Redesign of Gatwick Route 4 RNAV SIDs - Initial Options Appraisal

Initial Options Appraisal

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1 Introduction

1.1 Regulatory Requirement for Change

The introduction of RNAV[1] Standard Instrument Departures (SIDs) 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 we submitted an amended Route 4 proposal which was ratified by the CAA.

However, the community group 'Plane Justice' then 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. The Route 4 conventional SIDs were to be reverted to the track as published on 6 April 2017 whilst the RNAV SIDs assumed a temporary status.

The purpose of this project is to submit a new application for Performance Based Navigation (PBN) routes for Route 4 Standard Instrument Departures (SIDs) at Gatwick Airport under the guidance and requirements of the CAA's new Airspace Change Process, CAP1616 and is not connected in process to the previous airspace change.

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

The objectives of this 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[2] operating procedures and opportunities
- Provide long term predictability of flight paths.

The foundation for PBN is 'area navigation' or RNAV; aircraft departing LGW using the proposed Route 4 RNAV procedure will do so based on their PBN capability.

1.2 CAP1616 Airspace Change Process

The implementation of any changes to UK airspace is subject to the guidance contained in CAP1616. CAP 1616 is a seven-stage process published by the CAA that provides guidance on the process to follow when seeking to change the way airspace is used. The whole LGW CAP 1616 process is envisaged to take 2½ years. The seven stages of the process are as follows:

[1] RNAV - Area navigation is a method of instrument flight rules (IFR) navigation that allows an aircraft to choose any course within a network of navigation beacons, rather than navigate directly to and from the beacons

[2] 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).

- Stage 1 – Define
- **Stage 2 – Develop and Assess**
- Stage 3 – Consultation
- Stage 4 – Update and Submit
- Stage 5 – Decide
- Stage 6 - Implement
- Stage 7 – Post-Implementation Review

LGW are currently at Stage 2 which requires the development of options that seek to meet the approved Statement of Need. The options are required to align, where practicable, with the Design Principles generated in Stage 1. These options are then assessed to understand the positive/negative impacts before progressing to the Stage 2 Gateway.

1.3 Progress So Far

In December 2018, LGW submitted their Statement of Need to the CAA. This is the formal explanation as to why the airport wishes to change the airspace. The CAA indicated that an airspace change was an appropriate mechanism to achieve the objectives in LGW's Statement of Need. A copy of the Statement of Need and other associated documentation can be viewed at: https://airspacechange.caa.co.uk/umbraco/Surface/PublicSurface/DownloadDocument/393

On 27 September 2019, the first stage in the change process was successfully completed when the Airport's submission passed through the Stage 1 DEFINE Gateway.

The work undertaken during Stage 1 established a shortlist of Design Principles to act as a framework against which Design Options have been designed. The list of Design Principles can be found in the documents uploaded at Stage 1B on the CAA airspace change portal; the link can be found here: https://airspacechange.caa.co.uk/PublicProposalArea?pID=111

1.4 Step 2A – Options Development Summary

During Step 2A, LGW developed a list of design options for the new procedures.

In order to develop the options, the Instrument Flight Procedure (IFP) designers considered the fixed constraints identified during Stage 1A and the Design Principles established in Stage 1B. The initial list of all possible options was tested with the stakeholders at two focus groups, one in October 2019 and the second in November 2019, before LGW subsequently applied high-level criteria, derived from the Design Principles, in order to refine the comprehensive list of options carried forward for initial appraisal in Step 2B (this document).

A detailed explanation of how the constraints, design principles and high-level criteria were applied to the options development can be found in LGW Design Principles Evaluation that is uploaded to the portal in Step 2A. That document can be found on the CAA Airspace Change Portal.

1.5 Step 2B – Initial Options Appraisal

At Step 2B, the comprehensive list of options was tested against the criteria contained in CAP1616, Appendix E, Table E2 with the addition of a Qualitative Safety Assessment and a Qualitative Noise Assessment as required for a Level 1 change at this stage.

The methodology used for the Initial Options Appraisal is discussed in Section 2.

The Initial Options Appraisal is detailed in Section 4. The resultant shortlist of options to be taken forward to Stage 3 for detailed technical design and consultation is contained in Section 6.

2 Guidance and Methodology for Options Appraisal

CAP1616 requires sponsors to complete a formal Options Appraisal process that assesses the benefits of the various options compared to a baseline. At the Initial Options Appraisal, the requirement is only to determine the high-level criteria and then conduct a qualitative assessment against each option. This Initial Options Appraisal serves as the foundation for a more quantitative assessment later in the process.

2.1 CAP1616 Options Appraisal Requirements

The Options Appraisal process is carried out in accordance with the guidance in CAP1616, and in conjunction with The Green Book[3] and the Department of Transport's WebTAG[4], which constitute best practice in options appraisal.

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 finally a set of preferred options. The process is iterative with an Initial Options Appraisal (this document) being used to whittle down the longlist in Stage 2B, a Full Options Appraisal of the shortlist taking place in Stage 3 for consultation, and the Final Options Appraisal supporting the submission of the ACP application to the CAA.

The Options Appraisal consists of the following elements:

- High-level objective and assessment criteria.
- Baseline definition – current operations.
- Longlist of options (including a do-nothing/minimum option).
- Shortlist of options.
- Preferred or final option(s).

The options appraisal requirement of CAP1616 evolves through three iterations with the CAA reviewing at each phase as follows:

1. 'Initial' appraisal (this document) at Step 2B with the CAA review at the 'Develop and assess' gateway
2. 'Full' appraisal at Step 3A with the CAA review at Step 3B and the subsequent 'Consult' gateway
3. 'Final' appraisal at Step 4A, with the CAA review after the formal submission of the airspace change proposal at the end of Stage 4.

[3] The Green Book: Appraisal and Evaluation in Central Government:
https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government

[4] DfT transport analysis guidance WebTAG:
https://www.gov.uk/guidance/transport-analysis-guidance-webtag

Iteration 1, Initial Options Appraisal, is the subject of this document to be submitted to the CAA as part of Step 2B. The remainder of this section of the document focusses on the definition of the 'high-level objective and design principles' and the assessment method.

2.2 High Level Objectives and Assessment Criteria

For a Level 1 Airspace Change (which is the indicative classification of this airspace change), the appraisal criteria against which the options must be assessed, are contained in Table E2 of CAP1616. Table 1 below describes these, with the addition of the Safety Assessment Criteria.

Affected Group	Impact	Description
Communities	Noise impact on health and quality of life	Requires consideration of noise impact on communities including residents, schools, hospitals, parks and other sensitive areas.
Communities	Air Quality	Any change in air quality is to be considered.
Wider Society	Greenhouse Gas impact	Assessment of changes in greenhouse gas levels in accordance with WebTAG is required.
Wider Society	Capacity and resilience	A qualitative assessment of the impact on overall UK airspace structure.
General Aviation	Access	A qualitative assessment of the effect of the proposal on the access to airspace for GA users.
General Aviation / commercial airlines	Economic impact from increased effective capacity	Forecast increase in air transport movements and estimated passenger numbers or cargo tonnage carried.
General Aviation / commercial airlines	Fuel burn	The change sponsor must assess fuel costs based on its assumptions of the fleets in operation.
Commercial airlines	Training costs	An assessment of the need for training associated with the proposal.

Affected Group	Impact	Description
Commercial airlines	Other costs	Where there are likely to be other costs imposed on commercial aviation, these should be described.
Airport / Air navigation service provider	Infrastructure costs	Where a proposal requires a change in infrastructure, the associated costs should be assessed.
Airport / Air navigation service provider	Operational costs	Where a proposal would lead to a change in operational costs, these should be assessed.
Airport / Air navigation service provider	Deployment costs	Where a proposal would lead to a requirement for retraining and other deployment, the costs of these should be assessed.
Safety Assessment	Safety Assessment	CAP1616 requires a safety assessment of the proposal to be undertaken in accordance with CAP760.

Table 1 – Assessment Criteria for Level 1 Change

2.3 Method

2.3.1 Overview

The Initial Options Appraisal was carried out by comparing all the options side by side against the CAP1616 (Appendix E) costs and benefits criteria in tabular form. The Appraisal also included the results of a Qualitative Safety Assessment as described in Section 4, and the noise impact for communities was supported by a qualitative noise assessment as described in Appendix A1 to this document. The full analysis of all the options is similarly described in Appendix A2 and included as a separate MS Excel spreadsheet (posted as a PDF document on the CAA airspace change portal).

The Options Appraisal also compared the implementation of the proposed RNAV procedure against the current, temporary, RNAV SIDs.

2.3.2 The Appraisal Team

The appraisal team consisted of the following Suitably Qualified and Experienced Personnel (SQEP) who discussed and agreed the assessment of each option against the criteria:

- ANS ATM Operations Specialist
- LGW Head of Airspace Strategy & Engagement
- Subject Matter Expert coordinating the development of future airspace for Gatwick

- The following SQEP from LGW's appointed Aviation Consultancy:
  - Principal ACP Consultant
  - Principal Safety Engineer
  - Senior ACP Consultant
  - Senior Approved Airspace Designer

2.3.3 Shortlisting

Once all the options had been assessed against the criteria, the appraisal team reconvened to identify the short list to be taken forward to Stage 3.

The Shortlist and the method by which it was derived is contained in Section 6.

3 LGW Baseline Definition - Current Operations

3.1 Current Route 4 Departure Track

To provide some insight into the distribution of aircraft tracks currently departing from LGW on the Route 4 departure. Figure 1 below shows a snapshot of LGW departures at or below 4000ft and Figure 2 depicts the tracks at or below 6000ft.

General Aviation (GA) aircraft are not shown in these Figures; GA aircraft arrive and depart from the aerodrome along published VFR[5] routes, or routes agreed between the aircraft Captain and LGW Air Traffic Control (ATC). These VFR routes are not part of this airspace change project.

The aircraft tracks shown in each Figure were generated on 22 July 2018.

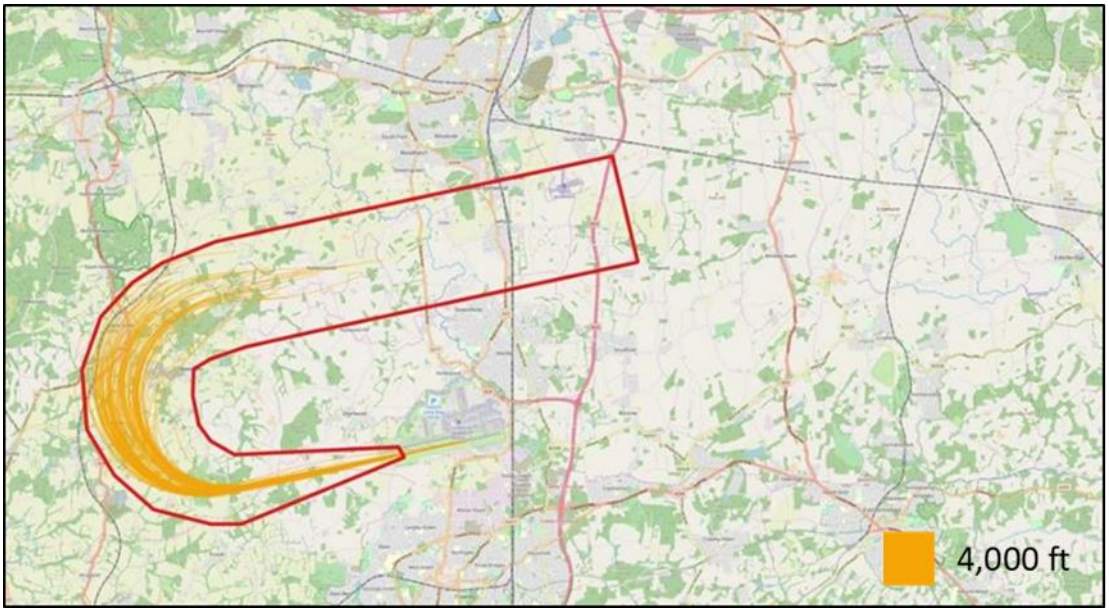

Figure 1 Aircraft tracks at or below 4,000 ft AMSL (single summer day, 22 July 2018)

[5] VFR – Visual Flight Rules (a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going).

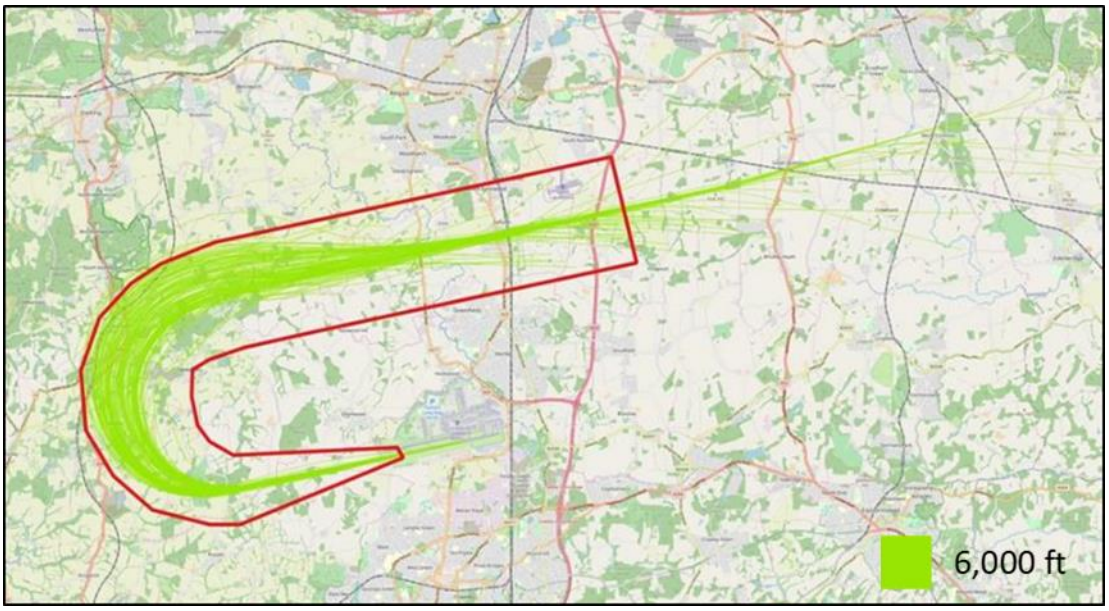

Figure 2 Aircraft tracks at or below 6,000 ft AMSL (single summer day, 22 July 2018)

3.2 Current Noise Impact for Communities

Aircraft flying along the procedures above in Figure 1 and Figure 2 generate a level of noise on the ground that may have an impact on local communities. Figure 3 shows a LGW 2018 summer day Leq noise contours generated with the actual 2018 summer day period modal split (82% west/18% east). The contours are plotted from 54 to 72 dBA at 3dB intervals and include all traffic, not just Route 4.

Culmulative estimates of the areas, populations and households with the 2018 summer actual day contours are provided in Table 2 below.

Leq (dBA)	Area (km²)	Population	Households
>54	76.5	10,450	4,150
>57	40.0	2,800	1,100
>60	23.2	1,450	550
>63	13.1	550	150
>66	6.9	300	100
>69	3.6	100	<50
>72	2.0	0	0

Table 2 -LGW 2018 Summer Day Actual Leq contours-area, population and household estimates derived from Noise Exposure Contours for Gatwick Airport 2018

The Department for Transport (DfT) directs that the CAA must consider this noise contour alongside many other environmental factors when reaching its decisions. This contour represents the average noise levels for the 16-hour period between 0700 and 2300 hrs during the summer season. DfT policy also regards this level as the point at which adverse effects begin to become evident on a community basis. However, LGW recognises that people are likely to be concerned about noise beyond this contour.

As can be seen from the contour shown below, the majority of the noise associated with the airport is predominantly distributed to the east and west and in the immediate vicinity of the airport itself. We would not expect this noise contour to change, as the intial take-off and final approach tracks will remain the same with any new designs. A noise assessment will be undertaken as part of the Full Options Apprasial at Stage 3.

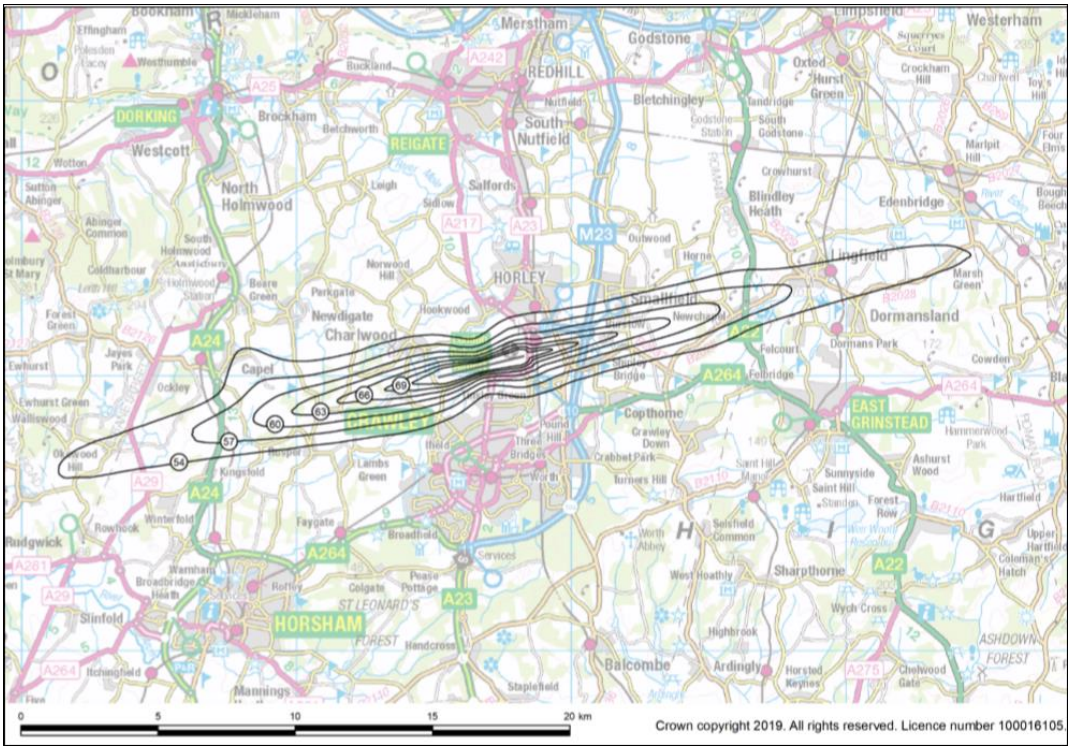

Figure 3 - Noise Contour 51dBA $L_{Aeq\ 16hr}$

3.3 Air Quality

Most of the area around LGW is not within an Air Quality Management Area (AQMA). There are, however, two declared AQMAs nearby. The Horley AQMA is the south west quadrant of Horley close to the airport. The Hazlewick AQMA encompasses Hazelwick Roundabout and areas along the adjoining roads. Both AQMAs were designated for exceedances of the annual mean NO2 air quality standard.

The airport has undertaken continuous NO2 monitoring at a fixed position at the eastern end of the runway for over 20 years. In addition, PM10 and PM2.5 is monitored at this site. There are four other continuous monitoring sites within 1km of LGW and a wide network of diffusion tubes operated by the local authorities. At the continuous monitoring sites, the annual mean NO2 concentrations over the past five years have consistently been well within the air quality standards.

Engagement with the local authorities on air quality is conducted through an annual joint report by LGW and Reigate & Banstead Borough Council to the GATCOM Steering Group, the annual Joint Local Authorities meeting on Air Quality convened by Crawley Borough Council, and ongoing dialogue and collaboration between LGW staff and the environmental health officers.

No changes to current tracks over the ground are proposed below 1000ft where air quality is typically measured. Therefore, no changes to air quality are expected; however, this will be assessed during the Full Options Appraisal at Stage 3.

3.4 Emissions

The extant Route 4 PBN procedures support effective and efficient performance of aircraft within the constraints of the existing London Terminal Manoeuvring Airspace design.

3.5 Capacity and Resilience

Maintaining the extant procedure does not place any constraints on runway throughput.

3.6 General Aviation Access

General Aviation (GA) aircraft may arrive and depart from the aerodrome along published VFR routes, or routes agreed between the aircraft Captain and LGW Air Traffic Control (ATC). These VFR routes are not the subject of this airspace change project and no changes are proposed to the way GA aircraft operate at LGW.

No changes are proposed to the parameters of the current airspace and therefore no change to airspace access is predicted.

3.7 Economic Impact: Commercial Airliners and GA

No increase in effective capacity is anticipated at LGW for the continued use of extant procedures and therefore no economic benefit is expected to be realised for commercial airliners or GA users by the redesign of Route 4 SIDs.

3.8 Fuel Burn: Commercial Airliners and GA

Fuel burn, as a function of track miles flown, is relatively efficient, and is predicted to be no greater for the extant PBN procedure. However, climb out restrictions that limit aircraft to not above 4000ft until abeam the airport, do increase fuel burn. A reduction in fuel burn is most likely to be associated with the removal of climb out restrictions. This is deemed not possible before the implementation of a modernised London airspace; this is being assessed as part of the FASI-S airspace change.

3.9 Infrastructure Costs

No additional infrastructure is required to maintain the current or implement new Route 4 SIDs.

3.10 Operational Costs

No changes to operational costs are attributable to maintaining the extant Route 4 SIDs or the implementation of new Route 4 SIDs beyond the cost of this airspace change.

3.11 Training Costs

No significant additional training costs are anticipated for the implementation of any change option.

3.12 Other Costs

It is not proportionate for LGW to assess potential other costs for commercial airlines - there may be costs associated with maintaining legacy systems to continue flying conventional navigation but there are too many variables (e.g. aircraft types, onboard system capability etc.) to consider these effectively.

3.13 Deployment Costs

There are no deployment costs attributable to continued use of extant procedure.

3.14 Safety Assessment

The primary means by which it is intended to provide safety assurance evidence to support the LGW ACP is a Safety Case. The Safety Case is under development and with reference to the baseline; the Safety Case includes claims, arguments and evidence that current operations at LGW are safe and this is a key assumption of the Safety Assurance Activities in Stage 2. Assurance evidence that extant operations are safe will be provided in the Full Options Appraisal during Stage 3.

4 Initial Options Appraisal Results

4.1 Introduction

This section of the report summarises the full longlist of options and presents a summary of the results extracted from Appendix A2. Section 6 describes how the shortlist derived from the longlist. The complete analysis is contained in Appendix A2 to this report 'Initial Options Appraisal Tables'.

4.2 Proposed Options and Do-Nothing Options

4.2.1 Proposed New Procedure

The proposed new procedure is the Route 4 PBN SID from Runway 26.

4.2.2 Comprehensive List of Options

Table 3 presents the Route 4 procedure and the comprehensive list of options under consideration in the Initial Options Appraisal (this document). The 'Do Nothing' procedure against which all the options are compared, is identified in column 1.

The Design Principles Evaluation (DPE) and the Options Development (OD), which includes a full list of the options and their development methodology, including map overlays, resulted in 3 options being taken forward to the next stage. These documents have been uploaded to the CAA airspace portal at Step 2A**.** The link to the CAA airspace portal is here.

'Do Nothing' Baseline Procedure	Proposed Procedure	Option	Basic Description of Options
LAM2X – fly-over fly-by	RNAV Route 4 SID	0	Currently flown LAM 2X
		1	Previously flown fly-by fly-by LAM1X
		2	Fly-over fly-by direct SUNAV
		3	Fly-by fly-by with dispersion late in the turn
		4	Fly-over fly-by with multiple turn points
		5	Fly-by fly-by with lower speed than option 1
		6	Fly-over fly-by with multiple initial and turn points
		7	Constant radius to fix with concentrated tracks
Total number of Options in Longlist		8	

Table 3 – Summary of number of options and comparative baseline

4.3 Results Summary

The table containing the full analysis carried out at the Initial Options Appraisal stage is delivered as a separate Appendix to this document – see Appendix A2 for details.

Table 4 below summarises the Initial Options Appraisal.

Colour Key									
Carry Forward	Meets LGW objectives, has insignificant impact.								
Carry Forward	Meets LGW objectives but would need some mitigation								
Reject	Fails to meet one or more objectives or has a significant impact that cannot be effectively mitigated								
Procedure	**Do Nothing**	**Proposed Option**	**Proposed Option**	**Proposed Option**	**Proposed Option**	**Proposed Option**	**Proposed Option**	**Proposed Option**	**Proposed Option**
RNAV Route 4 SID	LAM2X Fly-over Fly-by	Option 0	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7

Table 4 – Initial Options Appraisal results summary

5 Qualitative Safety Assessment

5.1 Safety Assessment Activities Required by CAP1616

A qualitative Safety Assessment is required for all options identified during Step 2B, and a detailed final safety assessment must be completed by the change sponsor prior to submission in Step 4B. LGW is carrying out the safety assessment activities in accordance with CAP760, the separate guidance provided by the CAA for safety assessment.

LGW is developing a full four-part Safety Case iteratively throughout the CAP1616 process which will be submitted to the CAA at Step 4B. CAP1616 requires a non-technical/plain English summary of the safety assessment for publication on the airspace portal.

5.2 Assessment Method

The Qualitative Safety Assessment uses the results of a formal Hazard Analysis and Risk Assessment (HARP) workshop held at LGW on 12 December 2019 during which the hazards, causes and consequences relating to each of the longlist of options were identified.

5.3 Additional Options Derived from the Safety Appraisal

There were no additional options added to the longlist post HARP.

5.4 Safety Assessment Results – Non-Technical Summary

The HARP identified a number of dependencies and/or influencing factors across the various options.

Four IFP options have significant Safety implications with all four of them conflicting with other aircraft using the Route 4 SID and three of them not accounting for the prevailing wind direction:

- One because of the degree of dispersion during the turn. Aircraft on the “inside” of the dispersion swathe may come into conflict with aircraft on outside of the dispersion swathe. Additionally, aircraft will choose different points at which to roll out to SUNAV, dependent upon aircraft type/performance and wind.
- Another one includes 3 waypoints placed abeam each other at a distance of 278m with the intention of providing a degree of apparent dispersion. This results in several potential routes that an aircraft may take, however this cannot be scheduled or planned. ATC will not know the aircraft’s intention.
- Two designs utilise three initial turning points placed sequentially 400m apart, one of them followed by 3 waypoints placed abeam each other after the turn. These result in several potential routes that an aircraft may take and a degree of dispersion. However, the choice of turning point cannot be scheduled or planned. ATC will not know the aircraft’s intention.

No other significant safety implications have been identified with the remaining IFP options and any identified hazards will be managed throughout the development of the Safety Case to ensure any appropriate mitigation is identified and implemented.

Those options that are taken forward to shortlist are subject to a full risk assessment as an element of developing the four-part Safety Case prior to submission of the ACP proposal at Step 4B.

The safety considerations relating to the individual options are contained in the full Options Appraisal Analysis Tables referenced as Appendix A2 of this report, which has been uploaded to the CAA airspace change portal as a separate file.

6 Design Options Shortlist

6.1 Shortlisting Method

Once the Initial Options Appraisal was complete, the team convened to consider the results and to decide how to reduce the options to a shortlist.

In total 8 Options were developed and appraised against the CAP1616 criteria, safety and noise assessment. The appraisal team discussed the analysis and worked through the options in Appendix A2 to agree on the selection of the shortlist based on the colour coding in Table 5.

Result	Description
Carry Forward	Meets objectives, insignificant impact, and is the Preferred Option for this procedure
Carry Forward	Meets objectives or has an insignificant impact but is less attractive
Reject	Fails to meet one or more objectives or has a significant impact that cannot be effectively mitigated

Table 5 – Colour coding Key

The preferred option was chosen from the green options, with viable alternative options being selected from the amber options. No red options were taken forward to the short list.

6.2 The Do-Nothing Option

The Do-Nothing option, which is the current suite of RNAV Route 4 SIDs, was reverted to temporary status following the decision by the Court (upon the request of the CAA) to quash, in January 2108, the CAA's original PIR decision in relation to Route 4. This option has attracted the support of a number of stakeholders, therefore, LGW has elected to take this option forward for further assessment during the Full Options Appraisal at Stage 3.

6.3 Shortlist of Options Taken Forward

The original 8 Options in the long list were reduced to 1 preferred option and 2 less attractive, but viable options.

Table 6 presents the shortlist of options carried forward to Stage 3 along with the associated Initial Appraisal Outcome for that option.

Shortlist Option	Initial Appraisal Outcome
Route 4 Option 0	Carried Forward – Preferred Option A shorter route than some rejected options, minimising track miles, noise, fuel burn and CO_2 emissions.
Route 4 Option 1	Carried Forward – meets objectives but less attractive than option 0. Slightly longer route and may require increased departure separations by ATC but may also offer a reduced noise impact on some communities.
Route 4 Option 7	Carried Forward – meets objectives but less attractive than option 0. This option is the shortest route and offers the most fuel-efficient flight profile and would allow ATC to manage the air traffic more efficiently. It flies a concentrated track across the ground enabling emissions to be kept to a minimum.

Table 6 – Shortlist of options carried forward to Stage 3

6.4 Next Step - Full Options Appraisal

6.4.1 CAP1616 Requirement

A full options appraisal of each of the shortlist options takes place at Step 3A and is required during preparation for consultation in Stage 3 to provide a fully developed quantitative assessment of the relevant costs and benefits associated with each option, along with full environmental assessments. This analysis will inform the selection of the Preferred Option and form part of the Consultation materials.

6.4.2 LGW Proposed Method Overview

The Initial Options Appraisal (this document) will be developed into a more quantitative assessment i.e. the costs and benefits of each option e.g. in terms of greenhouse gasses, noise, fuel burn etc. will be monetised using quantitative estimates from the DfT appraisal guidance[6] for health impacts associated with noise, and for the other impacts where possible. LGW will use the DfT's Web-based Transport Analysis Guidance (WebTAG) [6]

[6]DfT transport analysis guidance WebTAG:
https://www.gov.uk/guidance/transport-analysis-guidance-webtag

A1 Appendix A1: Qualitative Noise Assessment

A1.1 Qualitative Noise Assessment

In order to support the assessment of the noise related criteria in Section 4, LGW carried out a qualitative assessment of the likely noise impacts of each option on people on the ground. A comparative assessment was made amongst the options for each procedure taking into account the following contributors to noise exposure:

- length of track overpopulated areas/qualitative assessment of numbers overflown
- overflight of sensitive areas and communities below 7000ft e.g. schools, hospitals
- overflight of national parks, parkland, habitats.

Six design principles are applicable to the assessment of noise and are shown below:

- Design Principle 2 –
  - **Designs should be built to facilitate dispersion below 7,000 ft.**
- 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.**
- 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.**
- Design Principle 5 –
  - **Designs should seek to 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.**
- Design Principle 7 –
  - **Designs that seek to provide respite should not overfly previously unaffected populations.**

The qualitative noise assessment[7] of the options was supported by analysis of whether each option met the above stated design principles.

In general, the increased accuracy associated with the introduction of PBN procedures would minimise the spread of people overflown and concentrate the noise exposure onto fewer people with little opportunity for respite. None of the options enable continuous climb, this is necessary to meet constraints and to deconflict LGW traffic from arrivals and departures at Heathrow, Biggin Hill & Farnborough. It is hoped that, with the future

[7] See assessment against 'Communities, Noise Impact on health and Quality of life' criteria in Appendix A2

introduction of the FASI-S airspace, these options will enable continuous climb which will minimise noise associated with steep climb changes or prolonged segments of level flight.

A2 Appendix 2: Initial Options Appraisal (Full Table Analysis)

This Appendix **is uploaded to the CAA airspace change portal as a separate MS Excel based file** with the format as in the extract below. The Appendix contains the full analysis carried out on the comprehensive list of Options and is colour coded to identify the rejected options, the preferred options and the alternative viable options considered during CAP1616 Stage 2 DEVELOP AND ASSESS. **For the full Analysis, see document reference** 71248 054 Initial Options Appraisal Tables Issue 1 on the portal – please note that the Excel format has been converted to a PDF as required by the portal.

INITIAL OPTIONS APPRAISAL		Reason for Category				
KEY	Carry Forward	Meets LGW objectives, has insignificant impact, and is the Preferred Option for this procedure		Preferred by the majority of stakeholders		
	Carry Forward	Meets LGW objectives but would need some mitigation				
	Reject	Fails to meet one or more objectives or has a significant impact that cannot be effectively mitigated			Meets LGW objectives and will be further assessed in Stage 3	Meets LGW objectives and will be further assessed in Stage 3
Group	Impact	Level of Analysis	High-level Appraisal for changing the current situation	Option 0	Option 1	Option 7
Communities	Noise impact on health and quality of life	Initial Options Appraisal: Qualitative	The current temporary Route 4 RNAV will be replaced by a permanent RNAV procedure. Our aim is to find a permanent solution for Route 4 that has the least impact according to the Design Principles. RNAV procedures are predicted to reduce noise exposure versus extant conventional procedures due to the facilitation of continuous climb/descent profiles and optimum aircraft performance. However, it is not always possible to deliver these characteristics and each Option has been assessed to determine whether noise is minimised through these measures. The assessment also assessed the exposure of communities to noise i.e. whether the option minimises overflight of sensitive areas, public spaces and parks, built up environments and residential areas.	The current LAM2X SID is published in the current UKAIP and is the baseline option. The noise impact would remain the same as it is today. Qualitative assessment is that this is less noisy than option 1, 5, 7.	The LAM1X SID was previously published in the UKAIP. Its track takes it inside the village of Capel (to the east) and outside the village of Beare Green (to the west). After flying straight ahead after take-off, the aircraft will make its first turn not below 2500ft. The flight profile of this option will seek to minimise the adverse impact of noise in the area in between these 2 villages. They are not directly overflown, although a school and a caravan park are close to the planned flightpath. However, there is a possibility that the Route 3 SID NPR and the Route 4 NPR would be in close proximity to each other which may have an impact on health & quality of life by increasing noise pollution in that area. Once through the turn, the aircraft will climb to not above 4500ft and track direct to SUNAV, flying to the south of Reigate and Godstone.	Due to the degree of track concentration inherent in this design it will need further work ahead of public consultation to more accurately depict a track over the ground that will minimise the number of people overflown. The indicative swathe depicted and presented to stakeholders demonstrated the level to which traffic is expected to be concentrated on such a design. Currently, this option routes to the east of Capel and skirts just to the west of Beare Greene. Aircraft should be not below 1500ft as they turn towards a waypoint just to the south of Reigate, by which aircraft should be flying not below 3200ft. At the waypoint to the east of Salfords and south of Redhill aircraft should be not above 4000ft before tracking direct to SUNAV. Due to the concentration of tracks there may be some changes to the noise impacts in and around the villages of Beare Greene, Capel and Leigh.