designs should not be constrained by the existing NPR to 4000ft

Table 1 - Design Principles. Besides safety, the other options have no relative priority

2 CAP 1616 Stage 2

2.1 Introduction

The LGW Route 4 ACP is currently at Stage 2 – Develop & Assess stage of the CAP 1616 Airspace Change Process. Step 2A (Options Development) requires the change sponsor to develop a comprehensive list of options that address the Statement of Need and respond to the design principles developed through the two-way engagement process with LGW stakeholders during Stage 1. The comprehensive list of options is then qualitatively assessed against the Design Principles to complete Step 2A. Step 2B requires the Initial Options Appraisal of the remaining options against the Criteria contained in Table E2 of CAP1616.

2.2 Step 2A – Design Options Development

LGW developed a comprehensive list of options for the Route 4 SIDs; these options have been tested and developed with the help of our stakeholders via presentations and discussions at two focus groups. The first of these focus groups, was held on the 30 October 2019 and the second on the 21 November 2019.

The emphasis of the first focus group was for LGW to share the comprehensive list of design options with stakeholders and to allow them the opportunity to influence draft design options for further development. It also allowed us to further understand our stakeholder's preferences ahead of undertaking more detailed design work. These views were recorded at the event and further feedback was received via email.

The second focus group gave our stakeholders the opportunity to view the comprehensive list of options both via a presentation and also on eight large A1maps containing an overview of the various options, the local Areas of Outstanding Natural Beauty (AONB), local towns, churches, schools etc. and allowed our stakeholders to highlight on these maps their own places of interest and to bring those to the attention of the LGW airspace team. Alongside these maps, we provided an Ordnance Survey (OS) map with acetate overlays depicting all the various options for comparisons to be made by the stakeholders.

Our comprehensive list of options is described in Section 3 which also gives an overview of our design methodology and the rationale for our longlist of design options that are currently under consideration following the engagement activities with local stakeholders.

2.3 Step 2A - Design Principle Evaluation

Step 2A also requires us to evaluate our post-engagement design options against the Design Principles. Section 5 contains our Design Principle Evaluation of the longlist of options.

For the purposes of the Design Principles assessment, and specifically with reference to Design Principle 3, *New Route 4 designs options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012*, the term 'historic route' refers to the Route 4 Conventional SIDs in place between December 1999 and 2013 prior to the introduction of the RNAV-1 SIDs in November 2013.

2.4 Step 2B – Options Appraisal

The second part of Stage 2 (Step 2B) involves a formal appraisal of the options against the criteria of CAP1616 Table E2 in order to develop a short list to be taken forward to public consultation in Stage 3. Options Appraisal is used as a tool throughout the CAP1616 process to help refine the options from an initial longlist, down to a short list and a final set of preferred options. The process is iterative with the Initial Options Appraisal being used to refine the longlist in Stage 2B and it must consist of the following elements:

- High-level objective and assessment criteria
- Baseline description, i.e. the 'do nothing' option
- Comprehensive list of options
- Shortlist of options
- Preferred option.

Our Initial Options Appraisal, and a description of the shortlist taken forward to Stage 3 is available at Step 2B of the CAA Airspace Change Portal

2.5 Next steps

At the end of Step 2B, LGW will submit this Design Principles Evaluation document, along with the Option Development document and the Initial Options Appraisal, to the CAA for assessment at the Stage 2 Develop & Assess Gateway, currently programmed for 28 February 2020.

A Full Options Appraisal, including environmental and economic assessment of the shortlist will take place in Stage 3 in preparation for public consultation. The Final Options Appraisal supporting the submission of the ACP application to the CAA will take place at Stage 4.

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3 Comprehensive List of Options

3.1 Introduction

In accordance with CAP1616 LGW has developed a comprehensive list of options, guided by the design principles to meet our objectives developed in Stage 1. The Statement of Need and the Design Principles can be found on the CAA Airspace Change Portal at Step 1A and 1B respectively.

3.2 Comprehensive list of Design Options

It is critical that the initial comprehensive list of options is shared with the same stakeholders as in Stage 1 in order to allow those stakeholders to influence and shape this list into a longlist of options which can be evaluated against the design principles and ensure compliance with the required technical criteria.

The comprehensive list is shown in Table 2 below; these were shown to the stakeholders at the focus groups held on 30 October and 21 November 2019. A full list of the stakeholders invited, those who responded and those who attended each of these focus groups can be seen alongside this document on the CAA Airspace Change Portal

OPTION	OPTION DESCRIPTION	FEATURE
A	Wraparound south after take-off	• Conflict with Route 9 • Runway approach centreline crossing
B	Extension west on centreline after take-off (no turn below 4000ft)	• Conflict with Route 1 • Significant constraints of departure flows - delays • Increase in noise impact on extended centreline
C	Track further north after take-off	• Gatwick airport airspace constraints • Interaction with Heathrow • Increasing levels of residential housing
D	Offset departure north (22° turn immediately on departure)	• Aircraft would have to track south east following the turn to re-intercept the outbound track • Increase in track miles • Gatwick airport airspace constraints
E	Offset departure south (22° turn immediately on departure)	• Increase in track miles • New areas of population would be overflown • Respite not supported during initial engagement • Gatwick airport airspace constraints
0	Fly-by Fly-by LAM2X	• Current temporary status of Route 4 (as flown in 2018/20)
1	Fly-by Fly-by LAM1X	• Turn by KKW04 not below 2500ft
2	Fly-over Fly-by	• As per LAM2X but DIRECT SUNAV and no southerly track adjustment
3	Fly-by KKE09 & Fly-by KKE11	• Fly-by fly-by at multiple waypoints for dispersion
4	Fly-over Fly-by	• Multiple turn points with dispersion in the turn
5	Fly-by Fly-by	• Similar track across the ground as Option 3 but with a lower speed with a turn common to Option 4 above
6	Fly-over Fly-by	• Multiple turn points plus apparent dispersion in the turn
7	Constant Radius to fix	• Concentrated

Table 2 - Comprehensive List of Options [2]

2 An explanation of Fly-by/Fly-over way points can be found at Appendix A1.

Options A-E shown in Table 2 above were not taken forward because of the lack of support from the stakeholders, along with the stated safety issues, environmental constraints and proximity of other airports departure/arrival tracks. Full details are shown above against options A-E.

The longlist of options taken forward and supported by some or all stakeholders can be seen in Section 4 below.

4 Options Longlist

4.1 Options Summary

This section provides a description of the longlist of design options currently under consideration after undertaking engagement activities with local stakeholders; the detail can be seen in Table 3 below and full details of the options design methodology can be seen in paragraph 4.2.

These options were informed by the shortlisted design principles which are shown in section 1.2 and Table 1 above.

There are eight options in total, each of which are shown against an Ordnance Survey 1:50,000 background Map in Appendix A1. The nominal tracks are shown along with a representation of the area shaded in orange which is representative of the variation in overflight tracks given the proposed procedure design tool[3] used for each option.

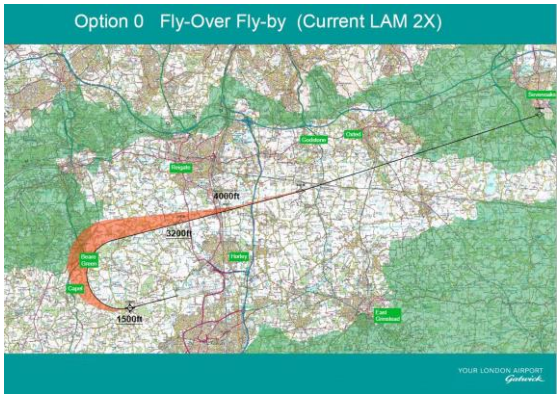
Option	Procedure	Basic Description	Action taken
0	Fly-over Fly-by LAM 2X	Fly over fly by at LAM2X, as per current flown	Taken forward to Stage 2B
1	Fly-by Fly-by LAM1X	Turn by KKW04 not below 2500ft	Taken forward to Stage 2B
2	Fly-over Fly-by	As per LAM2X but DIRECT SUNAV and no southerly track adjustment	Taken forward to Stage 2B
3	Fly-by KKE09 & Fly-by KKE11	Fly-by Fly-by at multiple waypoints for dispersion	Taken forward to Stage 2B
4	Fly-over Fly-by	Multiple turn points with dispersion in the turn	Taken forward to Stage 2B
5	Fly-by Fly-by, 2 90° turns	Similar track across the ground as #1 but with a lower speed	Taken forward to Stage 2B
6	Fly-over Fly-by	Multiple turn points with apparent dispersion in the turn	Taken forward to Stage 2B
7	Constant Radius to Fix	Concentrated	Taken forward to Stage 2B

Table 3 - Summary of Options Longlist

[3] Path Terminator ARINC 424 - ARINC 424 is a worldwide Standard for the navigation system database used by aircraft flight management systems to fly between waypoints in the proximity of airports.

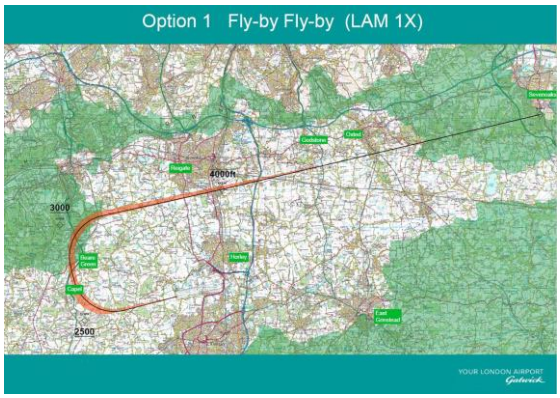
4.2 Detailed Description of the Options Longlist

4.2.1 Option 0



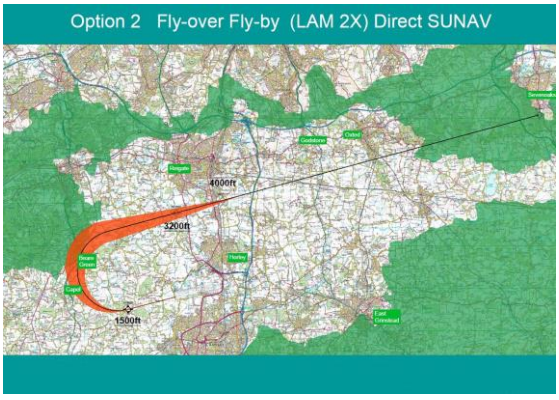
This is the currently flown LAM 2X Standard Instrument Departure (SID) as published in the UK AIP 2016. Following an initial fly-over waypoint (not below 1500ft max 220 KIAS) aircraft fly the turn using a Course to Fix Path Terminator that results in a degree of dispersion during the turn. For airspace, Way Point KKE09 is flown not below 3200ft and KKE11 not above 4000ft. The speed restriction of 220 KIAS is raised to 250 KIAS at WP KKE 11. Aircraft adjust track at KKE15 by 3° before routing to SUNAV at 5000ft.

4.2.2 Option 1



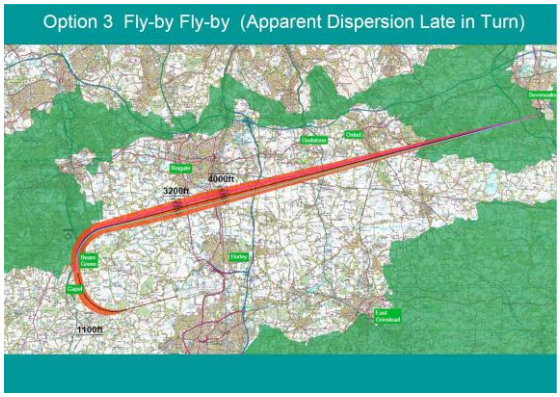
This was the previously published LAM 1X SID and was previously published in the UKAIP 2013. Aircraft fly straight ahead and make the first turn at KKW04 not below 2500ft. Two 90° turns at the fly-by waypoints KKW04 and KKN06 result in aircraft tracking 079° (True) following the turn. The turn is coded Track to Fix which results in a relatively small degree of dispersion in the turn. Aircraft must be below 4000ft at WP KKE14 where the speed restriction of 220 KIAS is raised to 250 KIAS. Aircraft remain on track 079° (True) to SUNAV at 5000ft.

4.2.3 Option 2



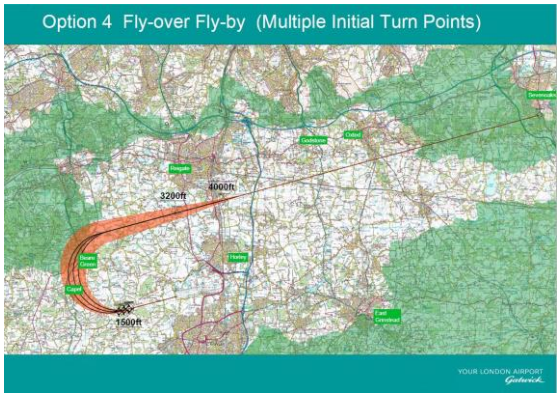
This option uses the same turn as described in Option 0, however, the track adjustment at KKE15 is removed and waypoint NEW 11 is placed on the course that aircraft would nominally roll out of the turn. WP NEW09 maintains the requirement for aircraft to be above 3200ft at a point abeam the original KKE09 and NEW 11 maintains the restriction of aircraft not climbing 4000ft at the point abeam KKE11. NEW11 lifts the speed restriction from 220 KIAS to 250 KIAS.

4.2.4 Option 3



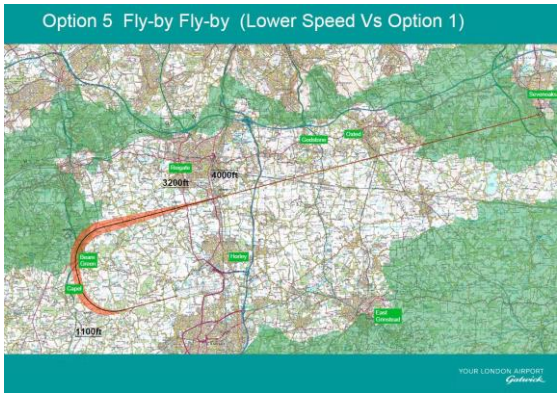
Aircraft fly straight ahead to KKXX01 and turn not below 1100ft. KKXX02 is the second of two 90° turns with a speed limit of 200 KIAS. Three waypoints are placed abeam each other at a distance of 278m with the intention of providing a degree of managed track dispersion. KKE 09 A, B and C provide different termination points for the paths following the turn although all are coded Course to Fix. This results in three courses being flown to different waypoints and these discreet paths are maintained to three waypoints KKE11 A, B C where the speed restriction of 220 KIAS is lifted to 250 KIAS and the three paths are coded Course to Fix to SUNAV at 5000 ft resulting in a gradual narrowing of the apparent dispersion.

4.2.5 Option 4



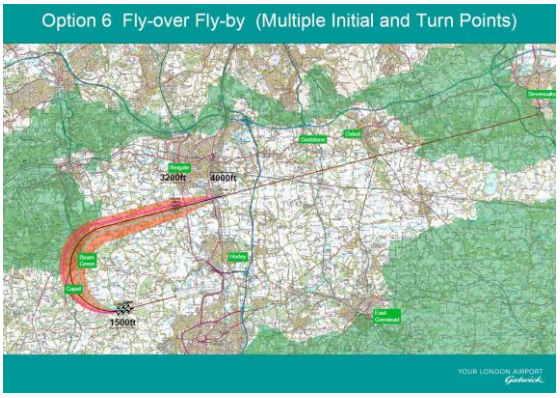
Option 4 utilises three initial turning points placed sequentially 400m apart. These waypoints are coded to ensure aircraft do not turn below 1500ft with the intention that there will be planned dispersion in the turn. The turn is designed to be flown with Course to Fix Path Terminators. Following the turn WP NEW09 maintains the requirement for aircraft to be above 3200ft at a point abeam the original KKE09 and NEW 11 maintains the restriction of aircraft not climbing 4000ft at the point abeam KKE11. NEW11 lifts the speed restriction from 220 KIAS to 250 KIAS.

4.2.6 Option 5



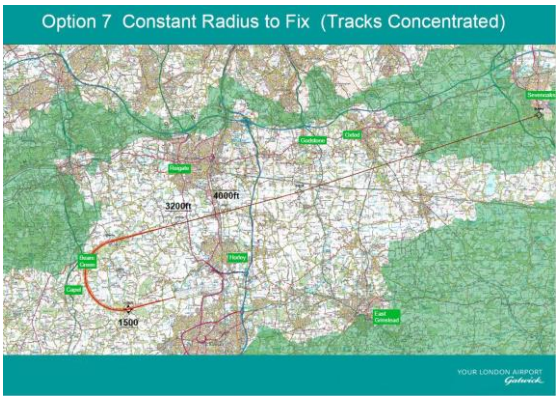
Option 5 uses the same methodology as option 1 which incorporates two 90° turns at fly-by waypoints followed by a direct track to SUNAV at 5000ft. The speed is reduced in the turn to 200 KIAS and this results in the waypoints being placed closer together, as a result the turn is completed to the south of that designed in Option 1. The 200 KIAS restriction is lifted to 250 KIAS at NEW12 creating a point of acceleration.

4.2.7 Option 6



This option is an amalgam of Options 3 and 4 and is expected to result in a degree of track dispersion in, and following, the turn. Option 6 brings the paths to a common waypoint at KK11A and from there a concentrated track of traffic to SUNAV at 5000ft utilising a Track to Fix Path Terminator, unlike the Course to Fix used in Option 3 which leads to a more gradual concentrating of the tracks closer to SUNAV.

4.2.8 Option 7



This option utilises a Constant Radius to Fix Path Terminator that will produce a concentrated track over the ground. KKW02 is coded as the first waypoint to ensure aircraft do not turn below 1500ft. Following the turn KKE09 and KKE11 fulfil the same function as described in Option 0 along with the track adjustment at KKE15 to SUNAV at 5000ft. Due the degree of concentration this the design will need further work ahead of the public consultation to more accurately depict a track over the ground that will minimise the numbers of peoples newly overflown. The indicative swathe depicted above and presented to key stakeholders demonstrated the level to which traffic is expected to be concentrated on such a design.

5 Design Principle Evaluation

5.1 Evaluation of the Options against the Design Principles

Each option has been assessed against the list of design principles shown in Table 1 in paragraph 1.1 above.

Table 4 below, and the individual 'Option' tables that follow, give an overview of how well each option aligns to each design principle; it shows a summary of the analysis conducted for each option with a high-level assessment of whether the design principle is either not met, partially met or fully met, as follows:

- A Light ORANGE box indicates that the specified option is **compliant** with or has no impact on the relevant technical criteria.
- An **ORANGE** box means that the specified option is **not fully compliant** with the relevant technical criteria, but mitigation is possible through agreed operating procedures or agreements.
- A **BROWN** box indicates that the specified option is **not compliant** with the relevant technical criteria and that there will be no possible plans available to mitigate the issue.

	Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
DP 1 - Route 4 options will be designed safely with full regulatory compliance.								
DP 2 - Designs should be built to facilitate dispersion below 7000 ft.								
DP 3 - New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.								
DP 4 - Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.								
DP 5 - Designs should seek to minimise the impact of noise on particularly sensitive areas.								
DP 6 - Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.								
DP 7 - Designs that seek to provide respite should not overfly previously unaffected populations.								
DP 8 - Route 4 designs should not be constrained by the existing NPR to 4000ft.								

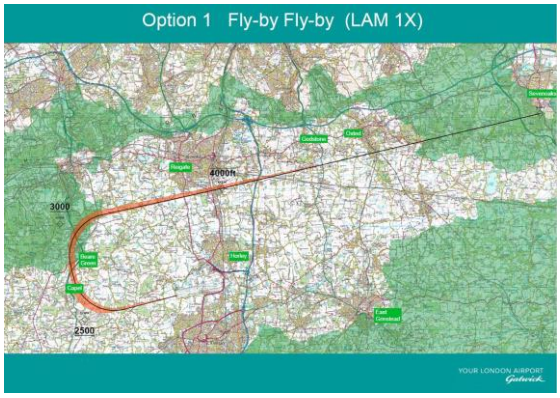
Table 4 - Design Principle Evaluation against Options

Design Principle Evaluation	**OPTION NO: 0**
Option Name: Fly-over, Fly-by Current LAM2X SID	ACCEPT

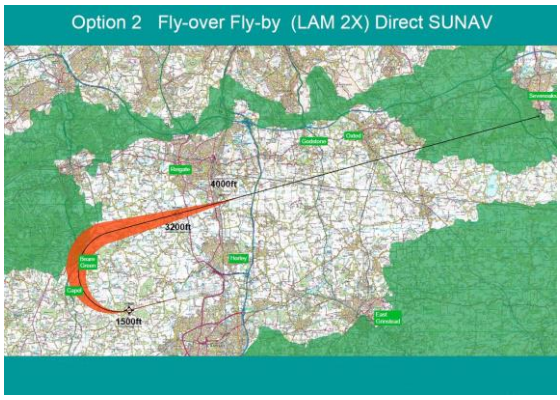
Description of Option: The current situation is included as an option for comparative purposes. The existing baseline for aircraft tracks is based on the temporary RNAV-1 SIDs which have been in place since May 2016.

Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design does facilitate dispersion below 7000ft, it has a course to fix turn which allows dispersion around the turn but not on the easterly track.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This particular design was introduced to closer reflect the traffic dispersion on the turn prior to the introduction of the 2012 P-RNAV and to correct the track so that aircraft flew along the published NPR.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design was introduced to closer reflect the traffic dispersion in the turn prior to the introduction of the 2012 P-RNAV and to correct the track so that aircraft flew along the published NPR. As with all dispersed designs it does not seek to minimise the number of people newly overflown.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design minimises the impact of noise on particularly sensitive areas but does overfly a portion of the AONB, so we believe it only partially meets this DP.			

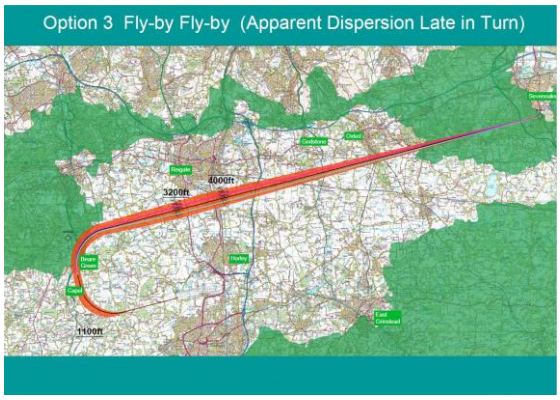
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure was designed to conform with the published NPR.			

Design Principle Evaluation			**OPTION NO: 1**
Option Name: Fly-by Fly-by LAM1X			ACCEPT
Description of Option: This SID was previously published in the UK AIP between 14 November 2013 – 25 May 2016. Two 90° turns. Climb straight ahead on RW heading for 4nm climbing not below 2500ft. Turn right heading 347.5° for 4.1nm. Turn right heading 079.7° T for 6.9nm climbing not above 4000ft. Then route direct SUNAV not above 5000ft.			
Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure will not facilitate dispersion below 7000ft.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: While this design does not specifically take the historic routings into consideration it does track further to the north on its easterly track akin to the historic routing.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design moves the track closer to Reigate which is currently unaffected.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design reduces the swathe of the traffic to minimise the impact on the AONB, as far as is practicable; however, the track is further north and closer to Reigate.			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET

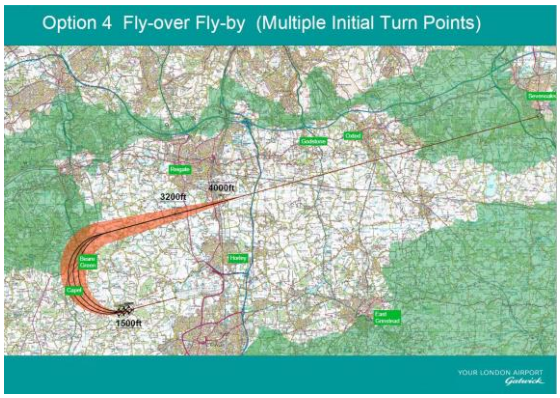
Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

Design Principle Evaluation			**OPTION NO: 2**
Option Name: Fly-over Fly-by (as Option 0 but DIRECT SUNAV)			ACCEPT
Description of Option: This SID, whilst using the same turn as Option O has no southerly track adjustment. Climb straight ahead for 2nm not below 1500ft. Turn right heading 077.1^0 T climbing not above 3200 ft. Continue heading and climb not above 4000 ft then route direct to SUNAV.			
Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to introduce dispersion below 7000ft in the turn but concentrates traffic on the easterly leg.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed with due regard for the historic routings in use prior to the introduction of RNAV routes in 2012. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013, prior to the introduction of the RNAV-1 SIDs in 2013. This option flies direct to SUNAV following the turn.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design was introduced to closer reflect the traffic dispersion prior to the introduction of the 2012 P-RNAV. Following the turn aircraft will route direct to SUNAV and will not correct onto the existing NPR which may impact previously unaffected population.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design minimises the impact of noise on particularly sensitive areas but does overfly a portion of the AONB, so we believe it only partially meets this DP.			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET

Summary of Qualitative Assessment: With the modernisation of airspace, through FASI_S, it is expected that the future air traffic situation will allow departing traffic to be given clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

Design Principle Evaluation			**OPTION NO: 3**
Option Name: Fly-by Fly-by LAM1X			ACCEPT
Description of Option: Climb straight ahead for 3.8nm not below 1100ft. Turn right to track 347.5⁰T for 3.5nm. Turn right to track 077.6⁰T for 4.7nm climbing to not below 3200ft. Maintain track 077.6⁰T for 2nm climbing not above 4000ft then route direct SUNAV.			
Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The design facilitates dispersion late in the turn and creates dispersion along the easterly track and so partially meets this DP.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed with due regard for the historic (pre-2013) traffic routing. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013 prior to the introduction of the RNAV-1 SIDs in 2013.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure has been designed to minimise the adverse impact of noise to *some* previously unaffected populations by introducing dispersion following the turn.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The design will minimise the impact of noise on particularly sensitive areas.			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET

Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

Design Principle Evaluation			**OPTION NO: 4**
Option Name: Fly-over Fly-by Multiple turn points.			ACCEPT
Description of Option: This option utilises three initial turn points placed sequentially 400m apart. Climb straight ahead for 2nm not below 1500ft. Turn right onto course 077.1°T, not below 3200ft. Continue on track for 2nm not above 4000ft and then route direct SUNAV.			
Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This option has been designed to allow dispersion below 7000ft through the use of three sequential turn points positioned on the initial climb but concentrates traffic along the easterly leg.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed with due regard for the historic routings in use prior to the introduction of RNAV routes in 2012. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013 prior to the introduction of the RNAV-1 SIDs in 2013.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This option has been designed to minimise the adverse impact of noise on previously unaffected populations by the utilisation of dispersion in the turn, similar to the pre 2013 P-RNAV.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The design will minimise the impact of noise on particularly sensitive areas wherever practicable. However, due to the multiple initial turn points, areas of the AONB are newly overflown.			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET

Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

Design Principle Evaluation	**OPTION NO: 5**
Option Name: Fly-by Fly-by - speed reduced from Option 1	ACCEPT

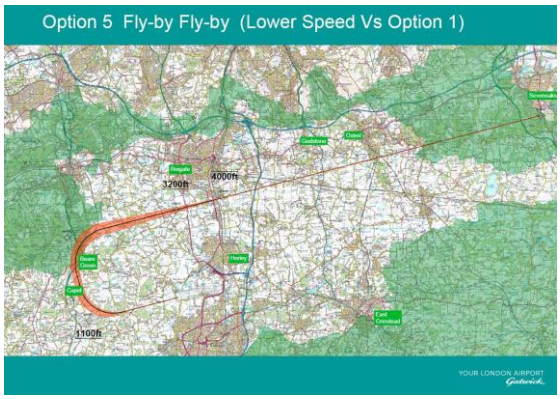
Description of Option: Using the same methodology as option1, incorporating 2 90° turns at fly-by waypoints followed by a direct track to SUNAV at 5000ft.

Climb straight ahead for 3.8nm not below 1100ft.

Turn right to track 347.5⁰ T for 3.5nm.

Turn right to track 077.6⁰ T for 4.7nm not below 3200ft.

Maintain 077.7⁰ T for 2nm, climbing to not above 4000ft and then fly direct SUNAV.



Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure will not facilitate dispersion below 7000ft.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed with due regard for the historic routings in use prior to the introduction of RNAV routes in 2012. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013 prior to the introduction of the RNAV-1 SIDs in 2013.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure has been designed in order to minimise the adverse impact of noise on previously unaffected populations by the utilisation of dispersion in the turn, similar to the pre 2013 P-RNAV. It is also flown at a lower speed.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: As this design is flown at a lower speed and therefore has a tighter turn it will minimise the impact of noise on particularly sensitive areas in comparison to option 1			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET

Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

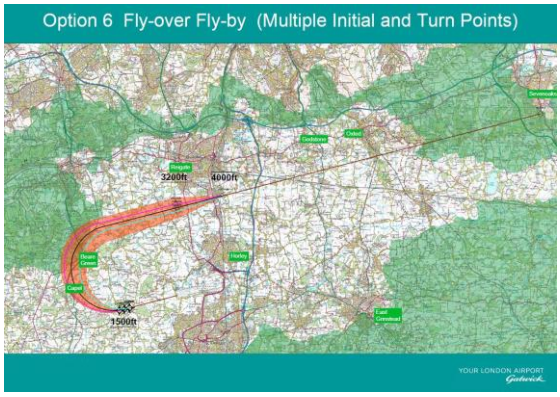
Design Principle Evaluation	**OPTION NO: 6**
Option Name: Fly-over Fly-by Multiple turn points.	ACCEPT

Description of Option: This is an amalgamation of options 3 and 4 resulting in systemised dispersion in, and following, the turn. The multiple courses, that comprise the design, described below are designed specifically to create dispersion.

Climb straight ahead for 2nm not below 1500ft.

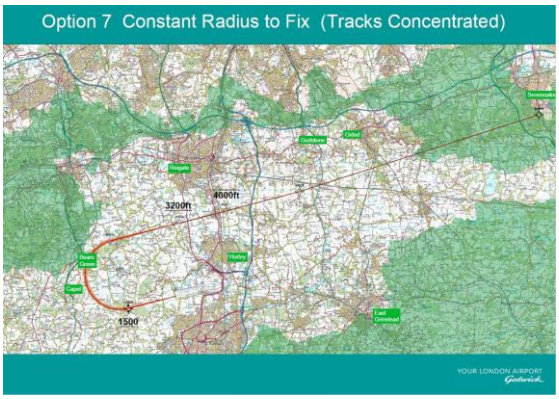
Turn right on to course 078.^{0}T, 077.5^{0}T, 077.7^{0}T (these are the multiple turn points) climbing to not below 3200ft.

Continue climb to not above 4000ft and then fly direct SUNAV.



(Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed using multiple tracks to create dispersion below 7000ft but concentrates traffic on the easterly leg.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed with due regard for the historic routings in use prior to the introduction of RNAV routes in 2012. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013 prior to the introduction of the RNAV-1 SIDs in 2013.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure has been designed to create wider dispersion during the first turn and moves the track closer to Reigate which is likely to impact populations currently unaffected.			

Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Due to the degree of dispersion this design will have a noise impact within the AONB, but this is kept to a minimum as far as practicable.			
Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design is not constrained by the existing NPR to 4000ft.			

Design Principle Evaluation			**OPTION NO: 7**
Option Name: Constant Radius to Fix			ACCEPT
Description of Option: This can be expected to produce concentrated tracks throughout the turn. Following the turn, KKE09 and KKE11 fulfil the same function as described in option 0. Climb straight ahead on Runway heading for 2nm climbing not below 1500ft. At KKW02 Fly constant radius fixed on Waypoint (TBN) to Waypoint (End Fix). Route via KKE09, KKE11 and KKE15 to SUNAV not above 5000ft.			
Design Principle 1: Route 4 options will be designed safely with full regulatory compliance.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The procedure has been designed to meet acceptable levels of flight safety by ensuring all tracks are designed to PANS-OPS criteria.			
Design Principle 2: Designs should be built to facilitate dispersion below 7000 ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design does not facilitate dispersion below 7000ft. It has been designed as constant radius to fix which, by design, concentrates aircraft tracks.			
Design Principle 3: New Route 4 design options should give due regard to the historic routings in use prior to the introduction of RNAV routes in 2012.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This route is designed to conform with the NPR and thus does not track very close to, or with the dispersion in the first turn that was evident with the historic traffic routing. The term 'historic route' refers to the Route 4 Conventional Standard Instrument Departures (SIDs) in place between December 1999 and November 2013 prior to the introduction of the RNAV-1 SIDs in 2013.			
Design Principle 4: Route 4 designs should seek to minimise the adverse impact of noise on previously unaffected populations and seek to reduce the total number of people overflown.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This procedure has been designed to align with the existing temporary RNAV-1 SIDs (Option 0) and thus minimise the adverse impact of noise on previously unaffected populations.			
Design Principle 5: Designs should seek to minimise the impact of noise on particularly sensitive areas.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: The design of option 7 will minimise the impact of noise on particularly sensitive areas, such as the AONB, by using a concentrated track			

Design Principle 6: Route 4 designs should enable transition to a vertical profile that allows an efficient, and potentially faster, climb to higher altitudes.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: With the modernisation of airspace, through FASI-S, it is expected that the future air traffic situation will allow departing traffic to be issued a clearance to climb above the designed altitude limits. Until that time, departing traffic will be issued a clearance to climb initially to not above 4000ft. Further climb to not above 7000ft will be issued, where the air traffic situation allows as soon as is practicable.			
Design Principle 7: Designs that seek to provide respite should not overfly previously unaffected populations.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: Not applicable as none of these options were designed to provide any respite in accordance with the wishes of the stakeholders engaged during CAP 1616 Step 1A/B.			
Design Principle 8: Route 4 designs should not be constrained by the existing NPR to 4000ft.	NOT MET	PARTIAL	MET
Summary of Qualitative Assessment: This design closely follows the nominal track of the existing NPR to 4000ft.			

6 Technical Criteria Evaluation of Design Options

6.1 Technical Criteria Evaluation

The technical criteria detailed in Appendix F to CAP 1616 form the basic structure on which the change sponsor builds a formal airspace change proposal. The tables in this section show how each of the developed options complies with the technical criteria detailed in the first column of the table, identifying where plans will need to be established to resolve any issues that may arise, as follows:

- A LIGHT ORANGE box indicates that the specified option is **compliant** with or has no impact on the relevant technical criteria.
- An ORANGE box means that the specified option is **not fully compliant** with the relevant technical criteria, but mitigation is possible through agreed operating procedures or agreements.
- A BROWN box indicates that the specified option is **not compliant** with the relevant technical criteria and that there will be no possible plans available to mitigate the issue.

6.2 Route 4 RNAV Standard Instrument Departures

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
Operational Impact									
	An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:	**Evidence of compliance/ mitigation**							
a	Impact on IFR general air traffic and operational air traffic or on VFR General Aviation (GA) traffic flow in or through the area								
b	Impact on VFR operations (including VFR routes where applicable)								
c	Consequential effects on procedures and capacity, i.e. on SIDs, STARs, and/or holding patterns. Details of existing or planned routes and holds	[4]		[4]	[4]	[4]	[4]	[4]	
d	Impact on aerodromes and other specific activities within or adjacent to the proposed airspace								
e	Any flight planning restrictions and/or route requirements								
Supporting Infrastructure/Resources									
	General Requirements	**Evidence of compliance/ mitigation**							

[4] Because of the dispersion designed within these options, this may lead to reduced departure separation and will also increase ATCO workload.

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
a	Evidence to support RNAV and conventional navigation as appropriate								
b	Evidence to support primary and secondary surveillance radar (SSR)								
c	Evidence of communications infrastructure including R/T coverage								
d	The effects of failure of equipment, procedures and/or personnel with respect to the overall management of the airspace must be considered	5	5	5	5	5	5	5	5
e	Effective responses to the failure modes that will enable the functions associated with airspace to be carried out	5	5	5	5	5	5	5	5
f	A clear statement on SSR code assignment requirements								
g	Evidence of sufficient numbers of suitably qualified staff required to provide air traffic services following the implementation of a change								
Airspace and Infrastructure									
	General Requirements	**Evidence of compliance/ mitigation**							
a	The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments								

[5] This will be addressed through the Safety Case.

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
b	Where an additional airspace structure is required for radar control purposes, the dimensions shall be such that radar control manoeuvres can be contained within the structure, allowing a safety buffer.								
c	The Air Traffic Management system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures								
d	Air traffic control procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures								
e	Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable								
f	There must be assurance, as far as practicable, against unauthorised incursions. This is usually done through the classification and promulgation								
g	Pilots shall be notified of any failure of navigational facilities and of any suitable alternative facilities available and the method of identifying failure and notification should be specified								
h	There must be sufficient R/T coverage to support the Air Traffic Management system within the totality of proposed controlled airspace								

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
i	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	6	6	6	6	6	6	6	6
j	Should there be any other aviation activity (low flying, gliding, parachuting, microlight site, etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests								
	ATS Route Requirements	**Evidence of compliance/ mitigation**							
a	There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources, to contain the aircraft within the route to the published RNP value in accordance with ICAO/Eurocontrol standards								
b	Where ATS routes adjoin terminal airspace there shall be suitable link routes as necessary for the ATM task								
c	All new routes should be designed to accommodate P-RNAV navigational requirements								
	Terminal Airspace Requirements	**Evidence of compliance/ mitigation**							
a	The airspace structure shall be of sufficient dimensions to contain appropriate procedures, holding patterns and their associated protected areas								

[6] Liaison with London Biggin Hill Airport will be required. Terminal Control may need to review the Epsom LOA.

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
b	There shall be effective integration of departure and arrival routes associated with the airspace structure and linking to designated runways and published instrument approach procedures (IAPs)								
c	Where possible, there shall be suitable linking routes between the proposed terminal airspace and existing en-route airspace structure								
d	The airspace structure shall be designed to ensure that adequate and appropriate terrain clearance can be readily applied within and adjacent to the proposed airspace								
e	Suitable arrangements for the control of all classes of aircraft (including transits) operating within or adjacent to the airspace in question, in all meteorological conditions and under all flight rules, shall be in place or will be put into effect by the change sponsor upon implementation of the change in question (if these do not already exist)								
f	The change sponsor shall ensure that sufficient visual reference points are established within or adjacent to the subject airspace to facilitate the effective integration of VFR arrivals, departures and transits of the airspace with IFR traffic								
g	There shall be suitable availability of radar control facilities								
h	All new procedures should, wherever possible, incorporate Continuous Descent Approach (CDA) profiles after aircraft leave the holding facility associated with that procedure								
	Off-Route Airspace Requirements	**Evidence of compliance/ mitigation**							

		Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
a	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered	6	6	6	6	6	6	6	6
b	Should there be any other aviation activity (military low flying, gliding, parachuting, microlight site etc) in the vicinity of the new airspace structure and no suitable operating agreements or air traffic control procedures can be devised, the change sponsor shall act to resolve any conflicting interests								

Environmental Assessment

	Theme	Content	Evidence of compliance/ mitigation							
a	Assessment of noise impacts	Consideration of noise impacts								
b	Assessment of CO_2 emissions	Consideration of the impacts on CO_2 emissions								
c	Assessment of local air quality	Consideration of the impacts on local air quality								

			Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7
d	Assessment of impacts upon tranquillity	Consideration of any impact upon tranquillity, notably on AONB or National Parks	7	7	7	7	7	7	7	

Table 5 - Technical Criteria Evaluation of Standard Instrument Departures.

[7] Route overflies Surrey Hills AONB during initial departure turn.

A1 Waypoints

A1.1 Explanation of Waypoints

Some procedures are constructed of a series of waypoints designed to be flown by the automatic systems that the majority of modern aircraft use for navigation. A waypoint is defined positionally by its Latitude and Longitude, and generally will not necessarily represent a physical feature on the ground but will be positioned so that the routes designed can be technically flyable by the aircraft. Some waypoints describe the point at which the route integrates with the national airways structure. The aircraft navigation systems will automatically direct the aircraft according to the routing designed into the procedure.

If a waypoint is designated a 'Fly-By' waypoint, the aircraft will initially be heading in the direction of the waypoint but the aircraft will anticipate a point in space to turn, so that the aircraft ends up heading directly towards the next waypoint in sequence, as shown in Figure 1 below. Depending on the angle of turn, the aircraft may not overfly the actual waypoint at all. In addition, the actual flight path that an aircraft follows during these turns will vary slightly depending on the flight performance of each aircraft, creating a small amount of dispersion of aircraft tracks during the turn. Some of the waypoints used for the LGW procedure designs are designated as 'Fly-By' waypoints.

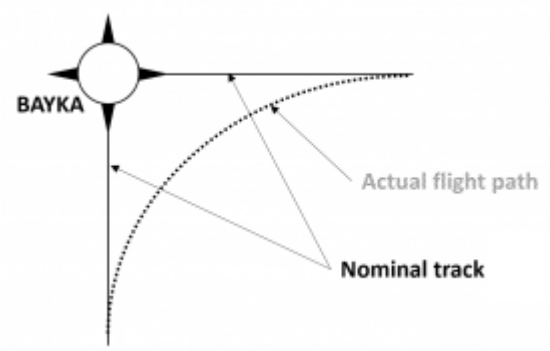


Figure 1 - Fly-By Waypoint

If a waypoint is designated a 'Fly-Over' waypoint, the aircraft navigational system will direct the aircraft to overfly the position of the waypoint prior to making the turn towards the next waypoint. The navigational system will make any heading adjustments back to the nominal track between the waypoints before directing the aircraft to the next waypoint, as shown in Figure 2 below.

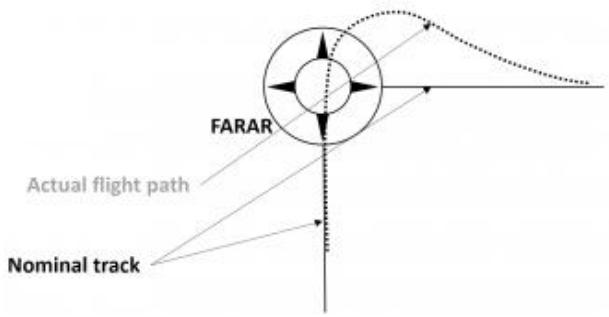


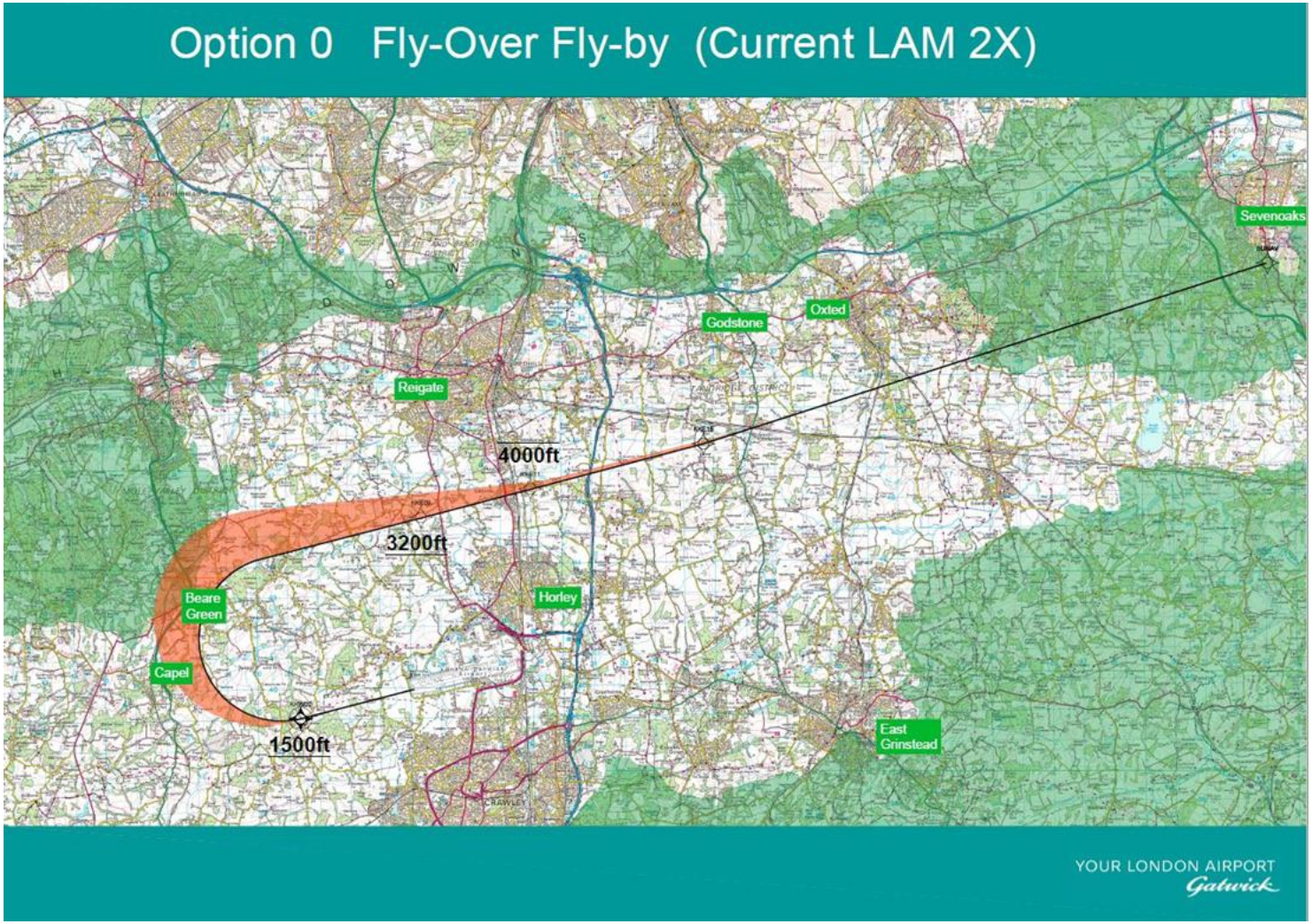
Figure 2 - Fly-Over Waypoint

A2 Ordnance Survey Maps of Design Options

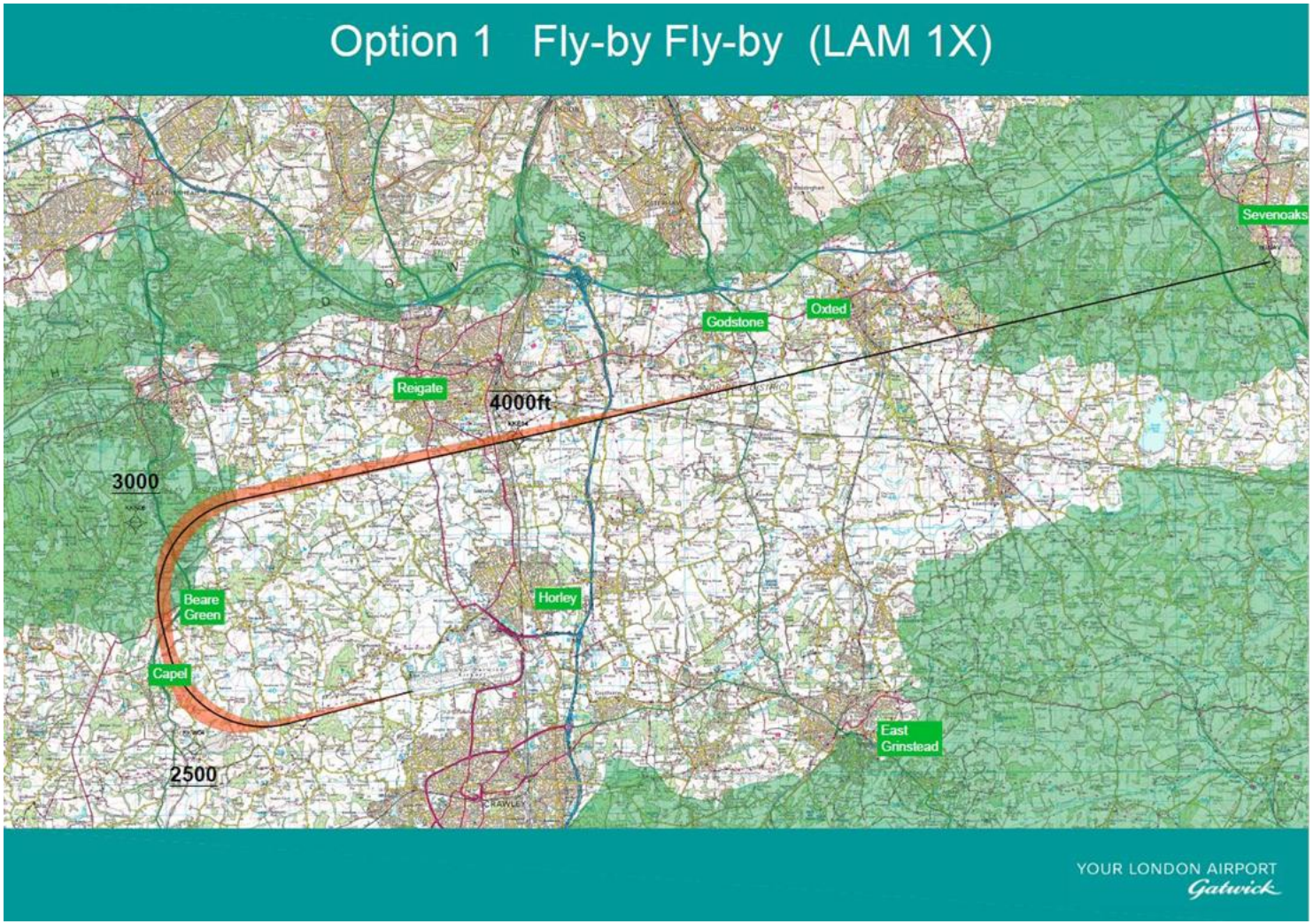
The following pages show the draft design options presented at the engagement events. These draft design slides were used to explain the features of each design and facilitate a 2-way discussion so invited stakeholders could understand the impact of each option and how each option has been developed from the design principles previously shared with stakeholders.

These slides were provided to stakeholders following the engagement events to allow then to return the feedback presented in this document.

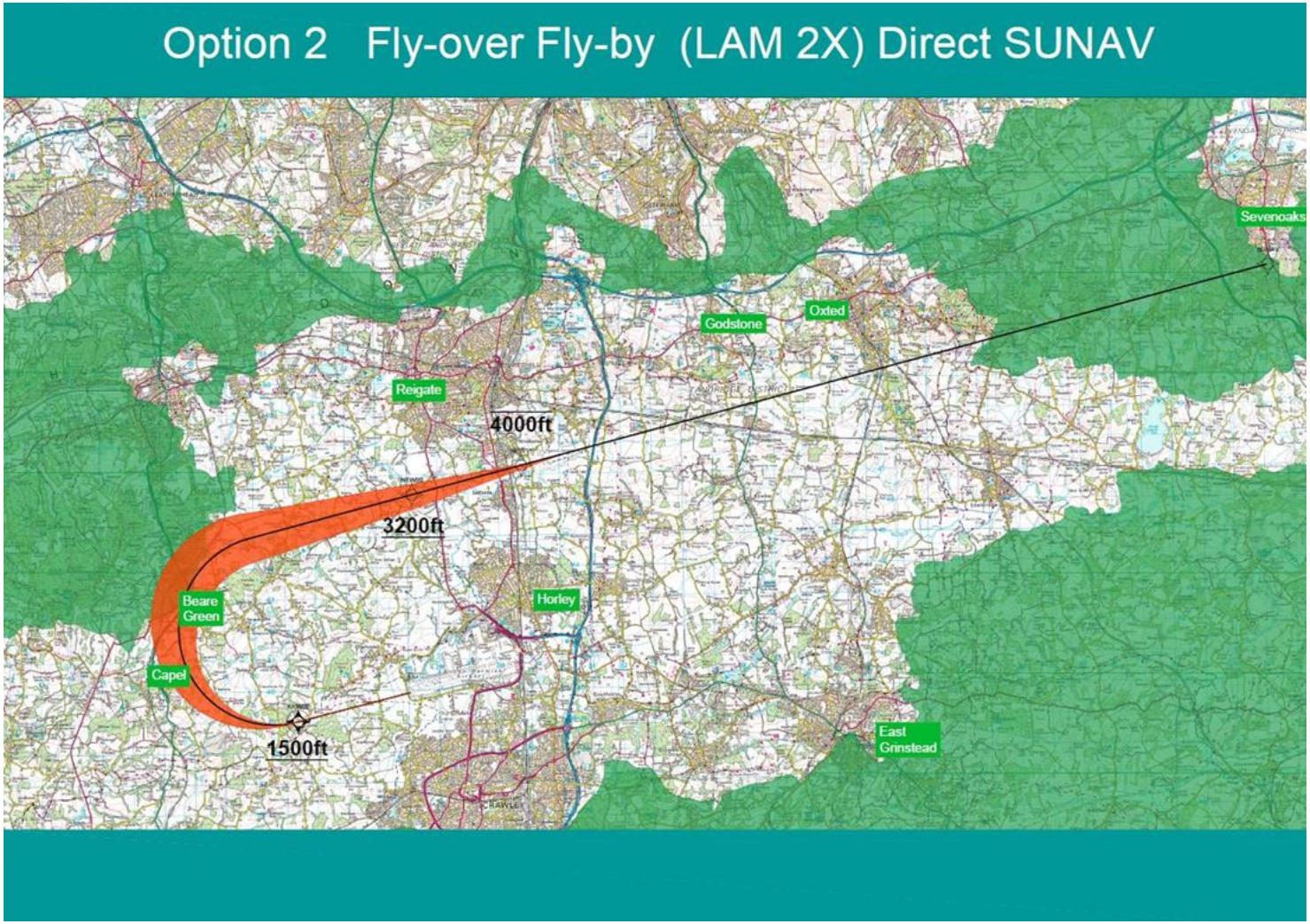
A2.1 Option 0


Option 0 Fly-Over Fly-by (Current LAM 2X)
Sevenoaks
Godstone
Oxted
Reigate
4000ft
3200ft
Beare Green
Horley
Capel
1500ft
East Grinstead
YOUR LONDON AIRPORT Gatwick

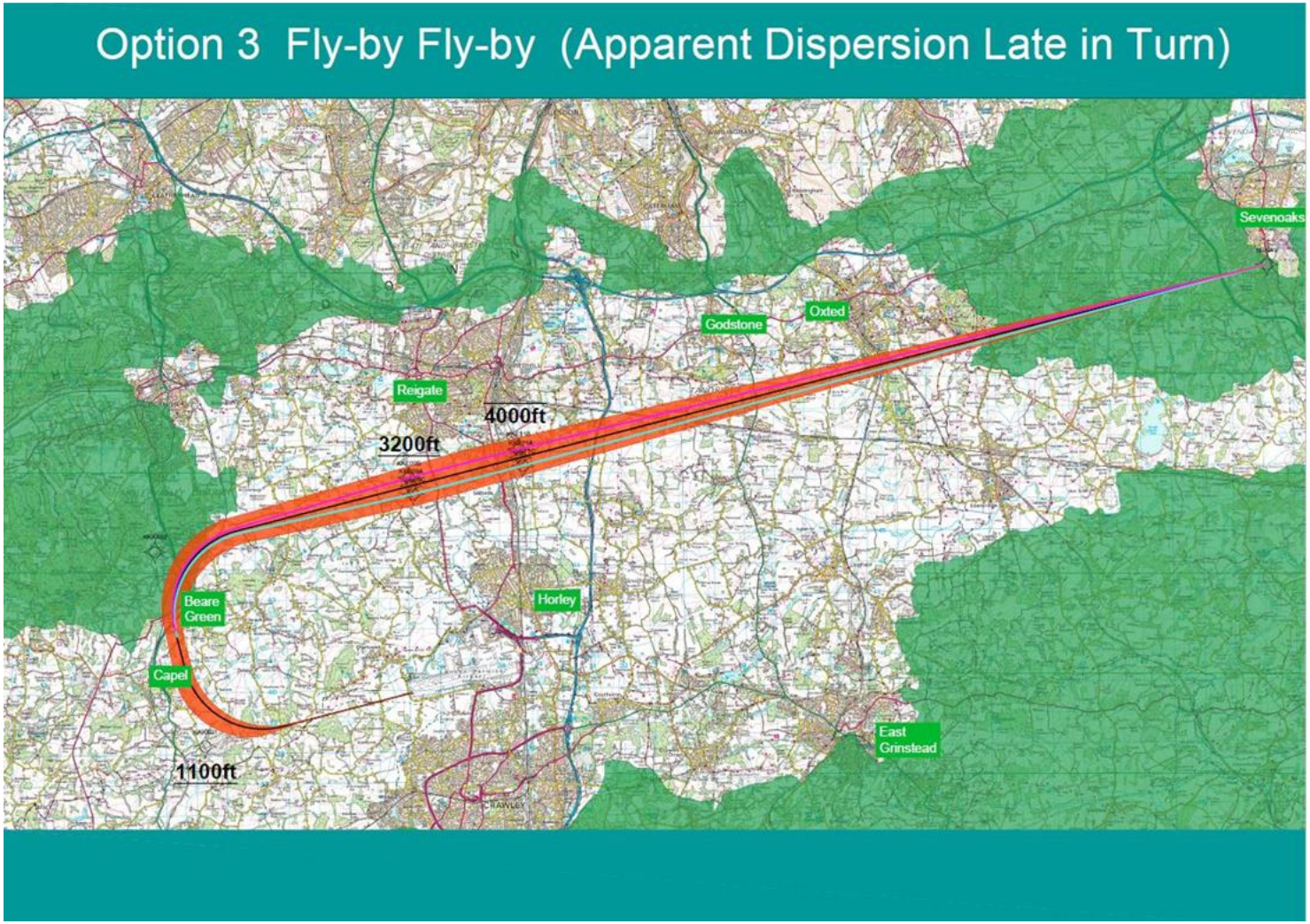
A2.2 Option 1


Option 1 Fly-by Fly-by (LAM 1X)
Sevenoaks
Oxted
Godstone
Reigate
4000ft
3000
Beare Green
Capel
Horley
East Grinstead
2500
YOUR LONDON AIRPORT Gatwick

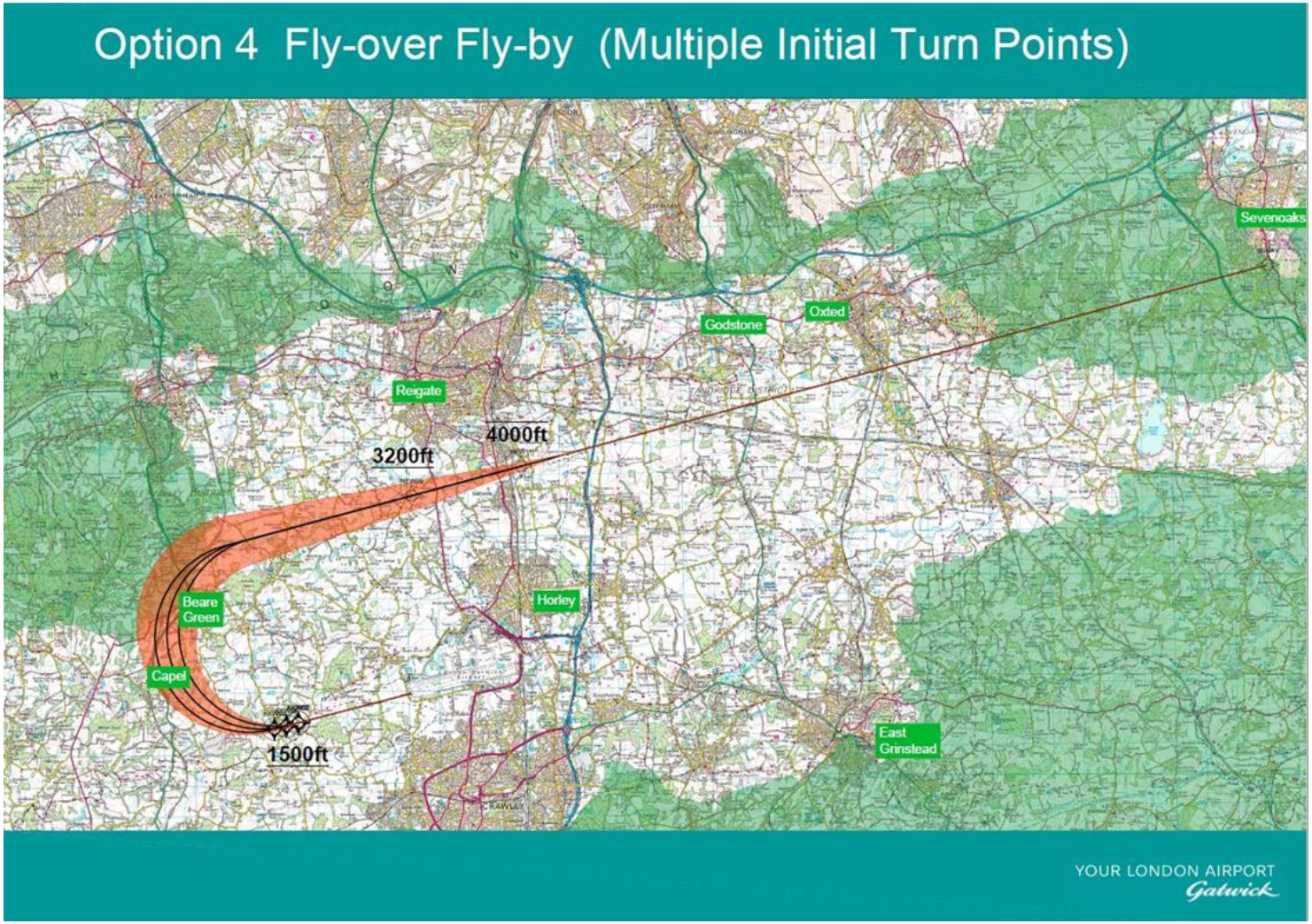
A2.3 Option 2


Option 2 Fly-over Fly-by (LAM 2X) Direct SUNAV
Sevenoaks
Godstone
Oxted
Reigate
4000ft
3200ft
Beare Green
Horley
Capel
1500ft
East Grinstead
CRAWLEY

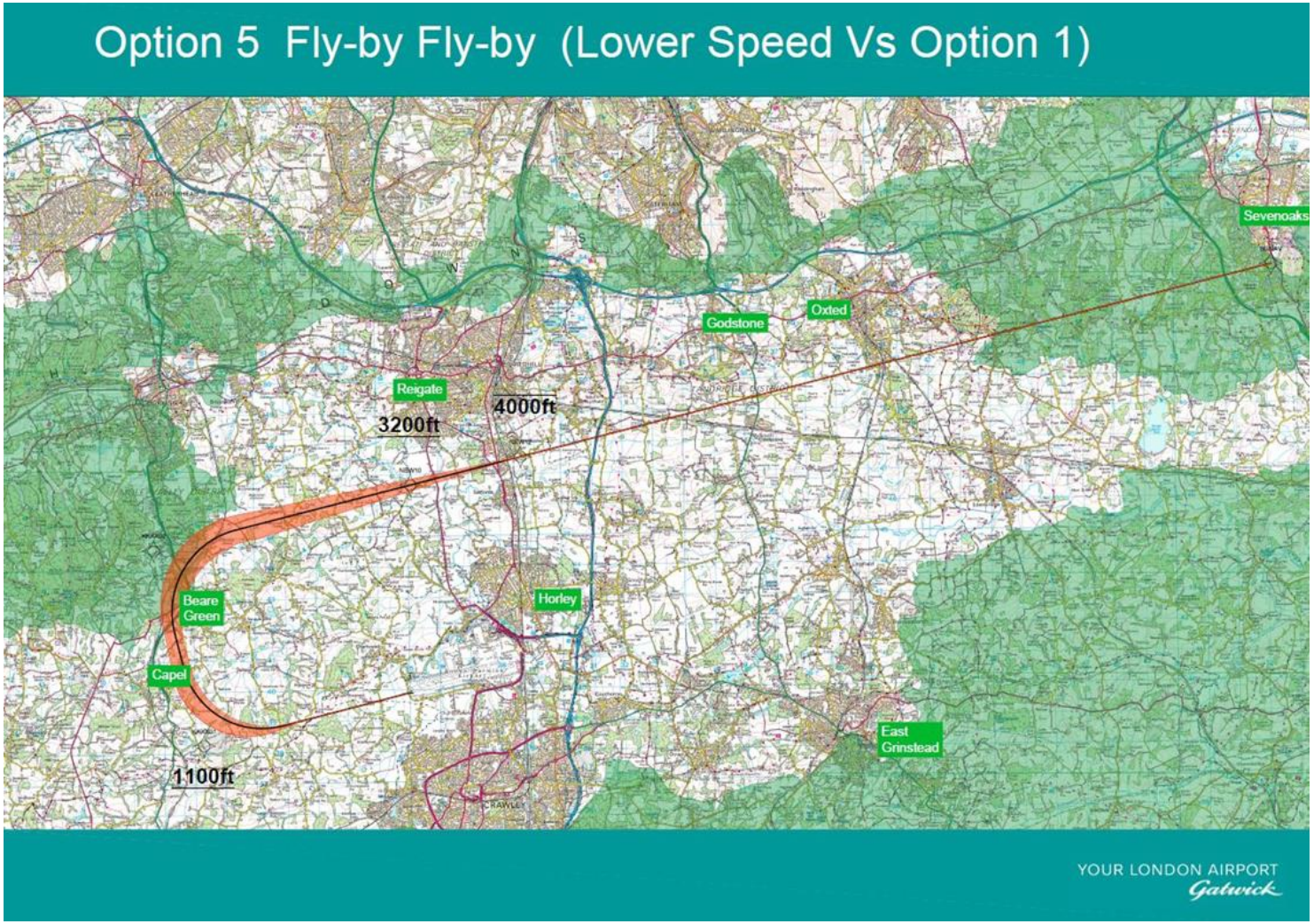
A2.4 Option 3


Option 3 Fly-by Fly-by (Apparent Dispersion Late in Turn)
Sevenoaks
Oxted
Godstone
Reigate
4000ft
3200ft
Beare Green
Horley
Capel
East Grinstead
1100ft

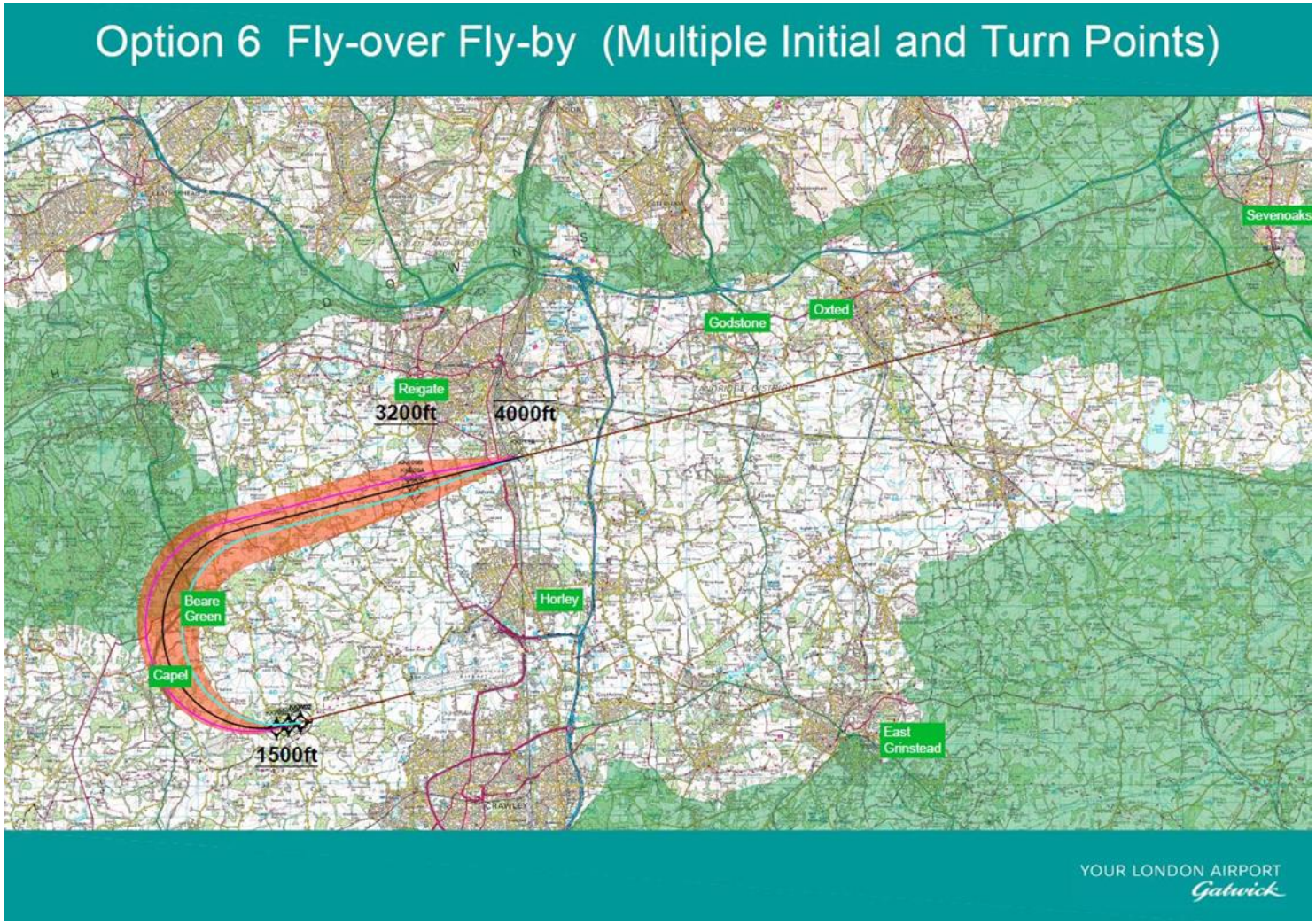
A2.5 Option 4


Option 4 Fly-over Fly-by (Multiple Initial Turn Points)
Sevenoaks
Godstone
Oxted
Reigate
4000ft
3200ft
Beare Green
Horley
Capel
1500ft
East Grinstead
YOUR LONDON AIRPORT Gatwick

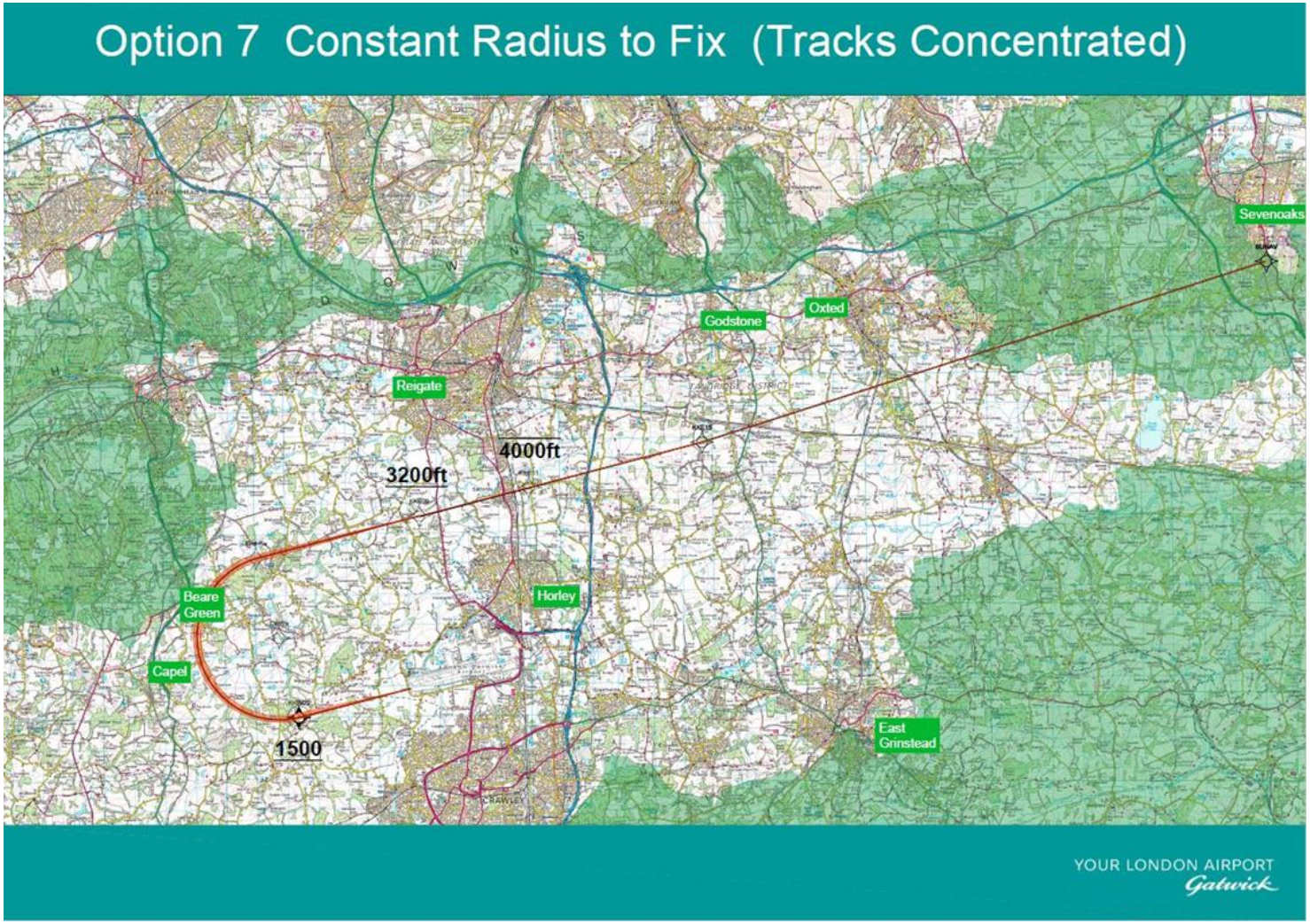
A2.6 Option 5


Option 5 Fly-by Fly-by (Lower Speed Vs Option 1)
Sevenoaks
Godstone
Oxted
Reigate
3200ft
4000ft
Beare Green
Capel
Horley
East Grinstead
1100ft
YOUR LONDON AIRPORT Gatwick

A2.7 Option 6


Option 6 Fly-over Fly-by (Multiple Initial and Turn Points)
Sevenoaks
Godstone
Oxted
Reigate
3200ft
4000ft
Beare Green
Capel
Horley
1500ft
East Grinstead
YOUR LONDON AIRPORT Gatwick

A2.8 Option 7


Option 7 Constant Radius to Fix (Tracks Concentrated)
Sevenoaks
Godstone
Oxted
Reigate
4000ft
3200ft
Beare Green
Horley
Capel
1500
East Grinstead
YOUR LONDON AIRPORT Gatwick