AIRSPACE
Modernising our flightpaths

GLASGOW AIRPORT MODERNISING OUR FLIGHTPATHS

Consultation Document
Introduction of aRea NAVigation (RNAV) Procedures
January 2018

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GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

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FOREWORD

The communities that we serve at Glasgow Airport have always been central to our decision-making processes and our success. Together, throughout our 52-year history, we have worked in partnership to achieve a great deal and as we look to the future we want our communities to remain at the heart of our business. We are continually improving the airport - investing and modernising to grow in a responsible and sustainable way. That is why your feedback is critically important to our continued success.

An industry-wide drive, led by our regulator, the Civil Aviation Authority (CAA), to create airspace infrastructure fit for the 21st century is now underway as part of its Future Airspace Strategy (FAS). A key element of the strategy involves the replacement of selected ground-based navigation aids across the UK with procedures predicated on new state-of-the-art satellite navigation systems by the end of the decade. Our air traffic control provider, NATS, has informed us that the ground-based navigation aid used at Glasgow Airport will be withdrawn in 2019 meaning we are required to modernise our approach and departure procedures.

Following a full and open consultation, it is our intention to request permission from the CAA to implement these new procedures which will minimise the amount of time planes queue, both in the air and on the ground, improve flight punctuality and reduce fuel and CO_2 emissions by 21%.

This document explains in detail what we are proposing to do, and how you can take part in the consultation. We are looking to gather as much feedback as possible to help ensure that everyone's views are given due consideration.

It is important to stress that we will only make changes to our flight paths once we have considered the views of all those who respond and have received regulatory approval from the CAA.

We also have a dedicated website - www.glasgowairport.com/airspace - which provides further information.

We are fully committed to growing the airport responsibly and modernising our airspace will help us achieve that. In that spirit we very much encourage you to take some time to consider our proposals and we look forward to hearing from you before the consultation period ends on Friday 13 April 2018.

Mark Johnston
Operations Director
Glasgow Airport

"We are fully committed to growing the airport responsibly and modernising our airspace will help us achieve that."


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EXECUTIVE SUMMARY

As part of the UK airspace modernisation programme, we have a requirement to modernise our current flight paths. Before we can do this, it is necessary that we consult with you on our proposals for smoother and more efficient procedures.

Our consultation outlines proposals to change our departure procedures and introduce supplementary approach procedures for aircraft flying to and from Glasgow Airport. These Instrument Flight Procedures (IFPs) are known as Standard Instrument Departures (SIDs) and Instrument Approach Procedures (IAPs). The proposed IFP changes are designed to enable us to better manage the airspace around the airport, without compromising the safety of aircraft, and to operate more smoothly and efficiently.

An essential part of the process of making these changes includes undertaking a wide-ranging consultation with our neighbours, the aviation industry and those organisations and people on the ground who may be affected. We have been consulting with aviation stakeholders since early 2016, and in addition, we conducted an early-engagement exercise with community representatives in the latter part of 2017.

Why are we doing it?

Advancements in navigation systems

The existing ground-based navigation aid upon which all the departure procedures at Glasgow are predicated is being withdrawn by the operator NATS Services Ltd (NSL) as part of a national modernisation programme approved by the industry regulator, the Civil Aviation Authority (CAA). The permanent withdrawal of this navigation aid is scheduled for the early part of 2019. In order that aircraft departing from Glasgow Airport can continue to access the Scottish Terminal Control Area (ScTMA) and the associated route network, it is necessary that we modernise the existing procedures. The proposed new procedures will be designed to meet the Future Airspace Strategy (FAS) using Performance-Based Navigation (PBN).

Changing Scottish aviation landscape

The basic structure of the UK's airspace was developed over 50 years ago. Since then there has been huge changes, including a hundred-fold increase in demand for aviation, as well as a move to simplify and harmonise the way airspace and air traffic control is used. In the UK and Ireland these and other issues are being met through the FAS which sets out a plan to modernise airspace by 2020.

The FAS is an aviation industry and government initiative to improve the efficiency of airspace and ensure that all parties are prepared for the legislative requirements to modernise. The benefits of implementing FAS include efficiencies that enable fuel savings, reductions in CO_2 and other emissions, reducing delays and, where possible, reducing the number of people affected by aviation noise.

What are we proposing to do?

We propose to replace the current ground-based navigation procedures with more advanced satellite-based procedures known as Area Navigation (RNAV) Global Navigation Satellite Systems (GNSS). These proposed procedures have been designed to improve the flow of air traffic whilst reducing fuel use, emissions and the number of people affected by aviation noise. The proposal includes temporary introduction of Omni-Directional Departure (ODD) procedures for each runway to accommodate those operators who are unable (for the short-term) to fly the RNAV procedures. Moving to satellite-based navigation technology supports the industry-wide drive to embrace advancements in navigation systems.

The withdrawal of the conventional navigation aid will also affect the approach procedures aircraft currently use at Glasgow Airport. As part of the 'modernisation' programme we are also seeking to enhance these approach procedures by introducing RNAV IAPs which will be explained in greater details within the consultation document.

The Consultation

The CAA specifies that the introduction of, or changes to, IFPs constitutes an Airspace Change that must be carried out in accordance with requirements specified in Civil Aviation Publication (CAP725[1]). This consultation is being conducted in accordance with the CAA's published requirements and will run from 15 January to 13 April 2018; a period of 13 weeks.

[1] CAP725: CAA Guidance on the Application of the Airspace Change Process. (dated March 2016)

Arrangement of this document

Whilst it is necessary that the consultation document covers and explains several complex technical issues, we have aimed to do so in a way that those not familiar with aviation terminology can understand how and why we have developed the proposed procedures. To make it manageable it is divided into five 'Parts' as listed below:

- Part 1 - The Consultation
  This section covers the consultation element of the proposal including detail about the consultation itself and how you can feed back your comments on the proposed procedures. Whether you are an aviation or a community stakeholder, we welcome your contribution to the consultation.

- Part 2 - Terminology Explained
  This section details some of the technical terminology. Its purpose is to explain how the procedures are designed, differences between the existing and proposed procedures and how these will align with the modern aircraft navigation technologies.

- Part 3 - Proposed Departure Procedures
  This section provides an overview of the proposed departure procedures and an explanation of those aspects which are common to all. It also describes the existing Noise Abatement Procedures (NAPs) in place at Glasgow Airport for departing aircraft, the changes that are proposed and the impacts these changes will have on the communities in and around Glasgow. Part 3 is supported by technical Annexes (A and B) covering the proposed designs for each runway in greater detail. These technical annexes are posted as separate documents, on our website, so as to reduce the size of the main document and provide consultees with improved access to the routes of specific interest to them.

- Part 4 - Proposed Approach Procedures
  This section explains the proposed introduction of RNAV IAPs.

- Part 5 - Airspace
  This section explains considerations relating to the existing Glasgow Airport's airspace. Glasgow Airport has a responsibility to periodically review the airspace for which it is a custodian. We would like to know if there are any issues caused by the existing arrangements and welcome feedback on how they may be improved. The merit of all responses will be considered in the subsequent airspace review.

Feedback

Our consultation document explains, as simply as possible, how each route may change and provide a comparison of where the aircraft fly today against where they will fly under the proposed new procedures. We are looking to gather as much feedback as possible to help ensure that our stakeholders' views are given due consideration. This is your opportunity to feedback observations and comments about the proposed changes. We would be very grateful if you could take the time to respond to this consultation by online form, email or post. Details of how this can be done can be found in paras 1.5 and 1.6 of Part 1 of this document.

"Our consultation outlines proposals to change our departure procedures and introduce supplementary approach procedures for aircraft flying to and from Glasgow Airport."

AN OVERVIEW OF THE PROCESS

REQUIREMENT APPRAISAL
JANUARY 2016 - MARCH 2016

OPTIONS DEVELOPMENT & PLANNING
APRIL 2016 - AUGUST 2017

EARLY ENGAGEMENT
SEPTEMBER 2017 - DECEMBER 2017

CONSULTATION LAUNCHED
JANUARY 2018
13 WEEKS

FEEDBACK ANALYSIS & ROUTE REFINEMENT
APRIL/MAY 2018
6-8 WEEKS

CAA REVIEW
JULY 2018
17 WEEKS

PREP FOR IMPLEMENTATION
DECEMBER 2018
16 WEEKS

FULL IMPLEMENTATION
EARLY 2019

1. THE CONSULTATION

Our Airspace Change proposals form part of an industry-wide initiative known as the Future Airspace Strategy (FAS).

1. INTRODUCTION

1.1 Background

1.1.1 Many airports have grown considerably requiring the revision of operational Air Traffic Management (ATM) systems. The airspace within which these routes are contained is a finite resource which must be used efficiently and flexibly to support a diverse set of users. It is against this backdrop that the International Civil Aviation Organisation's (ICAO) Global ATM Operational Concept was conceived spawning regional programmes such as the Single European Sky ATM Research (SESAR) Programme. SESAR was established to incorporate innovative technological developments to improve safety and efficiency whilst minimising the impact of aviation on the environment across Europe. The UK is meeting its obligations to SESAR through the Future Airspace Strategy (FAS).

1.1.2 As the UK moves towards implementing the FAS with the application of Performance Based Navigation (PBN)[2], the CAA recommends that all departure procedures should be designed as RNAV (aRea NAVigation) procedures with a navigation standard of RNAV-1 (these terms are explained more fully in **Part 2** this document).

1.1.3 The Glasgow (GOW) Very High Frequency (VHF) Omni Directional Range (VOR), pictured below, is being withdrawn as part of a 'modernisation' programme that is in keeping with the UK FAS policy. The withdrawal of the VOR facility has been approved by the CAA and is part of a national programme to reduce the footprint of the ground-based navigation infrastructure. The facility is located at the airport and is owned and operated by NATS Services Limited (NSL).

1.1.4 This consultation is about the proposed introduction of:

- RNAV SID procedures (departures);
- Omni-Directional Departures (ODDs); and
- RNAV IAPs (approaches).

1.1.5 These changes are compatible with CAA Policies governing PBN, the design of IFPs and with the airspace management arrangements in the ScTMA established for Prestwick Lower Airspace Systemisation (PLAS).

1.1.6 The driver for introducing these new procedures is the removal of the GOW VOR which provides an opportunity to modernise the ATM arrangements. We have sought to allow for (rather than actively encourage) greater capacity and growth in their design to future-proof airspace arrangements and in doing so, significantly reduce the likelihood of any further changes for the foreseeable future.

1.2 What is this Consultation NOT about?

1.2.1 It is appropriate at this stage to summarise what is not included in the scope of this consultation. This consultation is **not** about:

- The criteria used to design the IFPs - the CAA requires all procedures to be designed in accordance with ICAO Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) (see Part 2);
- Future growth of Glasgow Airport - the introduction of these procedures does not affect the development plans set out in the approved Airport Master Plan;
- The removal of the GOW VOR – this is beyond the scope of this consultation. It is the responsibility of NATS and has been approved by the CAA;
- The amendment of Conventional IAPs[3] in the documentation to reflect the removal of the GOW VOR facility – the remaining IAPs will not change materially;
- The CAA process for conducting airspace change – this is a mandated process that we are following (Please note that we have been authorised by the CAA to follow the CAP725 Process as detailed in the document dated March 2016);

- ACP consultations relating to Prestwick Centre (PC), Prestwick Airport (PIK) or Edinburgh Airport (EDI) – comments about any changes proposed by these organisations should be directed to the appropriate Change Sponsor;
- Department for Transport (DfT) and Scottish Parliamentary Policy on Airports and Airspace; or
- The Noise Action Plan or any of the measures for mitigation of effects of noise - this is being consulted on separately in parallel and can be accessed at www.glasgowairport.com/community/noise

1.2.2 Any comments in your responses which are about these aspects will be noted but discounted from the analysis.

1.3 Development of this Airspace Change

1.3.1 The work associated with conducting this consultation commenced in January 2016 when there was an understanding that the GOW VOR would be decommissioned by the end of 2017.

1.3.2 Since then the DfT and CAA have been consulting on UK Airspace Strategy and how airspace change should be conducted. The proposed and significant changes to the Airspace Change process are laid out in CAP1520 (Reference 17).

1.3.3 Given that the new Airspace Change process (CAP1616) had not been conceived or consulted upon when we embarked on this project, the CAA has endorsed the application of the existing process (CAP725). We have, however, gone above and beyond what is required by the existing CAP725 in order to align ourselves with the principles of the CAP1616 as much as we possibly can.

1.4 Who are we consulting?

1.4.1 Given the nature of the proposed changes, the CAA requires Glasgow Airport to conduct a stakeholder consultation in accordance with CAP725. We are targeting our consultation at those stakeholders and stakeholder groups who are most likely to be affected by the changes although we welcome the views of other interested parties who may also perceive they are affected by the proposed changes. The 13-week consultation will run from 15 January to 13 April 2018.

1.4.2 We are consulting airspace users who will most likely be using the proposed procedures; the airlines and aircraft operators who operate from or are based at Glasgow Airport, as well as General Aviation (GA) groups who may be affected by the proposals. We are consulting the adjacent Air Traffic Control (ATC) units that interface with Glasgow Airport ATC and the National Air Traffic Management Advisory Committee (NATMAC), a committee sponsored by the CAA who are consulted for advice and views on any major matter concerning airspace management.

1.4.3 Whilst there may be one or more consultees from a particular organisation, it is requested that a consolidated single response be presented on behalf of the organisation invited to participate. This does not preclude personal responses.

1.4.4 Whilst we have endeavoured to explain the proposed procedures as simply as possible, it is expected that some consultees may not be familiar with aviation terminology, particularly with the technical aspects of IFP design. The offer is made for anyone to seek clarification, preferably by e-mail, if they so desire. (See paragraph 1.9.3 for details). We ask that any such queries are submitted as early as possible (ideally via email to airspace@glasgowairport.com) in order that any subsequent responses to the consultation can be submitted within the consultation period. Due to the detailed and technical nature of the consultation, we are unable to accept responses or clarifications via social media.

1.4.5 We have added a list of "Frequently Asked Questions" that will likely arise from the consultation. These are posted separately on the Glasgow Airport website and to maintain validity, these will be updated as appropriate to the queries being received.

1.4.6 A list of the consultees is given separately in the **Appendix.**

[2] Performance-Based Navigation is the broad term used to describe the technologies that allow aircraft to fly flexible, accurate, repeatable, 3-dimensional flight paths using on-board equipment and capabilities. Further details of PBN concepts and UK CAA Policy can be found at www.caa.co.uk/pbn.
[3] Glasgow Airport will retain conventional Instrument Approach Procedures (IAPs) based on the Glasgow Non-Directional Locator Beacon (GLW NDB(L)) and the Instrument Landing System (ILS). There is no intention to remove these in the short/medium term, although they will be supplemented by new RNAV Approach Procedures.

1.5 Responding to the Consultation by Email or Online Form

1.5.1 You are invited to respond to the consultation via a dedicated e-mail address: airspace@glasgowairport.com or follow the links on the airport website: www.glasgowairport.com/airspace

1.5.2 Please indicate clearly that this is your response to the consultation. It would be particularly helpful if emails highlight the response being made as follows:

- SUPPORT – In favour;
- NO COMMENT – Lets us know that you have read the document and have nothing to add. This is still valuable feedback;
- NO OBJECTION – Neither in favour or not in favour;
- OBJECT – Not in favour. (Please explain)

1.5.3 For example: **RESPONSE: SUPPORT** – Name, Organisation, etc.

1.5.4 Responses involving any objections should be accompanied by an explanatory narrative.

1.6 Responding to the Consultation by Post

1.6.1 If you cannot submit your response by email you may do so in writing to the following address:
Airspace Consultation, Glasgow Airport Limited, Erskine Court, St Andrews Drive, Paisley, PA3 2SW

1.6.2 In responding by post, please use the same methodology in the title of your letter as articulated in paragraph 1.5.2 above to highlight the nature of your response.

1.7 Social Media

1.7.1 Due to the detailed and technical nature of the consultation, we are unable to accept responses or clarifications via social media. Social media will only be used to raise awareness about the consultation and remind consultees of the opportunity to engage.

1.8 Drop-in Sessions

1.8.1 We will hold a series of 'Drop-In' sessions aimed at providing stakeholders with the opportunity to discuss and seek clarification on the proposals. The details of these sessions will be published on our website www.glasgowairport.com/airspace

1.9 Acknowledgements and Feedback

1.9.1 E-mail responses will be electronically acknowledged by automatic response e-mail. Responses sent by post will not be acknowledged; if confirmation of receipt is required please use a recorded delivery service. Late responses received after the closing date will be logged and stored but not analysed.

1.9.2 Following the consultation period all responses received within the required timeframe will be reviewed, analysed and if required, responded to. All issues raised, if appropriate, will be responded to in the Consultation Response Document.

1.9.3. If you have any queries about what is presented in this document please contact us (as detailed in paragraph 1.5.1, 1.5.3 or 1.6.1 above) as soon as possible. Indicate clearly that this is a **QUERY** about the consultation. Note: If using the e-mail link detailed above you will receive the electronic automatic e-mail acknowledgement. We will be checking e-mails regularly and will respond to your query as quickly as possible.

1.9.4. A Glossary of Terms is included in **Part 1** to assist with your understanding of the technical terms used within this document. If this is an electronic version, hyperlinks will assist your reading.

1.9.5 A summary of the key issues raised in the consultation and further details of the next steps will be provided in a feedback report which will be published on the Glasgow Airport website. No personal details of respondents will be included in the report.

1.10 Confidentiality

1.10.1 The CAA requires that all consultation material, including copies of responses from consultees and others, is included in any formal submission to the CAA.

1.10.2 We undertake that, apart from the necessary submission of material to the CAA and essential use by our consultants for analysis purposes, we will not disclose any personal details or content of individual responses to any third parties. Our consultants are signatories to confidentiality agreements in this respect. The CAA will however publish all consultation material including responses received (albeit redacted) on their website.

1.10.3 We will treat all responses with due care and sensitivity as we are bound by the Data Protection Act. If you do not want your personal details to be forwarded to the CAA, please let us know as the CAA is also bound by the Freedom of Information Act.

1.11 Analysis of your Feedback

1.11.1 We will consider all relevant feedback received from consultees, taking into account the guidance from Government, the CAA and the various regulatory policy requirements.

1.11.2 A summary of the key issues raised in the consultation and conclusions drawn from the responses, together with further details of the next steps will be provided in a feedback report. This Consultation Response Document will be published on our website after we have had time to consider your feedback and will form part of the formal ACP to be submitted to the CAA.

1.11.3 All the feedback from the consultation will be made available to the CAA as part of the ACP. This will allow them to assess independently whether we have drawn the appropriate conclusions from the feedback received whilst, at the same time, complying with the procedure design and consultation requirements.

1.11.4 It is essential to note that whereas some changes may be individually desirable from a community point of view, they may not be feasible for procedure design or operational reasons or may be outweighed by disadvantages to other communities.

1.12 Compliance with the Consultation Process

1.12.1 If you have any concerns regarding our compliance with the consultation requirements set out in the CAA's guidance for airspace change (CAP725) you may direct your concerns to the CAA using the online form at:
www.caa.co.uk/fcs1521

Or by writing to:
Airspace Regulator (Co-ordination), Airspace Regulation, Safety and Airspace Regulation Group, CAA House, 45-59 Kingsway, London, WC2B 6TE

1.12.2 Please note that this form must not be used for direct responses to the consultation; doing this will make it unlikely that your views will be captured.

1.12.3 Furthermore, please note that the CAA will respond only to concerns about Glasgow Airport's compliance with the process. They will not comment on the proposal itself.

1.13 What happens next?

1.13.1 This consultation runs from 15 January to 13 April 2018, a period of 13 weeks, during which consultees can consider the proposed procedures and submit responses as detailed in Section 1.5 and 1.6 above.

1.13.2 After we have compiled a Consultation Response Document, we will compile a formal ACP for submission to the CAA, together with the proposed procedure designs. We expect to make this submission in July 2018.

1.13.3 The CAA will assess the ACP in conjunction with your feedback and in accordance with CAP725. The CAA will also assess the procedure designs in accordance with the provisions of two documents specifically related to procedure design (CAP778 and CAP785). We expect a regulatory decision on both aspects in November 2018.

1.13.4 It will be the CAAs decision whether or not to approve the proposals that we submit following this consultation. In reaching that decision they will assess whether the procedures and the airspace proposals submitted are safe and in compliance with their procedure design regulations and that we have correctly complied with their environmental analysis and consultation requirements.

1.13.5 The CAA's decision will be published on the CAA website via the ACP Portal[4] and on our website www.glasgowairport.com/airspace

1.13.6 Should the CAA approve the ACP and the associated procedure designs then we expect the procedures will be promulgated in the UK Aeronautical Publication (AIP) for implementation in February or March 2019. The UK AIP is a publication issued by NATS, with the authority granted by the Minister of State for Transport, containing aeronautical information of a lasting character, essential to air navigation. The UK AIP is updated every 28 days.

1.13.7 Approximately 12-months following the introduction of the proposed procedures, a Post Implementation Review (PIR) will be conducted to ensure that the objectives and benefits of the procedures have been achieved and that the ATM System is working as stated in the ACP documentation. The findings of the PIR will also be published on the CAA website.

"This consultation runs from 15 January to 13 April 2018, a period of 13 weeks."

[4] www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Decisions/FASI(N)/

GLOSSARY OF TERMS

TERM	EXPLANATION
A-weighted decibel dB(A)	Decibel (a unit of "loudness" of a sound), "A-weighted" (which matches the frequency response of the human ear).
AGL (or agl)	Above ground level. (Height)
Air Traffic Control Service (ATC)	A service provided for the purpose of preventing collisions between aircraft, and on the manoeuvring area between aircraft and obstructions; and expediting and maintaining an orderly flow of traffic.
Air Traffic Management (ATM)	The aggregation of the airborne and ground-based functions (air traffic services, airspace management and air traffic flow management) required to ensure the safe and efficient movement of aircraft during all phases of operations.
Air Traffic Service (ATS)	A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).
Altitude (ALT)	The distance, in feet, above mean sea level. This is the standard level reference for aircraft operations and airspace design at the lower levels to overcome variations in terrain. The aircraft altimeter is set to the barometric pressure at the aerodrome which has been adjusted to take account of the aerodrome elevation (known as QNH).
Altitude Based Priorities	The Government (through the DfT) has laid out altitude-based priorities which should be taken into account when considering the potential environmental impact of airspace changes. These priorities are intended solely to inform those responsible for considering and deciding permanent changes to the UK's airspace design. They set out the environmental priorities from the surface to 4,000 feet, from 4,000 feet to 7,000 feet and above 7,000 feet.
AMSL (or amsl)	Above mean sea level (Altitude)
aRea NAVigation (RNAV)	Area navigation is a method of instrument flight rules navigation that allows an aircraft to choose any course within a network of navigation beacons, rather than navigate directly to and from the beacons. This can conserve flight distance, reduce congestion, and allow flights into airports without beacons.
ATC	Air Traffic Control
ATM	Air Traffic Management
ATZ	Aerodrome Traffic Zone. An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.

TERM	EXPLANATION
CAA	Civil Aviation Authority
Capacity	The term used to describe how many aircraft can be accommodated within an airspace area or by a runway without compromising safety or generating excessive delay.
Centreline	The nominal track of a published route
CO_2	Carbon dioxide
Concentration	Refers to the density of aircraft flight paths over a given location. Generally, refers to high density where tracks are not spread out over a wide area. The opposite is Dispersion.
Continuous climb	A climb that is constant, i.e. without periods of level flight (sometimes referred to as "steps").
Continuous descent	A descent that is constant, without periods of level flight (sometimes referred to as "steps").
Controlled airspace	A generic term for airspace in which Air Traffic Control service is provided. There are different sub-classifications of airspace that define the types of air traffic services that are provided and the degree to which aircraft are required to participate. Aircraft flying in controlled airspace must follow instructions from Air Traffic Controllers. In the UK, Classes A-E are classed as controlled airspace. For more info see: www.nats.aero/ae-home/introduction-to-airspace
Control Area (CTA)	Controlled airspace extending upwards from a specified limit above the earth. Control Areas are situated above the Aerodrome Traffic Zone (ATZ) and afford protection over a larger area to a specified upper limit. See graphic at Figure 36, para 5.1.4.
Control Zone (CTR)	Controlled airspace extending upwards from the surface of the earth to a specified upper limit. Aerodrome Control Zones afford protection to aircraft within the immediate vicinity of aerodromes. See graphic at Figure 36, para 5.1.4.
Conventional navigation	The historic navigation standard by which aircraft fly, and procedures are designed, with reference to ground-based navigation aids.
Dispersion	Refers to the density of flight paths over a given area and generally refers to low density operations where tracks or routes are "spread out" over a wide area. The opposite of Concentration.
Distance Measuring Equipment (DME)	A transponder-based radio navigation technology that measures slant range distance by timing the propagation delay of VHF or UHF radio signals.
Final Approach Fix (FAF)	The last segment when approaching an airport is the final approach segment, which begins at the Final Approach Fix.

TERM	EXPLANATION
Future Airspace Strategy (FAS)	The CAA's blueprint for modernising UK airspace in line with European (SESAR) and other worldwide initiatives. The CAA explains the FAS here: www.caa.co.uk/fas
General Aviation (GA)	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. It covers sport and recreational flying and corporate jet and non-jet flights
Holding; holding area; Holding stacks	An airspace structure where aircraft circle one above the other at 1,000 feet intervals when queuing to land.
Inertial Referencing Unit (IRU)	An inertial reference unit (IRU) is a type of inertial sensor which uses gyroscopes and accelerometers to determine a moving aircraft's change in rotational attitude (angular orientation relative to some reference frame) and translational position (typically latitude, longitude and altitude) over a period of time.
Initial Approach Fix	The point where the initial approach segment of an instrument approach begins. An instrument approach procedure may have more than one initial approach fix and initial approach segment.
Instrument Landing System (ILS)	An ILS operates as a ground-based instrument approach system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals to enable a safe landing even during poor weather.
Intermediate Fix (IF)	The fix that identifies the beginning of the intermediate approach segment of an instrument approach procedure.
Lateral Navigation (LNAV)	Refers to navigating over a ground track with guidance from an electronic device that gives the pilot (or autopilot) error indications in the lateral direction only and not in the vertical direction. LNAV approaches are the most basic of RNAV approaches and as such they usually have the highest minimums.
Lateral and Vertical Navigation (LNAV/VNAV)	LNAV/VNAV approaches are for aircraft with vertical navigation capability (hence the "VNAV"). The vertical guidance is internally generated by barometric settings. A LNAV/VNAV approach is essentially a GPS version of an ILS approach.

TERM	EXPLANATION
Leq	Equivalent Continuous Sound Level - The level of hypothetical steady sound which, over the measurement period, would contain the same frequency weighted sound energy as the actual variable sound. It is used to assess long term environmental noise exposure and considers the impact of many noise events over longer periods. The extent of total noise exposure is illustrated by noise exposure contours (contours of equal Leq) which are, effectively, aggregations of SEL noise footprints of individual aircraft movements.
$L_{Aeq,16h}$	The A-weighted Leq measured over the 16 busiest day-time hours (0700-2300) is the normal time-period used to develop the Airport Noise Contours for day-time operations.
$L_{Aeq,8h}$	The A-weighted Leq measured over the 8 night-time hours (2300-0700) is the normal time-period used to develop the Airport Noise Contours for night-time operations.
Localiser Performance with Vertical Guidance (LPV)	The highest precision GPS aviation instrument approach procedures currently available without specialized aircrew training requirements, such as required navigation performance (RNP). Landing minima are usually similar to those of a Cat I Instrument Landing System (ILS)
L_{max}	The simplest measure of a noise event, such as an aircraft overflight, is L_{max} which is the maximum sound level recorded (in dB(A)).
Low altitude airspace	A generic term to describe airspace in the vicinity of an airport containing arrival and departure procedures below 4,000 feet. Airports have primary accountability for the design of procedures in this airspace as this and the local ATC operation is largely dictated by local environmental requirements, airport capacity and efficiency.
NATS	An air traffic service provider licensed by Government to provide the air navigation services in en-route airspace which connects the airports with each other and with the airspace of neighbouring States. NATS also provides ATS, under contract, to some airports.
Nautical Mile (NM)	Aviation measures most horizontal distances in nautical miles. One nautical mile is 1852 metres, making it approximately 15% longer than a statute mile. (Aviation uses metres for some horizontal distances such as runway lengths and visibility, but the standard measurement of vertical distance is feet.)
Noise Action Plan	Noise Action Plans are Action Plans designed to manage noise issues and effects arising from aircraft departing from and arriving an airport. Action Plans are a legal requirement under Directive 2002/49/EC relating to the Assessment and Management of Environmental Noise. The airport operators must draw up, or update, an Action Plan every five years.

TERM	EXPLANATION
Noise contours	The depiction of noise across a period of the day as a series of contours around the airport. Aircraft noise maps, which show lines joining points of equal noise, to illustrate the impact of aircraft noise around airports. Major airports publish annually or bi-annually the noise contours for the "daytime" period (0700 to 2300). These are referred to as the Leq (16 hours) noise contours.
Noise footprint	The depiction of noise from a single aircraft as a "footprint" around the airport. These are referred to as SEL footprints.
NSA	National Scenic Area
Nx contours	Nx contours (such as N65 and N60) show the locations where the number of events (i.e. flights) exceeds a pre-determined noise level, expressed in dB LAmax.
Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS)	PANS-OPS is contained in an ICAO Document 8168 which sets out the design criteria and rules for instrument flight procedures which include approach and departure procedures.
Performance-Based Navigation (PBN)	A generic term for modern standards for aircraft navigation capabilities (as opposed to conventional navigation standards). The design of future airspace routes and structures will be predicated on requiring a specified minimum navigation capability by all aircraft using the route or airspace structure. For more information, see www.caa.co.uk/pbn and www.eurocontrol.int/navigation/pbn
Radar Vectoring	Provision of navigational guidance to aircraft by ATC in the form of specified headings based on the use of radar.
Route	Published routes that aircraft are either 'required to' or 'plan to' follow. Routes have a nominal centreline which gives an indication of where the aircraft would be expected to fly; however, aircraft will fly along routes or route segments with varying degrees of accuracy based on a range of operational factors such as weather, aircraft weight, aircraft speed and altitude, and technical factors such as PBN specification and ATC intervention. The depiction of a nominal route on a map should not be taken as an indication that aircraft will not be seen elsewhere.
Route Network or Route Structure	The network of routes linking airports to each other and to the airspace of neighbouring States.
Runway designation	Airport runways are referenced by a 2-digit number which is derived from the orientation of the runway relative to magnetic north. For example, the runways at Glasgow Airport are orientated on a bearing of 046°M/226°M, the rounded-up reference numbers given to them are 05 and 23. Magnetic variation in the UK is gradually reducing over time.

TERM	EXPLANATION
Single European Sky ATM Research (SESAR)	The Single European Sky ATM Research (SESAR) programme is a major public-private cross-industry initiative. It brings together the aviation industry to develop new technologies and solutions that will improve the way Europe's airspace is managed and will oversee the implementation of its modernisation.
Standard Instrument Departure procedure (SID)	A published procedure for departing aircraft to follow which links an airport or a runway at an airport to the en-route airspace structure. A SID incorporates both airport and en-route ATC requirements for the integration of departure procedures with routes to and from other airports together with the Airport Operator's noise abatement requirements in proximity to the airport. It is presented in the UK AIP in graphical format to assist pilots in briefing themselves on the procedure and levels to be flown after departure. It also includes sufficient information for loading into aircraft navigation databases for use by aircraft flight management systems.
Tactical Vectoring	Air traffic control methods which involve air traffic controllers directing aircraft off the established route structures for reasons of safety or efficiency.
Terminal Control Area (TMA)	Terminal Control Areas are Control Areas normally established at the junction of airways in the vicinity of one or more major aerodromes. The Scottish Terminal Control Area (ScTMA) is an example of this and deals with air traffic arriving and departing from Glasgow, Edinburgh and Prestwick Airports.
Uncontrolled Airspace	There are different sub-classifications of airspace that define the types of air traffic services that are provided and the degree to which aircraft are required to participate. Aircraft flying in uncontrolled airspace are not mandated to take Air Traffic Services (ATS) but can call on them if and when required (e.g. flight information, alerting and distress services). In the UK, Class G airspace is defined as uncontrolled. For more info see: www.nats.aero/ae-home/introduction-to-airspace/
Vertical Navigation (VNAV)	An auto flight function which directs the vertical movement of an aircraft (i.e. gains or losses in its altitude).
WebTAG	WebTAG (Web-based Transport Analysis Guidance) is the Government's (DfT's) transport appraisal guidance and toolkit.

ABBREVIATIONS AND ACRONYMS

ACP	Airspace Change Proposal
AEDT	Aviation Environmental Design Tool
agl	Above Ground Level
AIP	Aeronautical Information Publication
amsl	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
ATZ	Aerodrome Traffic Zone
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAT	Commercial Air Transport
CTA	Control Area
CTR	Control Zone
DA	Danger Area
DfT	Department for Transport
DME	Distance Measuring Equipment (a ground-based navigation aid)
EDI	Edinburgh Airport
ERCD	Environmental Research and Consultancy Department (Department of UK CAA)
FAA	Federal Aviation Authority
FAF	Final Approach Fix
FAS	Future Airspace Strategy
FASI (N)	Future Airspace Strategy Implementation (North)
FMS	Flight Management Systems
GA	General Aviation
GNSS	Global Navigation Satellite Systems (space-based navigation aids, e.g. GPS)
IAF	Initial Approach Fix
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organisation
IF	Intermediate Fix
IFP	Instrument Flight Procedure
IFR	Instrument Flight Rules
ILS	Instrument Landing System (a ground-based navigation aid)
IRS/IRU	Inertial Reference System / Inertial Reference Unit
ISA	International Standard Atmosphere
LNAV	Lateral Navigation
LOAEL	Lowest Observed Adverse Effect Level
LPV	Localiser Performance with Vertical Guidance
MTWA	Maximum Total Weight Authorised
NAP	Noise Abatement Procedure
NATMAC	National Air Traffic Management Advisory Committee
NATS	The terminal ANSP (Previously National Air Traffic Services)
NDB	Non-Directional Beacon (a ground based navigation aid)
NERL	The en-route ANSP, NATS En-Route Limited
NM	Nautical Miles
NSA	National Scenic Area
NTK	Noise and Track Monitoring Equipment
ODD	Omni-Directional Departure
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PC	Prestwick Centre (NERL)
PBN	Performance Based Navigation
PIK	Prestwick Airport
PLAS	Prestwick Lower Airspace Systemisation
RNAV	Area Navigation
RNP	Required Navigation Performance
RTF	Radio Telephony
ScTMA	Scottish Terminal Control Area
SDDG	Scottish Development and Deployment Group
SEL	Sound Exposure Level
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Area
SSSI	Site of Specific Scientific Interest
TAS	True Airspeed
TMA	Terminal Control Area
WebTAG	Web-based Transport Analysis Guidance
VFR	Visual Flight Rules
VNAV	Vertical Navigation
VOR	VHF Omni-Directional Radio Range (a ground-based navigation aid)


AIRSIDE OPER
GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

2. TERMINOLOGY EXPLAINED

We are committed to conducting an open and thorough consultation.

2. TERMINOLOGY EXPLAINED

2.1 What is RNAV?

2.1.1 RNAV stands for aRea NAVigation. RNAV is a navigation technique which uses on-board navigation technology in an aircraft Flight Management System (FMS) to take data from several internal and external navigation sources, for example ground-based and space-based[5] navigation systems and an on-board Inertial Reference Systems (IRS) to work out where the aircraft is, where it needs to go to, and what it needs to do to follow a specified flight path.

2.1.2 Across the world, navigation using satellite navigation systems (known to most as 'SatNav'), is replacing traditional navigational means, enabling more efficient, reliable and direct routes that remove the need to zigzag across the country. Just like the 'SatNav' in your car, aircraft are using a slightly more sophisticated 'SatNav' in their FMS to navigate by this technique known as RNAV. Using traditional methods, procedures were defined by a network of ground-based navigational beacons which were not always positioned in optimal locations. RNAV allows navigation between "points-in-space" that can be established almost anywhere allowing routes to be straightened-out thus providing greater flexibility to route aircraft to exactly where they want to go. This means it is no longer necessary to ensure coverage from fixed navigational beacons that are limited by a number of environmental factors e.g. terrain. As in **Figure 1**, aircraft can get from A to B without going via C and D. The environmental benefits of this in terms of fuel burn and CO_2 emissions are clear.

2.1.3 The European Commission's SESAR and the UK's FAS specify that RNAV-1 should be the minimum navigation standard for operations in terminal airspace. In the case of Glasgow Airport, terminal airspace is defined as the ScTMA, the Control Zone (CTR) and the Control Areas (CTAs). More on airspace terminology can be found in Part 5.

2.1.4 RNAV makes aircraft navigation far more accurate than the conventional means of navigation resulting in more efficient use of the available airspace resource. RNAV-1 refers to a comprehensive navigation specification which includes a requirement (amongst other system performance criteria) for a maximum 1 Nautical Mile (NM) lateral navigation tolerance i.e. an aircraft is expected to be within 1NM of the flight track (95% of the time). The lateral navigation accuracy is not the only performance criterion specified, the standard also covers aircraft navigation system functionality, integrity requirements and flight crew training. In reality, aircraft approved for RNAV-1 operations will consistently achieve an actual navigation performance much better than 1NM. Constant review of RNAV-1 operations indicates that actual achieved navigation performance of approximately 0.1NM is consistently achieved.

2.1.5 Whilst most modern aircraft are suitably equipped and approved for RNAV-1 (or better), a few operators using older aircraft types are not. The progressive nature of current regulations in the UK and Europe will eventually result in the phasing out of these legacy aircraft types.

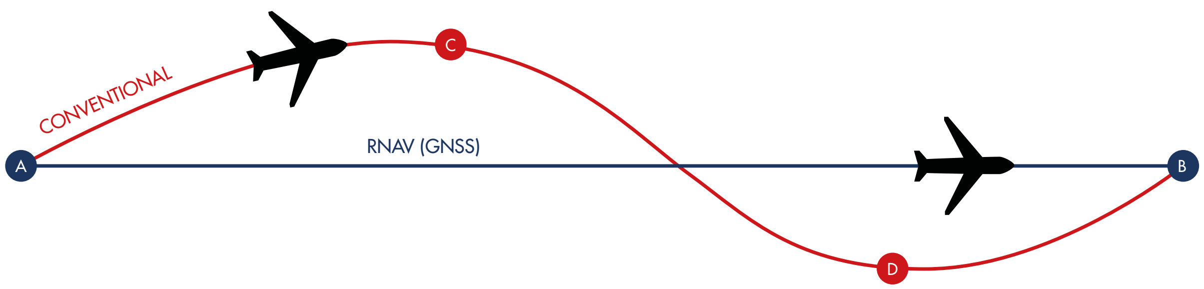


Figure 1: RNAV (GNSS) v Conventional Navigation

[5] Space-based navigation satellites are known as Global Navigation Satellite Systems (GNSS), of which the best-known system is the Global Positioning System (GPS).

2.1.6 In the meantime, whilst the FAS requires new terminal airspace procedures to be designed using RNAV, the CAA allows the retention of non RNAV (conventional) procedures, where necessary, for use by aircraft and aircraft operators that are not approved for RNAV-1 operations.

2.1.7 In the initial stages of the development of the RNAV procedures, we carried out a survey of the equipage and approval status of applicable aircraft operators using the airport. It was established that most were (or would be by 2018) equipped and approved for RNAV-1 operations in UK and European terminal airspace.

2.1.8 As it has now been determined that there is sufficient DME coverage to support the proposed SID procedures in the ScTMA, it should now be possible for them to be additionally published as RNAV (DME/DME/IRU)[6][7] SIDs. The position of the RNAV waypoints can therefore be established by conventional means by aircraft not yet equipped to use satellite-based navigation (GNSS). The on-board navigational systems can ascertain from a combination of data from the DMEs and the Inertial Referencing Unit where the aircraft is and ultimately fly the RNAV procedure.

2.1.9 We propose to replace the conventional SIDs with a suite of RNAV-1 SIDs. Provision will be made for non-RNAV-1 approved aircraft to access the route network using Omni Directional Departures (ODD) provided for each runway. Additionally, we are proposing to complement the existing conventional IAPs with RNAV IAPs.

2.2 What are SID Procedures?

2.2.1 The International Civil Aviation Organisation (ICAO) defines SIDs as follows: '……designated Instrument Flight Procedure (IFP) departure routes linking an aerodrome, or a specified runway at an aerodrome, with a specified significant point, normally on a designated Air Traffic Service (ATS) Route at which the en-route phase of flight commences.'

2.2.2 These departure procedures are repeatable and act as a standard clearance to a pilot. They are distributed for aviation use in the UK AIP, a document published by the CAA[8] in accordance with International Standards and which contains all aeronautical information relevant to aircraft operations in UK airspace.

2.2.3 The purpose of a SID is to:

- Provide a standardised ATC clearance that links the aerodrome and/or departure runway with the route network;
- Ensure adequate clearance from obstacles in the departure path;
- Reflect Noise Abatement requirements of the Airport Operator; and
- Provide a pre-determined flight procedure in graphical and textual format so that pilots can brief themselves in advance on the procedure and the required climb gradients to be followed on departure.

2.2.4 In publishing SIDs, complex departure instructions can be simplified, potential misinterpretations can be avoided and Radio-Telephony (RTF) loading can be reduced.

2.2.5 SIDs are designed in such a way as to ensure that they:

- Are safe to fly by each of the aircraft categories required to use them;
- Meet the ATS requirement for the safe integration and separation of aircraft on closely spaced routes in complex terminal airspace;
- Meet the environmental requirements of the Airport Operator as closely as practicable.

2.2.6 It is inevitable that there will be conflicts between ATM and environmental considerations. Stakeholders must work closely together to derive the best possible compromise whilst still satisfying the procedure design requirements. The safety of flight operations and the ATM system is paramount and must be demonstrated throughout.

2.2.7 The CAA requires that all SID procedures be designed in accordance with international criteria for the design of IFPs[9] together with any "Differences" that the UK CAA has notified[10]. The CAA has published its requirements in CAP778[11] and CAP785[12] and several other Policy Statements and guidance documents.[13][14][15]

[6] Distance Measuring Equipment/Distance Measuring Equipment/Inertial Referencing Unit (DME/DME/IRU) – Basically, the use of two ground based aids and an internal aircraft navigational aid to establish position reporting enabling the use of RNAV. [7] CAA Draft Policy Statement, DME Assessment Criteria in Support of the Implementation of RNAV-1 Standard Instrument Departures (SIDs) at UK Airports, dated 18 April 2016. [8] Civil Aviation Publication (CAP) 032. [9] ICAO Document 8168 Volume 2: Procedures for Air Navigation Services - Aircraft Operations: Construction of Instrument and Visual Flight Procedures (known as "PANS-OPS"). [10] For example, the UK specifies that after take-off no turn may be commenced below 500ft above aerodrome level (aal), whereas PANS-OPS permits turns to be commenced at 394 feet above aerodrome level. [11] CAP778: Policy and Guidance for the Design and Operation of Departure Procedures in UK Airspace. [12] CAP785: Approval Requirements for Instrument Flight Procedures for Use in UK Airspace. [13] CAP1378: Airspace Design Guidance: Noise Mitigation Considerations when Designing PBN Departure and Arrival Procedures, dated April 2016. [14] CAP1379: CAP1379 - Description of Today's ATC Route Structure and Operational Techniques, dated March 2016. [15] CAP1385: Performance-based Navigation (PBN): Enhanced Route Spacing Guidance, dated April 2016.

2.2.8 The "PANS-OPS" document describes various technical parameters for designing procedures, including atmospheric conditions based on the International Standard Atmosphere (ISA), nominal procedure design speeds, nominal turn radii, minimum and nominal climb rates etc. The procedure design provides a "nominal ground track" appropriate to the specified set of parameters against which obstacle clearance can be assessed. However, "on the day" there will be many variables which may result in aircraft following a slightly different flight path to the "nominal ground track" of the procedure, but within the safety parameters for obstacle clearance. For example:

- Atmospheric conditions are seldom, if ever, precisely the same as those of the ISA used for the procedure design. Temperature, pressure, wind speed and direction, and the rate at which they change with altitude are all variables which affect aircraft climb and turn performance;
- Aircraft will inevitably fly at different speeds due to different load factors (weight), operator safety procedures and a variety of other operator defined influences; and
- The procedure design criteria must always reflect the "worst possible case" in aircraft performance and navigation to protect aircraft from obstacle hazards. Typically, aircraft have a considerably better actual performance (for example, climb or turn performance) than is reflected in the procedure design criteria. The design parameters provide the minimum criteria for continued safe operation of aircraft where there is a combination of adverse circumstances.

2.2.9 There will always be an element of dispersion, or a "swathe", on either side of the nominal procedure design track in which aircraft can legitimately be expected to fly whilst retaining adequate protection from obstacles or other airspace hazards. Procedure design accounts for the level of dispersion based on the accuracy required for the procedure. Technological advancements continue to improve accuracy and repeatability and, in so doing, reduce the width of the swathe.

2.2.10 As well as describing a route, a SID procedure also includes a vertical profile that an aircraft is required to fly. The vertical profile can be expressed in terms of a minimum climb gradient (for obstacle clearance or ATM requirements) or in terms of minimum or maximum altitudes at specified points along the route. It must specify an upper limit for the procedure. Once, after take-off, the aircraft is under the control of a Radar Controller, it can be instructed to climb above these specified levels to achieve safe tactical "real-time" integration of the departing aircraft with other flights. This tactical control allows aircraft to climb as quickly as possible to their ultimate cruising level.

2.3 Will aircraft always fly the SID Flight Paths?

2.3.1 Aircraft do not always follow the flight path and altitudes specified in the SID procedure. The SID procedures do however form the basic framework of the route network.

2.3.2 SIDs reduce the requirement for inter-agency coordination between ATC units. This reduction in ATC and pilot workload makes for a more efficient way of getting the maximum number of aircraft into the air from several airports in close proximity and on a myriad of routes that cross each other.

2.3.3 Once airborne, the Controllers' task is to get the aircraft climbing as quickly as possible to their cruising level.

2.3.4 The norm is for aircraft to follow the SIDs as published allowing for a repeatable systemised array of flightpaths. However, should the need arise, once Noise Abatement Procedures (NAPs – explained further in paragraph 3.7) have been satisfied, controllers need the flexibility to turn aircraft away from the nominal SID flight path using tactical radar control techniques (known as radar vectoring) to separate aircraft from each other and achieve efficient and expeditious flight profiles. The precise aircraft tracks arising from radar vectoring will vary from flight to-flight depending on the position, altitude and routing of other aircraft in the ATM System at the time. Inclement weather can also create a need to take aircraft away from the published route.

2.3.5 The proposed SIDs represent efficient flight paths into the route network that accord with the requirements of the operation of the ScTMA as a whole (as is practicable within the limits of procedure design criteria and the disposition of other procedures). It is expected that aircraft would generally be left on the SID route if expeditious climb clearance could be given without coming into conflict with other flights.

2.4 What is an Omni-Directional Departure?

2.4.1 An ODD is a convenient and simple method of ensuring obstacle clearance for IFR departing aircraft who are unable to meet the technological requirements of the proposed SIDs. In the UK, ODDs are designed on the basis that an aircraft maintains runway direction to a minimum height of 500 feet above aerodrome level before commencing a turn. Where additional altitude (beyond 500 feet) is required for obstacle clearance, the aircraft continue straight-ahead until sufficient obstacle clearance is achieved. A turn may then be made to join the route network.

2.4.2 At Glasgow, aircraft will be issued an ODD to access the route network if they are either:

- non-RNAV-1 capable; or
- non-GNSS equipped.

2.4.3 The ATC clearance will specify that the ODD procedure is to be followed in compliance with the proposed NAPs. This is similar to that currently provided for aircraft who are unable to comply with the existing departures.

2.4.4 It is proposed that the ODD procedure clears an aircraft to follow runway heading to an altitude of 6,000 feet on a minimum 7% Procedure Design Gradient (PDG). The altitude and gradient has been determined as the most efficient and reasonable by all operators. Once NAPs have been met (i.e. on passing 4,000 feet), ATC will be at liberty to turn the aircraft in the required direction.

2.4.5 The introduction of these ODDs will be a transitional or temporary arrangement purely to meet the needs of the operators who are unable to meet the technological requirements of the proposed SIDs. We will give operators two years grace within which to make the necessary upgrades to their fleet and we will subsequently withdraw the ODDs two years after their publication.

2.5 What are IAPs?

2.5.1 Instrument Approach Procedures (IAPs) are a series of predetermined manoeuvres for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually.

2.5.2 The existing primary IAP is a conventional procedure known as the Instrument Landing System (ILS); this will be complemented with RNAV IAPs using the same technologies as the proposed SIDs.

2.5.3 FAS requires new terminal airspace procedures to be designed as RNAV procedures whilst allowing the retention of non-RNAV (conventional) procedures, where necessary.

2.5.4 The ILS will remain the primary approach aid for aircraft carrying out an instrument approach at Glasgow Airport with the new RNAV IAPs providing the redundancy required for continued operations when the ILS is out of service.

2.6 Runway Usage

2.6.1 A runway may be used in two directions depending on wind direction amongst other factors. Our runway is no different and therefore the same piece of ground is used in two directions and is referred to in plural as two runways. Runway 23[16] (towards the south-west) is used approximately three quarters[17] of the time for both arriving and departing aircraft as the prevailing wind in the UK is generally from the south-west. As far as possible, aircraft need to land and take-off into wind. Runway 05 (towards the north-east) is used for the remaining one quarter of the time as the prevailing wind is not generally from this direction. Figures 2 and 3 overleaf depict this.

2.7 Department for Transport Environmental Guidance - 2014

2.7.1 In 2014, the Department for Transport (DfT) revised their guidance to the CAA on how it should exercise its functions[18] relating to the environmental impact of Civil Aviation; this resulted in the introduction of the concept of altitude-based priorities for airspace development and associated route structures. Departure procedures should be designed to enable aircraft to operate efficiently and to minimise the number of people subject to noise disturbance on the ground whilst taking account of the overriding need to maintain an acceptable level of safety.

[16] Runway Designation: See Glossary. [17] The 10-year modal split (average) indicates a 78%/22% split in favour of Runway 23. [18] Under the auspices of the Transport Act 2000, the Secretaries of State (SoS) for Transport and Defence issue directions to the CAA amplifying its functions and responsibilities, including Directions with respect to minimising the environmental impact of aviation. The DfT Guidance amplifies how the SoS expect the CAA to carry out these environmental functions. The CAA, in turn, exercises its responsibility through the auspices of CAP725 (now CAP1616) and requires the sponsors of airspace change to consider, inter alia, the DfT Guidance in developing their proposals.

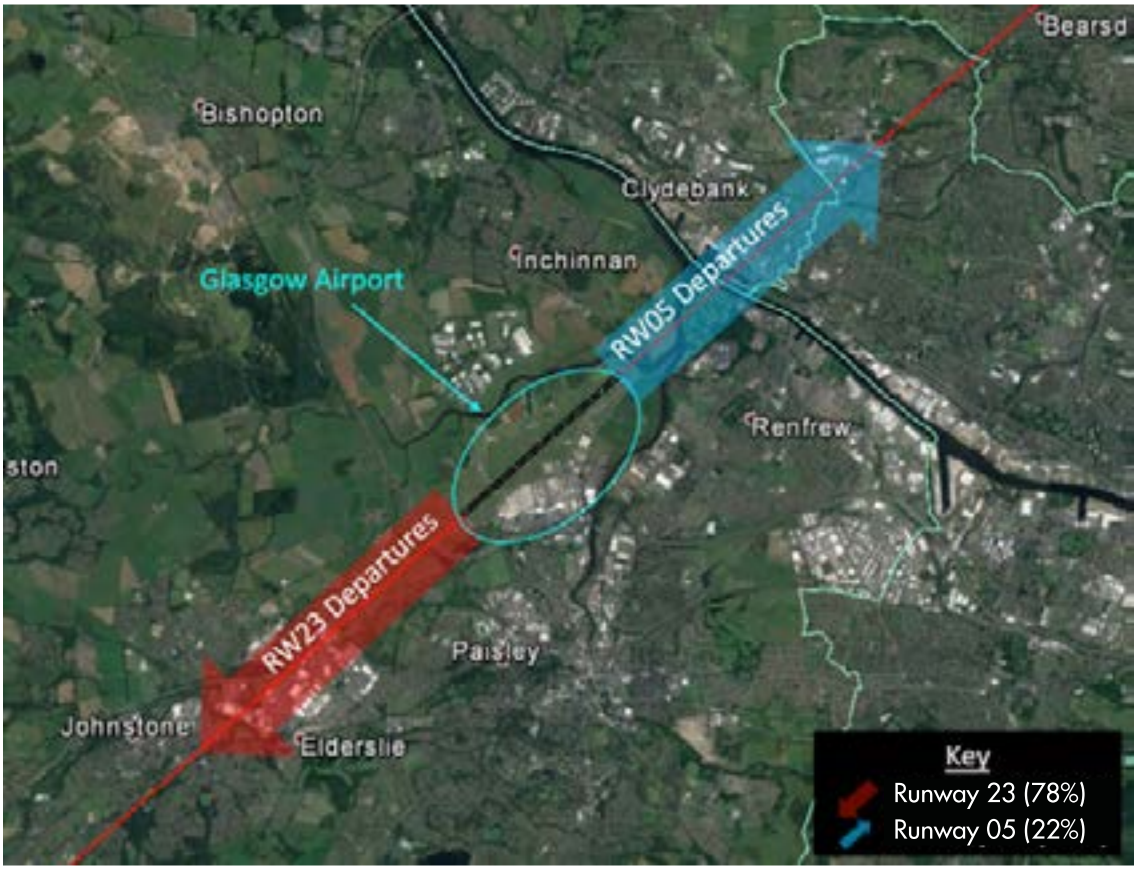


Figure 2: Runway Usage Departures

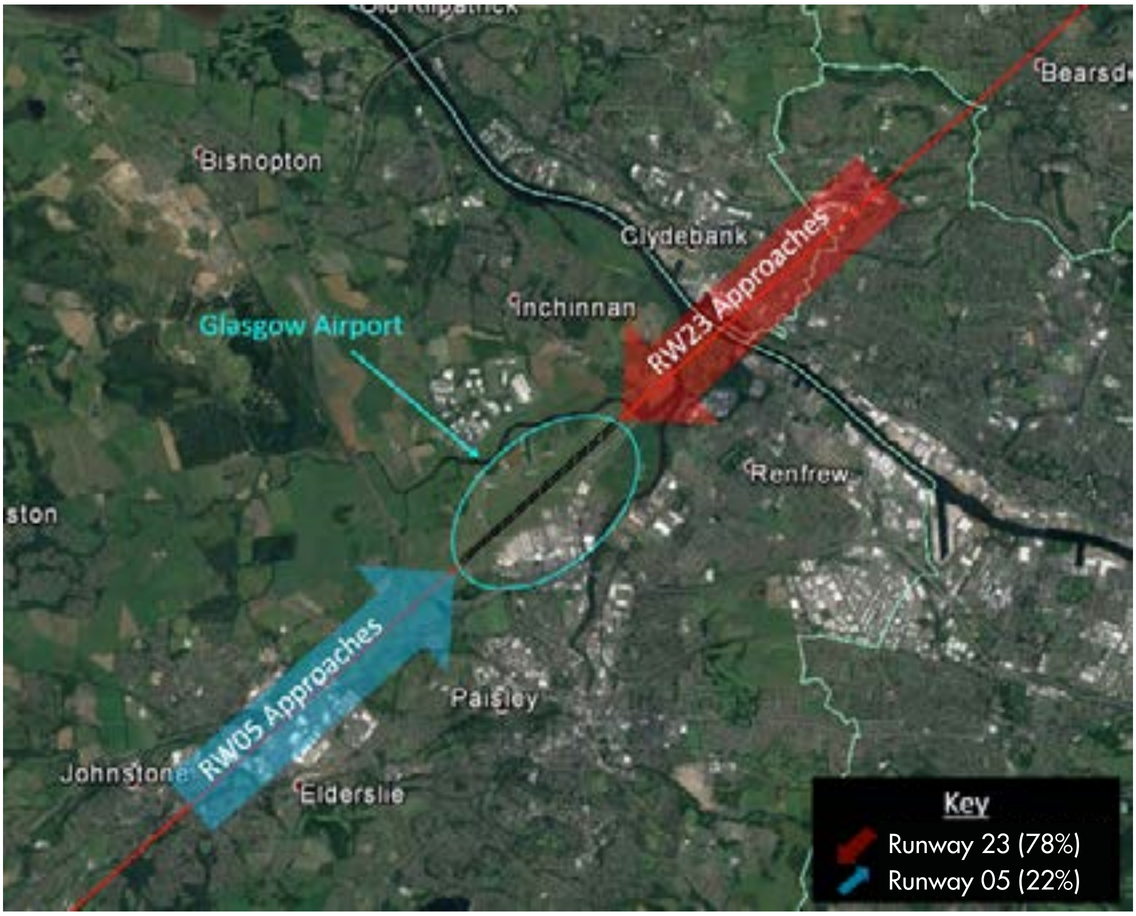


Figure 3: Runway Usage Approaches

2.8 Department for Transport Environmental Guidance – 2017

2.8.1 In February 2017, the DfT commenced a consultation on a new UK Airspace Policy and associated guidance to the CAA on how it should exercise its functions relating to the environmental impact of Civil Aviation. The results of this consultation were released in October 2017 (see References 14, 16 and 18). The Government elected to implement a range of proposals including:

- A new Secretary of State Call-In Power on airspace changes of national importance, providing high level direction and a democratic back-stop on the most significant airspace change decisions, something much called for by communities;
- Important changes to aviation noise compensation policy, to improve fairness and transparency;
- The creation of an Independent Commission on Civil Aviation Noise (ICCAN) - an important step in building trust between industry and communities;
- A new requirement for options analysis in airspace change, to enable communities to engage with a transparent airspace change process and ensure options such as multiple routes are considered; and
- New metrics, lower thresholds and appraisal guidance to assess noise impacts and their impacts on health and quality of life.

2.8.2 A key change was that where it used to seek to limit and where possible reduce the number of people significantly affected by aviation noise, it now seeks to limit and where possible reduce the number of people experiencing the adverse effects of aviation noise.

2.8.3 The DfT has advocated the use of Web-based Transport Analysis Guidance (WebTAG) as it includes a module for assessing the impacts of noise including specifically from aviation, on health and quality of life. WebTAG is the DfT's guidance on appraising transport schemes. TAG Unit A3 includes an approach to analysing the possible health effects associated with aviation noise, based on World Health Organisation (WHO) guidance and research reports from Department for Environment, Food and Rural Affairs (Defra) and the Interdepartmental Group on Costs and Benefits (Noise). This tool allows decisions on transport schemes to take account of the costs and benefits of different options with regards to noise.

2.8.4 The new Airspace Change process (CAP1616) had not been conceived or consulted upon when we embarked on this project, and as a result, the CAA endorsed the application of the existing process (CAP725). The timescales we are now faced with unfortunately do not afford us the luxury of being able to follow some aspects of the new guidance. In particular, the options analysis is not presented in the manner that will be expected of similar projects under CAP1616. However, we have gone above and beyond what is required by the existing CAP725 in order to align ourselves with the principles of the CAP1616 as much as we possibly can in the available time. This has included commissioning additional environmental work such as assessing noise to lower thresholds and the use of additional metrics such as WebTAG (see paragraph 3.17).

2.8.5 The altitude-based priorities, which we have borne in mind throughout the development of our proposals, are still considered appropriate by the DfT. These state that noise should be the environmental priority for route design up to 4,000 feet above mean sea level (amsl). Noise should still take precedence over carbon emissions between 4,000-7,000 feet amsl unless CO_2 emissions would be disproportionately increased. Above 7,000 feet amsl, noise is no longer considered an environmental priority.

2.9 Concentration vs Dispersion or Respite

2.9.1 It is widely acknowledged, and supported in DfT guidance, that the application of PBN principles to terminal airspace operations, including the introduction of RNAV SID procedures, will serve to enhance aircraft navigational accuracy, meaning that aircraft will be more concentrated towards the centreline of published procedures. This means that noise impacts will be spread over a smaller area and fewer people will be exposed to aircraft noise than has historically been the case. The unintended result is that those affected by aviation noise (albeit fewer) may well be affected on a more regular basis.

2.9.2 The 2017 DfT guidance considers the impact of concentrating the flight paths of aircraft over narrowly defined routes against the alternative possibility of dispersing flight paths over a wider area. This is principally considered in the context of any necessary overflight of densely populated areas. Government policy has, for many years, been that the best environmental outcome was derived from the concentration of departures over the least number of practical routes designed specifically to minimise the number of people overflown at low levels.

2.9.3 Whenever possible, and subject to safety and operational constraints, procedures should avoid densely populated areas at low level with flight over less populated, open countryside preferred.

2.9.4 The 2017 DfT guidance is no longer so prescriptive as the Government believes there is 'no one size fits all' solution. Local communities should be engaged to determine whether concentration or dispersion is most desirable. It notes that 'Concentrated routes will often be preferable from a noise perspective for airspace changes below 4,000 feet amsl. This will tend to limit the number of people exposed to higher noise levels where there are stronger associations with adverse effects on health and quality of life.' The CAA is required to seek assurances from change sponsors that any opportunity to provide respite and relief to communities affected by aviation noise through dispersal or multiple routes have been adequately considered. Various options have been considered for concentrating departures on the minimum number of concentrated tracks against wider dispersal of flight paths over a larger ground footprint. Our assessment is that the measures we are proposing provide the best option for limiting and reducing the overall number of people affected by the adverse effects of aviation noise.

2.9.5 In developing the SID procedures detailed in this consultation, due consideration has been made to minimise the overall effect on those overflown within the requirements of procedure design criteria and the route network. In common with most airports and their proximity to large built up areas, it is inevitable that some populated areas will continue to be overflown by the route structure.

2.9.6 It is anticipated that the more accurate and consistent track keeping can be expected to narrow down the lateral spread of tracks in the initial turns and lead to fewer people being overflown. We considered splitting the southbound traffic over two or three departure procedures to provide relief and respite although airspace and procedure design criteria limited what was possible. The proposed concentration of the southbound departing traffic out over two new RNAV SIDs, from each runway end, will result in the reduction of the size of the swathe affected today; reducing the overall noise effect. We have sought to build-in known periods of respite (more detail on this in **Part 3** and **Annex A**), in accordance with current Government thinking.

2.10 Summary of Part 2

2.10.1 In Part 2 of this Consultation Document we have explained, in some broad detail, the background to the various operational, regulatory and environmental requirements that must be considered in the design of IFPs to support the airport. Each of these areas of consideration are, in themselves, complex technical subjects, often with competing priorities.

2.10.2 In designing IFPs, which are suitable for operational use, it is necessary for a careful balance to be struck between competing priorities. At all times, the safety of the operation of aircraft and the ATM System remains paramount.

2.10.3 The Key Messages in this document are as follows:

- Our Airspace Change Programme is part of a national industry initiative (FAS);
- Airspace safety remains our key priority;
- The proposed procedures seek to minimise the total adverse effects of noise on the communities exposed;
- The proposed procedures are designed to result in more efficient operations; and
- We are committed to conducting an open and thorough consultation.

2.10.4 **Parts 3 and 4** of this document go on to describe the proposed SID designs and the proposed amendments to the approach procedures in detail and explain how the competing requirements have been balanced to arrive at a workable and optimal (within existing constraints) procedure configuration proposal.

3. PROPOSED DEPARTURE PROCEDURES

The proposed procedures will allow aircraft to fly more efficient, reliable and direct routes.

3. PROPOSED DEPARTURE PROCEDURES

3.1 Conceptual Development of the Procedures

3.1.1 This part of the consultation document, together with the accompanying technical annexes, details the concept of operations for departures off each runway. Any potential environmental impact of any changes is also addressed. We have also broadly outlined other options that have been considered in the development of the final procedures and the reasons why these other options were discounted.

3.1.2 Realistically there are only three available options; Do Nothing, Replicate or Redesign:

- **Do Nothing** – this option is simply not available because the navigational aid that the current procedures rely upon is being withdrawn.
- **Replicate** – although on face-value this may seem the obvious choice, it is not always possible to replicate conventional procedures accurately owing to the differing parameters involved in the design and approval of RNAV procedures. Furthermore, there was an opportunity for improvements to be made both operationally and environmentally.
- **Redesign** – this option is considered the most favourable as there is potential to deliver environmental and operational benefits from the complete redesign of the array of departure procedures. More detail on the development of this option can be found in **Annexes A and B.**

3.1.3 As a basic principle, the SID procedures (including their appropriate protection areas) should be wholly contained within the existing controlled airspace around Glasgow Airport.

3.1.4 Nine SIDs off each runway are currently used by aircraft departing from Glasgow Airport to enter the route network (18 SIDs). See the magenta coloured lines on **Figures 5 and 7**:

- To the north-east (via the PERTH (PTH) VOR): This SID is applicable to aircraft departing to Aberdeen, the Orkneys, and for aircraft going further afield to some Scandinavian destinations and occasionally aircraft avoiding airspace restrictions in Northern Europe.
- To the west (via navigational position ROBBO[19]): This SID is applicable to aircraft departing to Trans-Atlantic destinations and turbo-prop aircraft to the Western Isles.
- To the north (via navigational positions LOMON and FOYLE): These SIDs are applicable to aircraft departing to destinations in northern Scotland, the Western Isles and Trans-Atlantic destinations and can be busier during large scale military exercises over the Atlantic.
- To the north-west (via navigational positions CLYDE): This SID is applicable to aircraft departing towards the more southerly Western Isles (such as Tiree, Barra and Islay) and Trans-Atlantic destinations.
- To the south (via the TURNBERRY (TRN) and TALLA (TLA) VORs, and navigational positions NORBO and LUSIV): These SIDs are applicable to aircraft departing to destinations in England, Ireland, the European Mainland and the Canary Islands.

3.1.5 SID procedures have been developed to accommodate these routes from our runways, albeit there has been significant rationalisation. The result is the development of nine new RNAV-1 SID procedures to replace 18 conventional SIDs. The current SIDs, as published, are not regularly adhered to and as a result, the tracks over the ground, evident in the track keeping data, are not a true reflection of these published procedures. The proposed SIDs, by contrast, will be adhered to more closely resulting in greater predictability and consistency.

[19] ATS Significant navigational positions which are not marked by a ground-based navigation aid are given a 5-letter pronounceable Name Code (5LNC) allocated by ICAO. Navigational positions which are at ground-based navigational aids (e.g. VOR, NDB (See Glossary)) are described by the 3-letter identification code of the navigation aid. RNAV waypoints which are not intended to be used in RTF between pilots and ATC are given alphanumeric 5-digit identifier.

3.1.6 The ‘heat-map’ or ‘Track Density’ diagram at **Figure 4** graphically shows the existing spread of departure traffic (based on a 14-day Summer period in 2016) and identifies the existing density of tracks or ‘hot-spots’. The scenario depicted does not accord with UK Government policy of concentrating traffic (in most cases) on the fewest number of specified routes. What we are proposing will ‘tidy-up’ this picture through repeatable concentration of traffic below 4,000 feet more in line with UK policy[20].

3.1.7 It must be emphasised that the departure procedures from Glasgow Airport are only one element of the myriad of routes accessing the overlying route network. Safety is paramount at all times in the development and design of both the individual procedures and the overall route network. This means that sometimes we cannot design a procedure precisely where we would like to because of overriding ATM system safety requirements. For example, CAP1385 (Reference 13) provides guidance on the minimum distance required between routes and this has to some extent limited what has been possible in the development of our proposals.

3.1.8 The ScTMA contains a complex array of interacting departure and arrival procedures, all of which must be designed to ensure safe separation between aircraft on a strategic basis and to fit into the “anti-clockwise flow” of the basic route network of the UK. The overarching operational requirement for procedures to and from Glasgow Airport to fit into the higher-level route network constrains the flexibility available to develop departure procedures at the lower levels.

3.1.9 Similarly, ATC at both Glasgow Airport and at PC must retain the operational flexibility to integrate aircraft with one another to achieve the most orderly and expeditious traffic flow and to get departing aircraft climbing to their cruising levels as quickly as possible, (this is explained in **Part 2** (para 2.3) of the consultation document and is amplified where necessary in **Annex A and B**). Once aircraft have met the requirements of the NAPs, ATC need to retain the operational flexibility to route aircraft tactically away from the published track when clear of other aircraft within controlled airspace. Communities may continue to see departing aircraft flying over

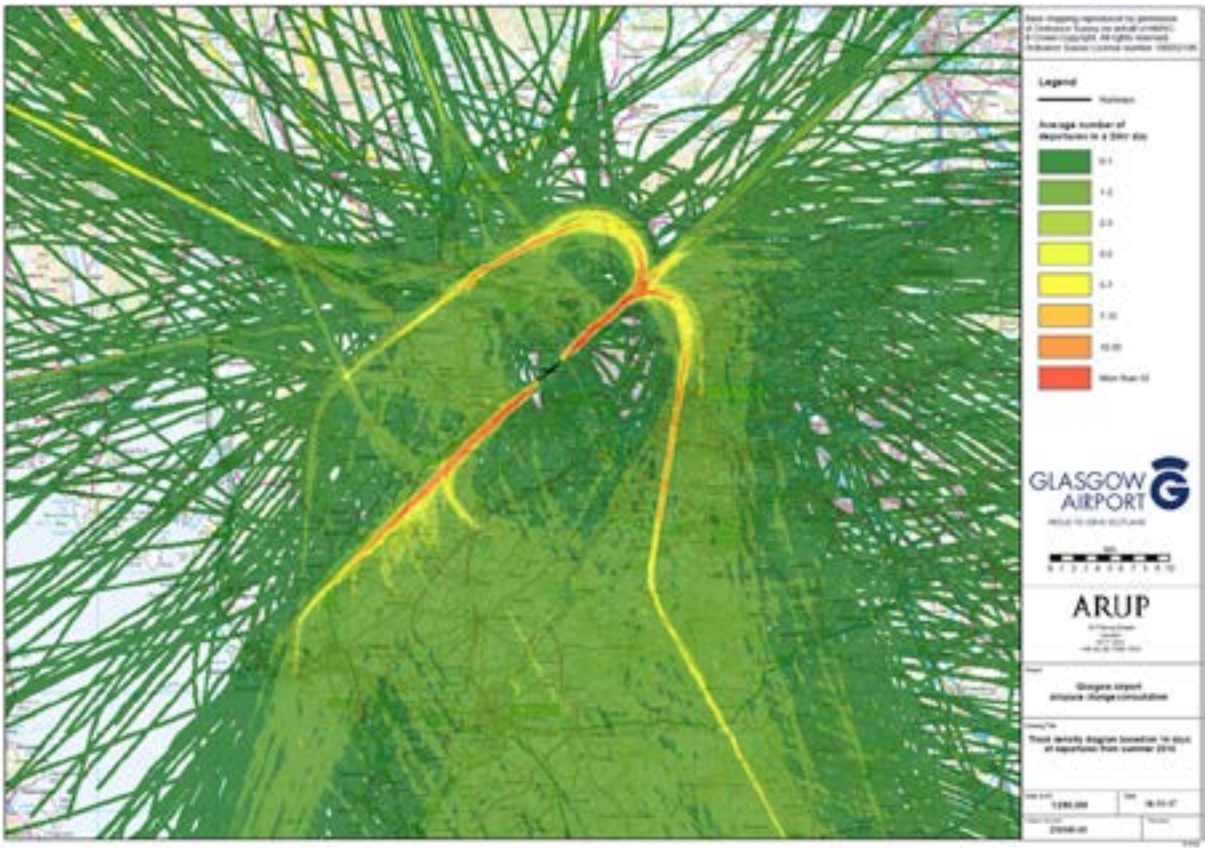


Figure 4: Track Density Plot based on 14 days of 2016 Summer Departures

[20] See Section 5 of the UK Airspace Policy: A framework for balanced decisions on the design and use of airspace, www.gov.uk/government/uploads/system/uploads/attachment_data/file/588186/uk-airspace-policy-a-framework-for-balanced-decisions-on-the-design-and-use-of-airspace-web-version.pdf

areas outside the published SID routings once NAPs have been adhered to. Notwithstanding this, the SID procedures do represent an efficient strategic route structure, within the necessary procedure design and environmental constraints, for integrating the traffic flows with the minimum of inter-controller co-ordination. It is therefore expected that this airspace systemisation will result in a significant reduction in the practice of radar vectoring.

3.1.10 Within each SID description we have apportioned 2016 traffic to the new procedures to give an indicated utilisation. Additionally, forecast growth for 10 years beyond the planned implementation year (2019) is taken into account in the environmental metrics.

3.2 Overview - Proposed SID Procedures

3.2.1 In this section we provide a brief overview of the SID procedures. The technical and detailed descriptions of the individual procedures are published as separate supporting documents (Annexes A and B). The description of the NAP part of the SIDs, common to all nine procedures, is detailed in paragraph 3.7 below.

3.2.2 The SID names are conceptual only purely for this consultation process and are loosely based upon Scottish individuals who have introduced innovation or change. Once the ACP is finalised the names will be converted to the required international standard for publication.

3.2.3 The SIDs are individually detailed at Annexes A and B as follows:

- Annex A – Runway 05 SIDs; and
- Annex B – Runway 23 SIDs.

3.2.4 By breaking these out into two separate annexes, consultees can view the SIDs of specific interest to them as separate documents without the needing to download the information for all the procedures.

3.3 How will the proposed SIDs differ to those that exist today?

3.3.1 The existing procedures rely on a network of ground-based navigation aids to define tracks aligned directly towards or away from those navigation facilities. By contrast, the new procedures are not constrained in this way and tracks can be designed between "points in space" which are not aligned to the ground-based infrastructure. Furthermore, as explained previously, satellite navigation results in greater predictability and repeatability of the tracks flown.

3.3.2 Most of the proposed SIDs have a steeper minimum climb gradient associated with them than the existing SIDs meaning that aircraft will climb quicker on departing the airport. This steeper climb will not make any perceivable difference to passengers.

3.3.3 This proposed array reduces the number and complexity of the departure procedures to a more appropriate level and, should they be implemented, will enable aircraft to depart the airport in a more efficient and predictable manner.

3.4 Proposed Upper Limit of all SIDs

3.4.1 Glasgow Airport is relatively close to Edinburgh Airport (EDI) and Prestwick Airport (PIK) whose arrival and departure routes must be integrated with each other. In addition, we need to take due regard of any potential future growth of Cumbernauld Airport.

3.4.2 As a consequence of these various interactions, Glasgow Airport departure procedures must initially be limited to a maximum altitude of 6,000 feet within the procedure design for flight safety reasons.

3.4.3 A climb clearance above 6,000 feet will be given by ATC at PC. This will ensure that aircraft are able to continue climbing above the published upper limit of the SID procedures as soon as it is safe to do so with respect to other aircraft.

3.4.4 Investigations into the possibility of allowing the southbound SIDs to continue climbing to a Flight Level are ongoing at the request of the PLAS team at PC as this may result in a smoother overall operation. This will have no impact on the SIDs at a lower level and will be invisible to community stakeholders, we do however welcome the views of aviation stakeholders on this matter.

3.5 Runway 23

3.5.1 **Figure 5** below depicts the proposed SIDs from Runway 23 as compared with the existing SID array. **Figure 6** (overleaf) is a close-up of the initial climb out portion.

Figure 5: Runway 23 - Proposed SIDs vs Current Published SIDs

ⓘ More detailed maps available online at **glasgowairport.com/airspace**

"The technical and detailed descriptions of the individual procedures are published as separate supporting documents (Annexes A and B)."

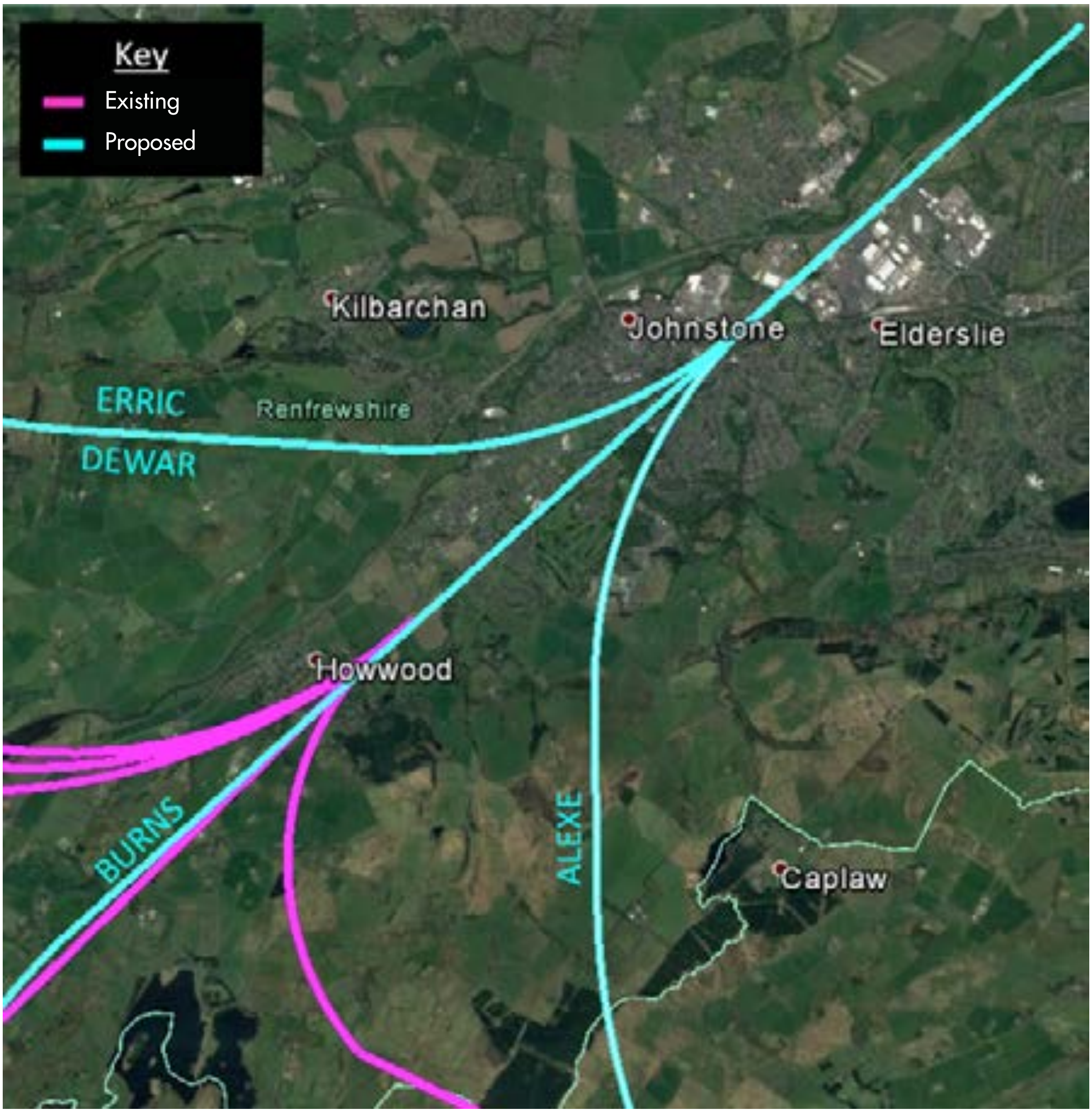


Figure 6: Runway 23 - Proposed SIDs vs Current Published SIDs – Close-in view

3.6 Runway 05

3.6.1 **Figure 7** depicts the proposed SIDs from Runway 05 as compared with the existing SID array. **Figure 8** is an expansion of the initial climb out portion.

3.7 Noise Abatement Procedures

3.7.1 Glasgow Airport operates comprehensive NAPs for departing aircraft to minimise the noise impact and the number of people affected near the airport. The NAPs apply to all aircraft, jet and non-jet, of more than 5.7 tonnes Maximum Total Weight Authorised (MTWA).

3.7.2 The NAPs must be adapted to reflect the proposed changes. Further explanation is given below to assist understanding of what these changes would be and how they are assessed. A detailed evaluation of the noise and other possible environmental impacts for each proposed procedure is given in the coming paragraphs and the technical annexes.

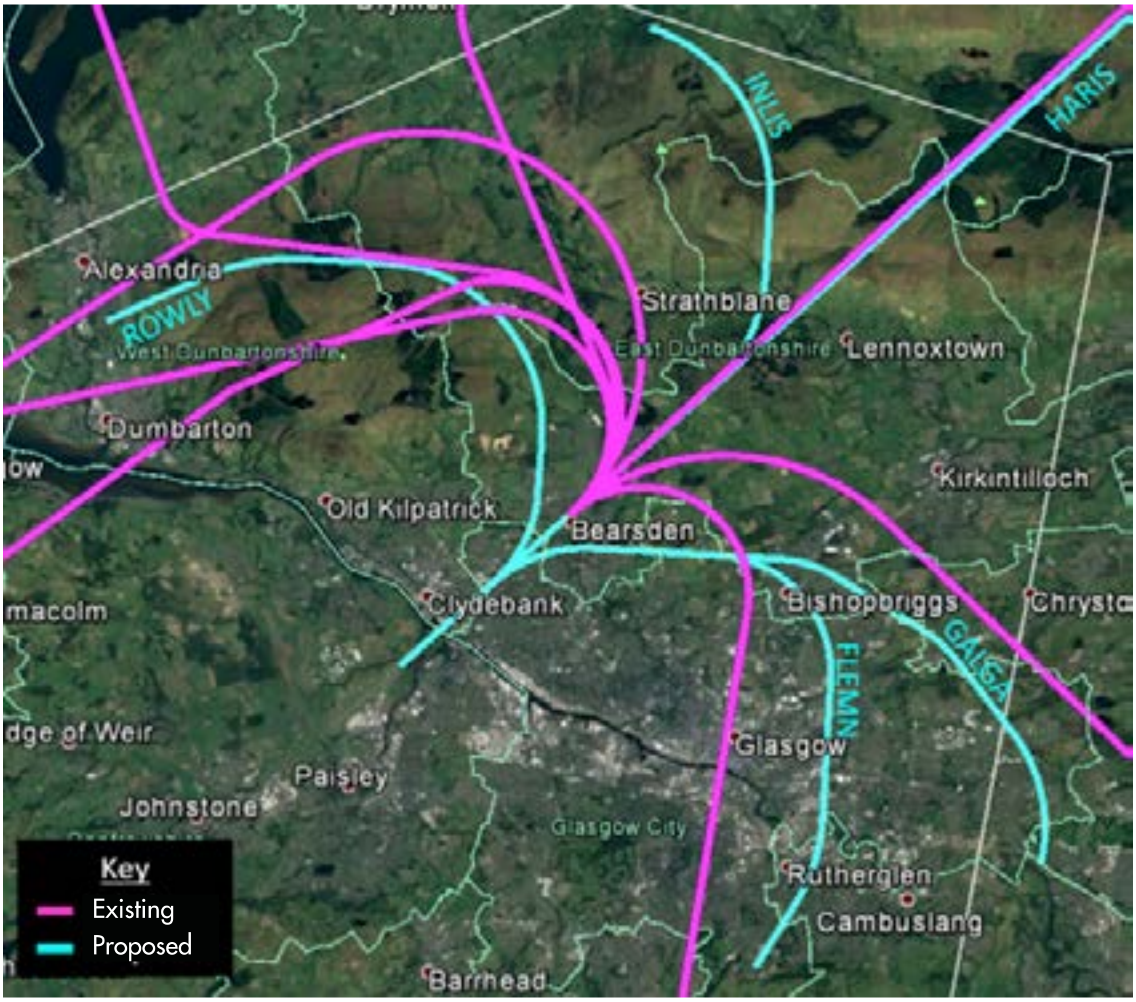


Figure 7: Runway 05 - Proposed SIDs vs Current Published SIDs

Figure 8: Runway 05 – Proposed SIDS vs Current Published SIDs – Close-in view

ⓘ More detailed maps available online at **glasgowairport.com/airspace**

3.7.3 The existing NAPs require aircraft to fly straight ahead for a minimum distance of 5 NM. It is proposed that the NAPs be adapted to meet the requirements of the proposed SIDs and aircraft would then be expected to follow the new procedures to a minimum altitude of 4,000 feet unless there is a safety-related reason for them to be deviated from it. This is because the proposed departures have earlier turns built-in to them that would preclude aircraft from maintaining a straight ahead track to 5NM.

3.7.4 Aircraft following the ODDs will be expected to maintain a straight-ahead profile until passing at least 4,000 feet unless there is a safety-related reason for them to be deviated from it.

3.7.5 The NAP requirements shall apply in all weather conditions unless weather avoidance is required for safety reasons. Above 4,000 feet, ATC will be at liberty to vector (turn) the aircraft as the operational scenario demands. The SIDs have been optimised to reduce the likelihood of vectoring being required.

3.7.6 We propose to build in 'Respite' into the operational use of our SID procedures on Runway 05. Respite is defined by the CAA as 'Planned and notified periods where overflight or noise impact are reduced or halted to allow communities undisturbed time'. More details on this can be found in **Annex A** to this document.

3.7.7 We will simultaneously be launching a consultation on our Noise Action Plan (a 5-yearly requirement) in January 2018. More details on this separate consultation can be found at www.glasgowairport.com/community/noise

3.8 Noise and Track Monitoring

3.8.1 Glasgow Airport utilise a Noise and Track Monitoring (NTK) System which measures and records the noise generated and tracks flown by arriving and departing aircraft as recorded by ATC radar systems. Diagrams in this document showing historic tracks flown by aircraft are derived from the NTK System.

3.9 Noise Metrics

3.9.1 There are an increasing number of metrics associated with the measurement of aviation noise. We have engaged specialist noise consultants (ARUP) to produce noise contour charts not only to meet DfT and CAA requirements but also to provide you, the Consultee, with sufficient information to help you understand what the changes will mean in relation to noise.

3.9.2 ARUP have used the Federal Aviation Authority's (FAA) Aviation Environmental Design Tool (AEDT 2d), which is a recognised noise modelling tool for aviation purposes, to develop the noise contour charts.

3.9.3 The metrics commissioned consider five scenarios for comparison:

- Current situation (baseline 2017);
- Situation immediately following airspace change (2019);
- Situation at proposed implementation without airspace change (2019);
- Situation after aircraft traffic has increased without airspace change (2029); and
- Situation after aircraft traffic has increased following airspace change (2029).

3.10 Population Data

3.10.1 The population data used for the metrics is derived from the 2011 UK Census (the most recent available) enhanced by postcode level projected population data to represent 2017 from CACI Limited. Population counts in the tables included in this document are rounded to the nearest 100 as recommended by the CAA. The contours for the 2019 and 2029 scenarios assume population figures remain as they are in 2017 which we accept is most unlikely.

3.11 Understanding the noise numbers

3.11.1 Some of the environmental information provided relates to theoretical maximum noise levels that may be experienced by people on the ground from an aircraft flying directly overhead. This is known as L_{max}. The unit of measurement is A-weighted decibels (dB(A)) (loudness of noise matched to the frequency response of the human ear).

3.11.2 The CAA Environmental Research and Consultancy Department (ERCD) has produced L_{max} data as a function of aircraft height above the ground (together with the degree of uncertainty of the data) for representative groupings of aircraft. We have extracted data from ERCD pertinent to the aircraft types that are likely to operate from Glasgow Airport and utilise the SID procedures. **Table 1** provides a comparison to the level of noise that can be expected.

3.11.3 The aircraft types predominantly operating services from Glasgow Airport (Airbus A319 and Boeing B737-800) are grouped together with other comparable aircraft for noise measurement purposes as detailed in **Table 2**.

NOISE	NOISE LEVEL (dB(A)
Chainsaw at 1m distance	110
Disco, at 1m from speaker	100
Diesel truck passing by 10 m away	90
Kerbside of a busy road, 5m away	80
Vacuum cleaner, 1m away	70
Conversational speech, 1m away	**60**
Quiet Office	50
Room in a quiet suburban area	40
Quiet Library	30

Table 1: Everyday examples of noise levels.

SPECIFIC AIRCRAFT TYPES	NOISE GROUPING	GROUP
ATR-42; ATR-72;	50-70 seat regional turboprop	A
Bombardier CRJ; Embraer 135/145	50 seat regional jet	B
Bombardier CRJ700/900;	70-90 seat regional jet	C
Airbus A318/319/320/321; Boeing B737-600/700/800/900	**125-180 seat single-aisle 2-engine jet**	**D**
Airbus A330, Boeing 767-300/400	250 seat twin-aisle 2-engine jet	E
Airbus A340-200/300/500/600, Boeing 777-200/300/ER	300-350 seat twin-aisle jet	F
Boeing 747-400	400 seat 4-engine jet	G
Airbus A380	500 seat 4-engine jet	H

Table 2: Aircraft Noise Groups

Height (ft)	A	B	C	D	E	F	G	H
1000-2000	78-71	78-70	85-75	85-75	92-83	90-81	92-84	91-84
2000-3000	71-67	70-65	75-68	75-70	83-77	81-75	84-79	84-80
3000-4000	67-64	65-60	68-64	70-66	77-73	75-71	79-75	80-76
4000-5000	64-62	60-57	64-61	66-63	73-69	71-67	75-72	76-73
5000-6000	62-60	57-55	61-58	**63-60**	69-66	67-64	72-69	73-71
6000-7000	60-58		58-56	60-59	66-64	64-62	69-67	71-68

Table 3: Average L_{max} for departing aircraft for noise assessment purposes

3.11.4 **Table 3** gives the L_{max} noise levels that the CAA noise modelling has developed for these aircraft groups for departing aircraft as a function of height above the ground.

3.11.5 From this you can see that an A319 or a B737-800 passing 5,001 feet (height above the ground) would result in an expected noise level of 63-60 dB(A) L_{max} (equivalent to the noise level of conversational speech, 1 metre away).

3.11.6 'Height' as mentioned above, refers to a vertical point above the ground (above ground level (agl) whereas 'Altitude' refers to a vertical point above mean sea level. If the ground has an elevation of 1,000 feet and an aircraft is at altitude 5,000 feet over that point, it is only at a height of 4,000 feet above the ground. This is an important distinction to understand as most references to vertical levels in this document are altitude-based (above mean sea level). **Figure 9** below depicts this scenario. It should be assumed, unless stated otherwise, that we are referring to altitude for the remainder of the document.

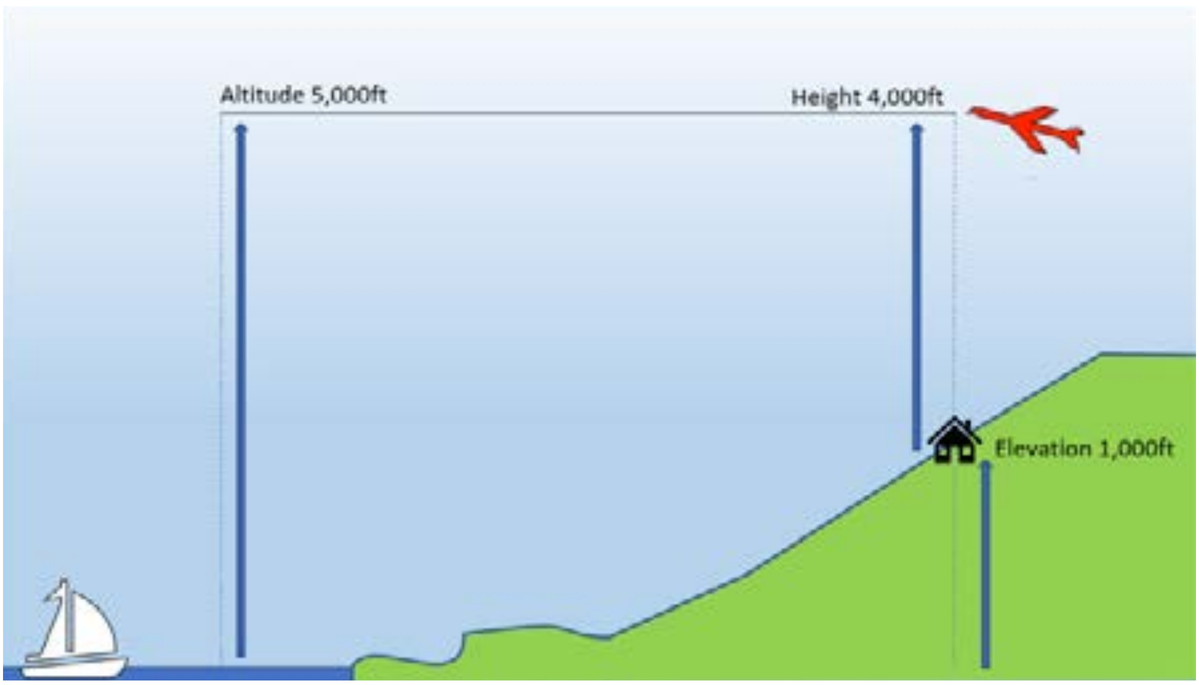


Figure 9: Altitude and Height Explained

3.11.7 **Figures 10 and 11** are NTK altitude-referenced, colour-coded track plots showing the achieved climb profile of departing aircraft on the existing procedures over a sample period. These plots, when viewed in connection to **Table 3** above, should enable the reader to better understand the existing noise exposure in the Glasgow Airport region. The dark green tracks show aircraft above 6,999 feet. Most of the red tracks that appear to turn away from the runway early and remain red are propeller driven aircraft, many of which will be General Aviation aircraft not climbing above 3,000 feet and following Entry Exit lanes to the local flying training areas or via the River Clyde. These aircraft result in much lower noise levels.

3.11.8 Whereas L_{max} detailed in the paragraphs above relate to the maximum noise generated by individual aircraft groups, the Government is also concerned about noise experienced over a longer period (measured over a 16-hour period for day and an 8-hour period for night). This is known as $L_{Aeq,\ 16h}$ and $L_{Aeq,\ 8h}$ and these are metrics used to assess the impact of noise on the quality of life of the community.

3.11.9 Noise (L_{Aeq}) contour charts are produced to show how aircraft noise from both landing and departing aircraft is distributed near the airport. L_{Aeq} is the equivalent continuous sound level measured in a unit called the "A-weighted decibel" (dB(A)), where dB means decibel (a unit of "loudness") and A-weighted means matched to the frequency response of the human ear.

3.11.10 The Government Aviation Policy Framework considers the 57dB $L_{Aeq,16h}$ contour as marking the approximate onset of significant community annoyance. What is more difficult to define is the Significant Observed Adverse Effect Level (SOAEL), the exact point at which the average person would be expected to begin to experience 'significant' adverse effects on health and quality of life. The Lowest Observed Adverse Effect Level (LOAEL), the point at which adverse effects begin to be seen on a 'community' basis has been recently determined to be 51dB $L_{Aeq,16h}$ during daytime (previously 57db) and 45dB $L_{Aeq,\ 8h}$ at night-time. Note: $L_{Aeq,16h}$ and $L_{Aeq,\ 8h}$ depicted in the Noise Contour Charts and L_{max} detailed in **Table 3** (on previous page) are different units of measurement. See **Glossary of Terms** for definitions.

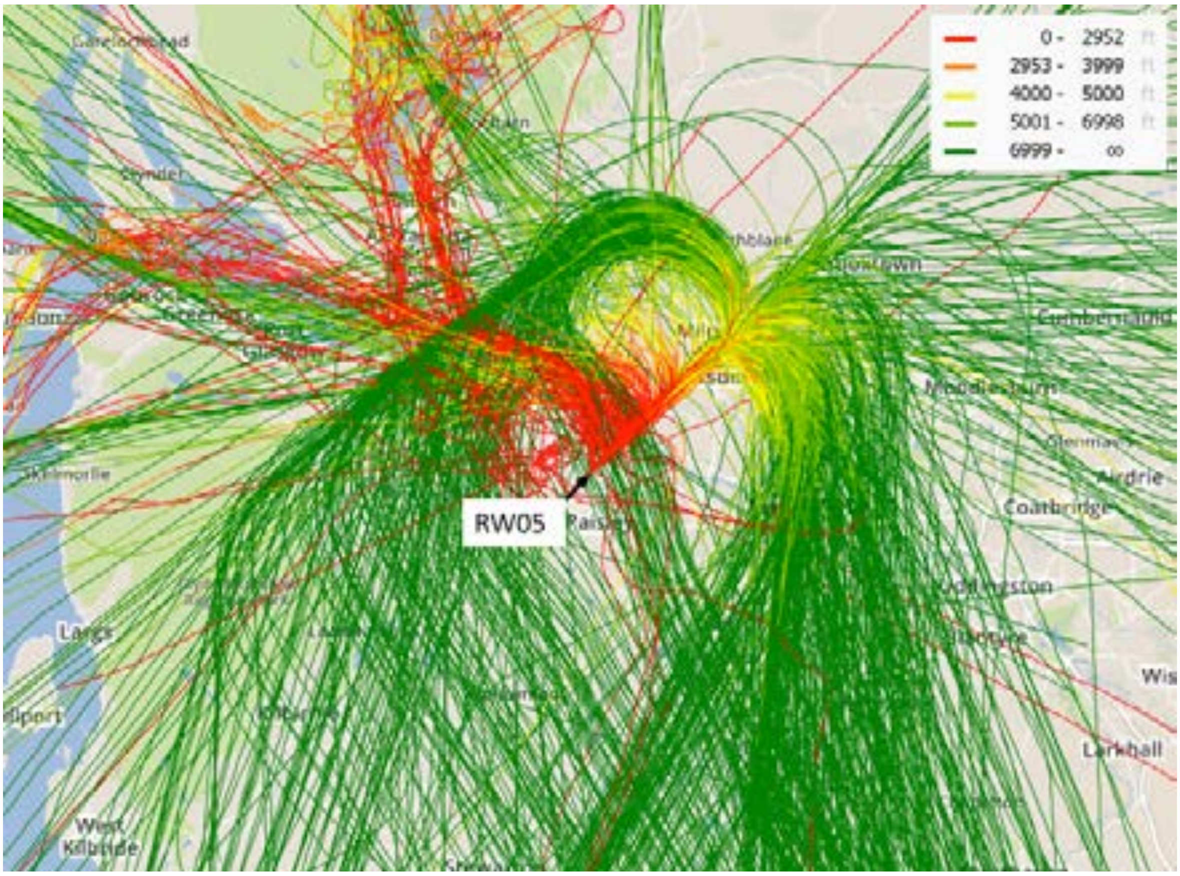


Figure 10: Altitude Referenced NTK Plot for Runway 05 Departures - 1-7 May 2017

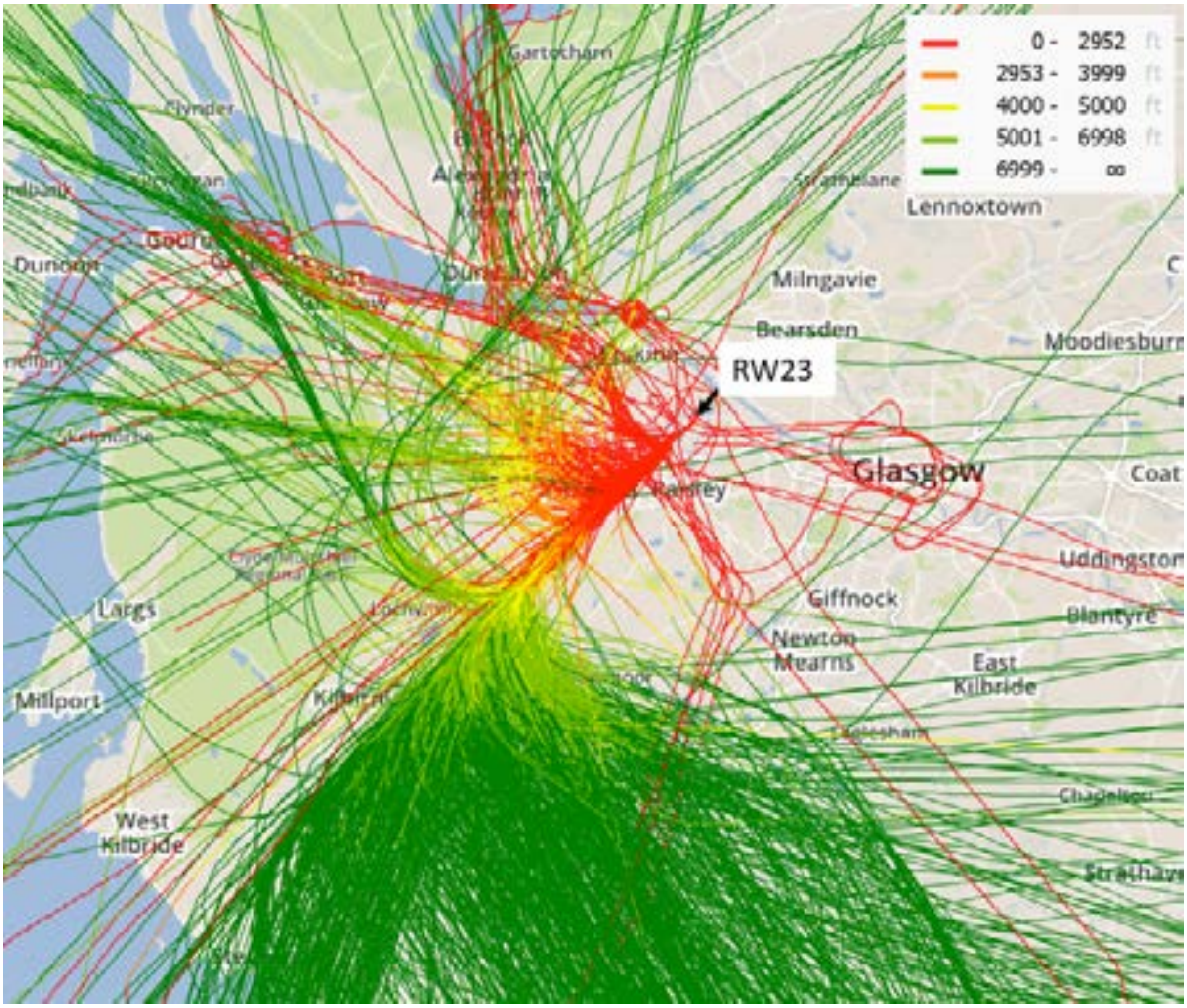


Figure 11: Altitude Referenced NTK Plot for Runway 23 Departures - 11-17 June 2017

ⓘ More detailed maps available online at **glasgowairport.com/airspace**

3.11.11 Following due consideration of the emerging changes to Government Policy, we chose to commission modelling using the 51dB (day) and 45dB (night) contours as the lowest levels.

3.12 Daytime Summer Average $L_{Aeq,\ 16h}$ Contours

3.12.1 The CAA requires noise exposure contours to be produced for any airspace change which entails change to departure procedures below 4,000 feet. The contours must be produced for the current situation (2017); the situation immediately following the change (2019) (this scenario takes into account the forecast traffic growth); and the predicted situation with and without the new arrangements based on forecasted growth 10 years after implementation (2029). We have also looked at the scenario of the implementation year with forecast traffic growth (2019) assuming no change has happened. The contours for all these scenarios can be downloaded separately from our website www.glasgowairport.com/airspace

3.12.2 The noise contour charts are calculated to show the noise distribution over a daytime 16-hour period ($L_{Aeq,\ 16h}$) between 0700 and 2300 for a typical summer's day. This is mainly because airports are normally busier during the summer period and a greater number of movements are likely to produce higher L_{Aeq} values. The noise calculation therefore produces a cautious estimate (i.e. tends to over-estimate) noise exposure. The $L_{Aeq,\ 16h}$ contours were based on Glasgow Airport traffic data for the 92-day summer period (16 June to 15 September 2017, 0700-2300 local time). Noise levels from 51dB(A) to 72dB(A) at 3dB(A) intervals are plotted. This 3dB(A) interval methodology is standard the 51dB(A) minimum meets DfT and CAA requirements.

3.12.3 The contours for the Daytime Summer Average $L_{Aeq,\ 16h}$ (2019 comparisons) can be viewed over the coming pages in **Figures 12 and 13**. From the contour charts the number of households and the population contained within each contour can be assessed and so the effects of changes to routes and traffic profiles close to the airport can be estimated. We have extracted the population data and put it into **Table 4** (below). The population figures are rounded to the nearest 100.

3.12.4 The highlighted top row of Table 4 (below) represents the cumulative population contained within the noise footprint measured for daytime, i.e. it is the outer contour that incorporates all the other contours and the population contained within them. The proposed change (2019) scenario shows a reduction in the overall noise footprint (i.e. those encompassed by the measured contours down to the 51dB(A) contour) by 3.2%, equating to 3,000 people less than under the existing arrangements. The number of people contained within the 51db(A) contour increases by 2029, regardless of whether or not change has taken place, as a result of projected traffic growth (not projected population growth). The scenario with the proposed airspace change by 2029 has overall 2.8% less people within the measured contours than the scenario without the airspace changes in 2029. Note: The top line (51dBA) is key as all the other contours are included in this figure.

3.12.5 The outer contour, on the maps over the following pages, shows the Lowest Observed Adverse Effect Level (LOAEL), the 51dB(A) contour. This is the point at which adverse effects begin to be experienced on a 'community' basis. The contours are shaped in this non-uniform shape for a variety of reasons; they factor in arrivals and departures of both runways which are not equally used and they factor in terrain (hence the contour 'islands' to the north-east). The reason for the strange 'growth' to the south-west is the inclusion of the proposed SID ALEXE which turns left earlier that the existing SIDs as discussed in greater depth in **Annex B**.

L_{Aeq}	CUMULATIVE POPULATION WITHIN THE CONTOUR					
	2019 without change	2019 proposed change	2019 % difference	2029 without change	2029 proposed change	2029 % difference
> 51dB	**89,500**	**86,500**	**-3.2%**	**101,700**	**98,800**	**-2.8%**
> 54dB	51.000	50,600	-0.8%	63,000	62,900	-0.1%
> 57dB	17,400	18,100	4.5%	23,900	26,200	9.7%
> 60dB	4,400	4,500	2.8%	6,500	6,800	5.3%
> 63dB	1,000	1,000	0%	1,400	1,600	8%
> 66dB	0	0	0%	<100	<100	-44.4%
> 69dB	0	0	0%	0	0	0%
> 72dB	0	0	0%	0	0	0%

Table 4: $L_{Aeq,\ 16h}$ comparison

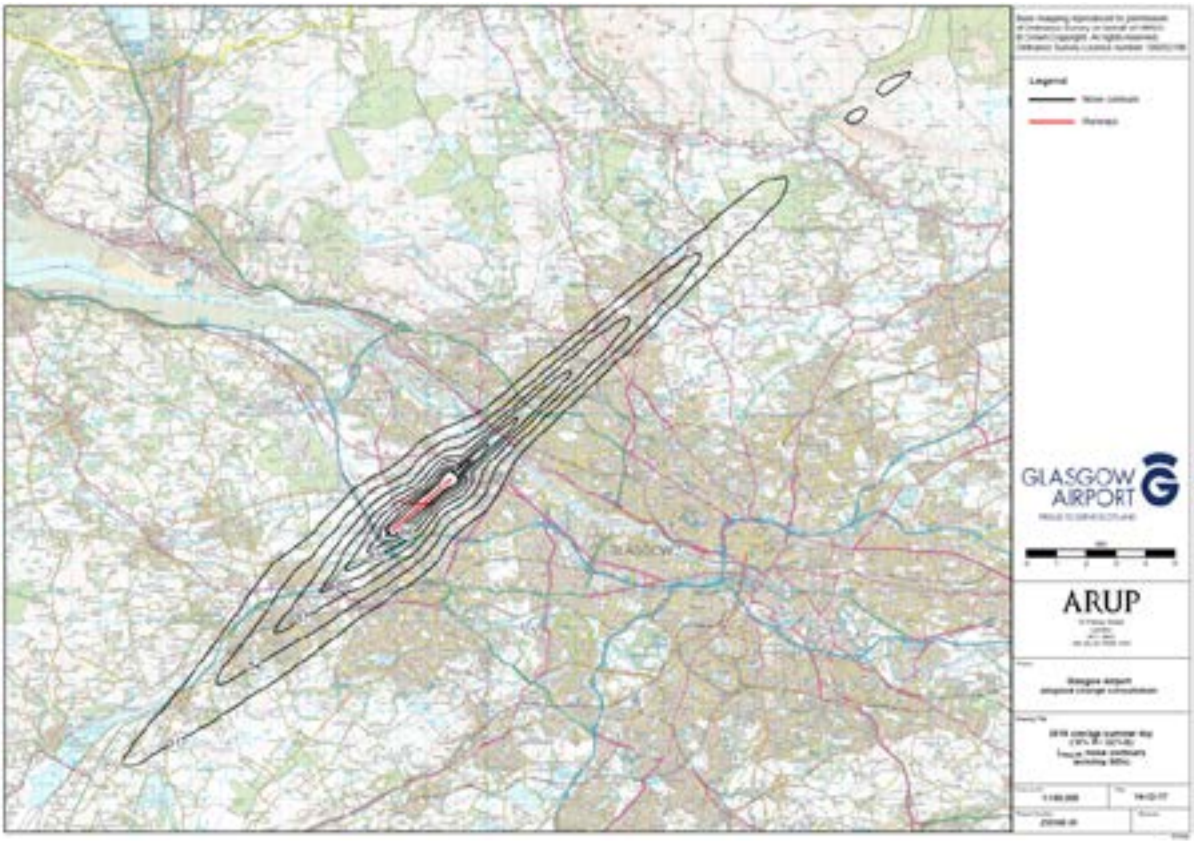


Figure 12: 2019 Average Summer Day $L_{Aeq,\ 16h}$ Noise Contours (Existing SIDs – Without Change)

Figure 13: 2019 Average Summer Day $L_{Aeq,\ 16h}$ Noise Contours (Proposed SIDs – With Change)

More detailed maps available online at **glasgowairport.com/airspace**

3.13 Night-time Summer Average $L_{Aeq,\ 8h}$ Contours

3.13.1 These noise contour charts are calculated to show the noise distribution over a night-time 8-hour period ($L_{Aeq,\ 8h}$) between 2300 and 0700 for a typical summer's night. As with the day-time equivalents, this is mainly because airports are normally busier during the summer period with a greater number of movements likely to produce higher L_{Aeq} values. The $L_{Aeq,\ 8h}$ contours were based on Glasgow Airport traffic data for the 92-day summer period (16 June to 15 September 2017, 2300-0700 local time). Noise levels from 45dB(A) to 61dB(A) at 3dB(A) intervals are plotted. This 3dB(A) interval methodology is standard throughout the UK and meets emerging DfT and CAA requirements. Note: "Night" for Glasgow Airport operations is currently set out in UK AIP as the period between 2330 and 0659 (Local Time). This will be updated to reflect the new proposed time window representing night-time.

3.13.2 As with the daytime contours, the number of households and the population within each contour can be assessed and so the effects of changes to routes and traffic profiles close to the airport can be estimated. The highlighted top row of Table 5 (below) represents the cumulative population contained within the noise footprint measured for night-time, i.e. it is the outer contour that incorporates all the other contours and the population contained within them. It shows that when the 2019 situations are compared, under the proposed scenario, there is a reduction in the overall noise footprint (i.e. those encompassed by the 45dB(A) contour) by 2.5%. This equates to over 2,000 people less than under the existing arrangements. The number of people contained within the 45db(A) contour increases by 2029 regardless of whether or not change has taken place as a result of projected traffic growth (not projected population growth). The scenario with the proposed airspace change by 2029 has overall 1.2% less people within the measured contours than the scenario without the airspace changes in 2029. Note: The top line (45dBA) is key as all the other contours are included in this figure.

3.13.3 The contours for the 2019 scenarios can be seen over the coming pages. The contours for all these scenarios can be downloaded separately from our website www.glasgowairport.com/airspace

L_{Aeq}	CUMULATIVE POPULATION WITHIN THE CONTOUR					
	2019 without change	2019 proposed change	2019 % difference	2029 without change	2029 proposed change	2029 % difference
> 45dB	**84,400**	**82,300**	**-2.5%**	**93,700**	**92,600**	**-1.2%**
> 48dB	48,300	47,300	-2%	59,200	57,900	-2.1%
> 51dB	20,200	20,400	1.3%	26,900	27,500	2.4%
> 54dB	6,400	6,400	0%	8,900	9,200	3.4%
> 57dB	1,300	1,400	6.9%	2,000	2,100	2.9%
> 60dB	0	0		<100	<100	0%
> 63dB	0	0		0	0	0%
> 66dB	0	0		0	0	0%

Table 5: $L_{Aeq,\ 8h}$ comparison

Figure 14: 2019 Average Summer Night $L_{Aeq,\ 8h}$ Noise Contours (Existing SIDs – Without Change)

Figure 15: 2019 Average Summer Night $L_{Aeq,\ 8h}$ Noise Contours (Proposed SIDs – With Change)

ⓘ More detailed maps available online at glasgowairport.com/airspace

3.14 Nx Contours

3.14.1 L_{Aeq} contours tend to be limited to showing the impacts of noise close to the airport, i.e. below 4,000 feet. Nx contours are a secondary noise metric intended to show the impacts of noise beyond that. Nx contours show the locations where the number of events (i.e. flights) exceeds a pre-determined noise level, expressed in dB LAmax. For example, N65 contours show the number of events where the noise level from those flights exceeds 65 dB LAmax. The levels of 65 dB LAmax for daytime flights and N60 for night-time flights were selected because they are specified in the DfT's Air Navigation Guidance as supplementary metrics. We have commissioned the Nx contours to show the impact of noise between 4,000 and 7,000 feet in accordance with CAA requirements.

3.14.2 As with L_{Aeq} contours, the N65 contours must reflect a long-term average summer day (16 hours, from 0700 to 2300) and the N60 contours must reflect a long-term average summer night (8 hours, 2300 to 0700), using actual runway usage and including all air traffic movements. The contours for all these scenarios can be downloaded separately from our website www.glasgowairport.com/airspace

3.15 N65 (Daytime) Contours

3.15.1 **Table 6** (below) shows the population within frequency contours where the noise level from flights exceeds 65 dB LAmax. The number of people within the >150 contour increases from 2019 to 2029 by virtue of projected traffic growth (not projected population growth). During the average summer day, in the 2029 proposed scenario, 10,700 people are projected to experience >150 events of noise level exceeding 65 dB LAmax (as opposed to 12,000 without the change). This represents an improvement of 11% were the proposed changes to be made.

3.15.2 The overall N65 footprint is projected to increase by 1.9% in 2019 (with change) but the table shows that this decreases to 1% by 2029. The associated 2019 N65 contour charts are shown over the coming pages in **Figures 16 and 17**. The contours for the proposed scenario has a 'bulbous growth' towards the south that is the result of the inclusion of SID ALEXE which turns left earlier than any of the existing SIDs.

L_{Aeq}	POPULATION WITHIN THE CONTOUR					
	2019 without change	2019 proposed change	2019 % difference	2029 without change	2029 proposed change	2029 % difference
> 10	**141,900**	**144,700**	**1.9%**	**152,800**	**154,500**	**1%**
> 50	77,500	75,000	-3.2%	81,400	83,400	2%
> 100	32,100	33,700	5.1%	52,600	51,300	-2%
> 150	100	100	0	12,000	10,700	**-11%**

Table 6: N65 (Daytime) Comparison

Figure 16: 2019 Average Summer Day N65 Noise Contours (Existing SIDs)

Figure 17: 2019 Average Summer Day N65 Noise Contours (Proposed SIDs)

3.16 N60 (Night-time) Contours

3.16.1 The table below shows the population within frequency contours where the noise level from flights exceeds 60 dB LAmax. In 2019, the number of people experiencing >20 noise events exceeding 60dB LAmax remains the same regardless of whether or not the proposed changes are implemented. With traffic growth, the 2029 proposed scenario shows that 26,885 (number rounded up to the nearest 100 in the table) people are projected to experience >20 events, during the average summer night, where the noise level exceeds 60 dB LAmax, this represents an increase of 2.3% as compared with the scenario without change in the same year. The overall N60 contour is reduced with change in 2019 by 3.1%. Once projected traffic growth in 2029 is factored in, this perceived improvement decreases to 1.5%. The associated 2029 N60 contour charts are shown below and overleaf in **Figures 18 and 19**.

L_{Aeq}	POPULATION WITHIN THE CONTOUR					
	2019 without change	2019 proposed change	2019 % difference	2029 without change	2029 proposed change	2029 % difference
> 10	**81,000**	**78,500**	**-3.1%**	**95,800**	**94,300**	**-1.5%**
> 15	39,500	36,000	8.8%	64,800	67,100	3.4%
> 20	400	400	0%	26,300	26,900	**2.3%**

Table 7: N60 (Night-time) Comparison

Figure 18: 2019 Average Summer Night N60 Noise Contours (Existing SIDs)

ⓘ More detailed maps available online at glasgowairport.com/airspace

Figure 19: 2019 Average Summer Night N60 Noise Contours (Proposed SIDs)

3.17 WebTAG

3.17.1 The new CAA requirement is that airports demonstrate that they have considered the impacts that any changes in noise will have on those significantly affected, including impacts on communities' health and quality of life brought about as a result of noise. Although we are not mandated to do so, we have elected to include such a study in our work.

3.17.2 The DfT's Transport Analysis Guidance (WebTAG) enables a relative comparison to be made between the noise impacts of change options. By monetising the impacts (annoyance, sleep disturbance and cardiovascular health impacts), a comparison can be made between the noise impacts of a range of options, by making a comparison to the baseline (i.e. assuming no change) for each of those options.

3.17.3 The determination of the magnitude of these health impacts is based on exposure response relationships derived from a multitude of research studies on noise and health. These exposure-response relationships allow the prediction of health impacts (the response) based on an individual's exposure to a noise source of a particular level (the exposure). The health impacts are determined for situations with and without the airspace change, and the exposure-response relationships are then used to determine the benefit or dis-benefit in health impacts as a result of the airspace change.

3.17.4 WebTAG then provides a monetised value (i.e. a monetary valuation is applied) for the impact of changes in noise exposure, based on the number of Disability Adjusted Life Years (DALYs) lost or gained for each scenario. A DALY can be thought of as one lost year of "healthy" life DALYs across the population exposed, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability.

3.17.5 We have conducted a WebTAG assessment for annoyance and health impacts during the day and sleep disturbance and health impacts during the night. The forecast year used was 2029. Positive monetary figures depict a benefit (improvement) with the proposed array, negative monetary figures depict a disadvantage with the proposals. The overall message from the WebTAG analysis is that there is a £4.8m improvement in terms of the impacts of noise on health and quality of life.

3.17.6 The number of households estimated to experience a reduction in daytime noise was almost double that of the number estimated to experience an increase. Furthermore, the number of households estimated to experience a reduction in night-time noise was greater than that of the number estimated to experience an increase.

3.18 Difference Contours

3.18.1 Difference Contours are designed to depict how an airspace change redistributes noise burdens. These contours show the relative increase or decrease in noise exposure, typically in L_{Aeq}, on a base scenario, which is normally chosen to be the current situation. The increases decreases are shown in a graduated colour coded heat map, **red** showing a relative increase and **blue** showing a relative decrease in the noise. The contours for all the scenarios included can be downloaded separately from our website www.glasgowairport.com/airspace

3.18.2 **Figures 20 and 21** depict the difference between 2019 (without change) and the situation immediately following the proposed airspace change (in 2019) during the day ($L_{Aeq,\ 16h}$) and during the night ($L_{Aeq,8h}$) respectively. The areas depicted in green, through yellow and orange to red would experience a relative increase in noise, as expected, associated with the earlier left and right turns on the proposed departure procedures.

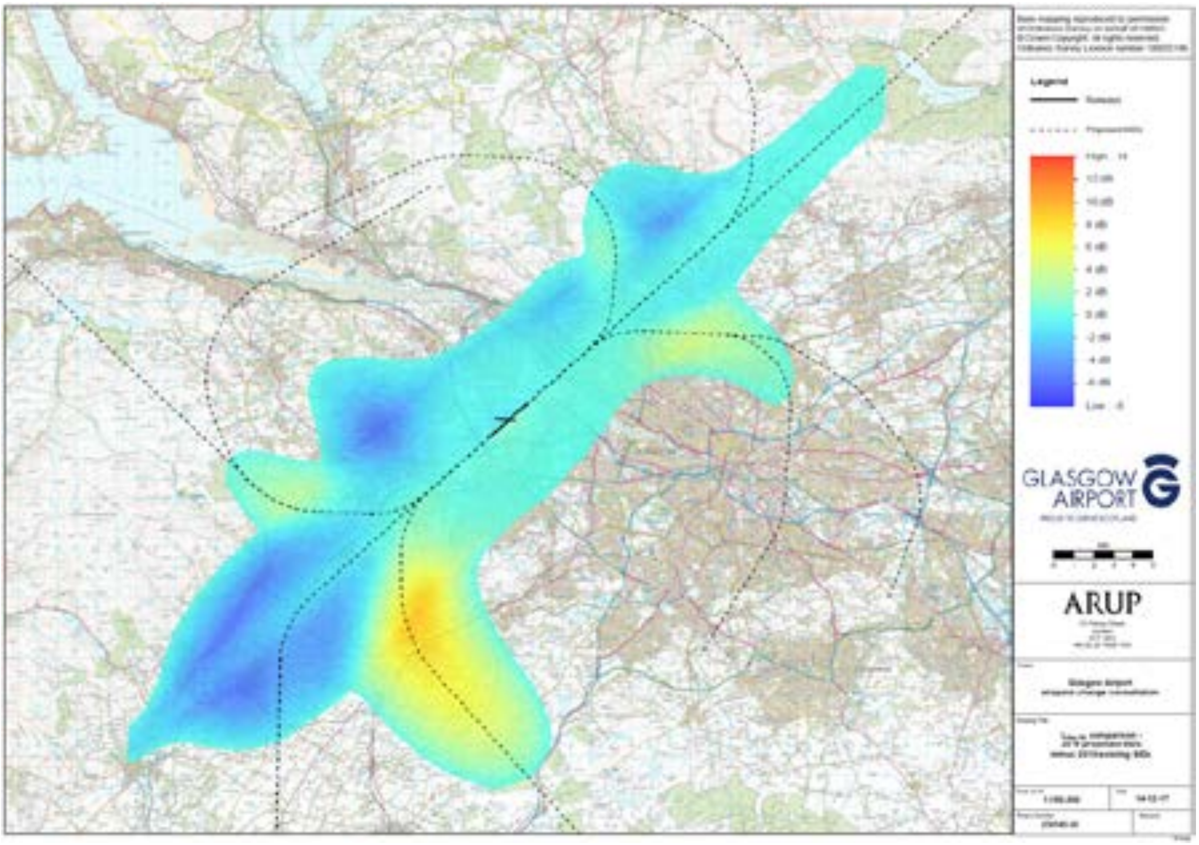


Figure 20: Daytime ($L_{Aeq,\ 16h}$) Difference Contours - 2019 Proposed SIDs minus 2019 existing SIDs

ⓘ More detailed maps available online at glasgowairport.com/airspace

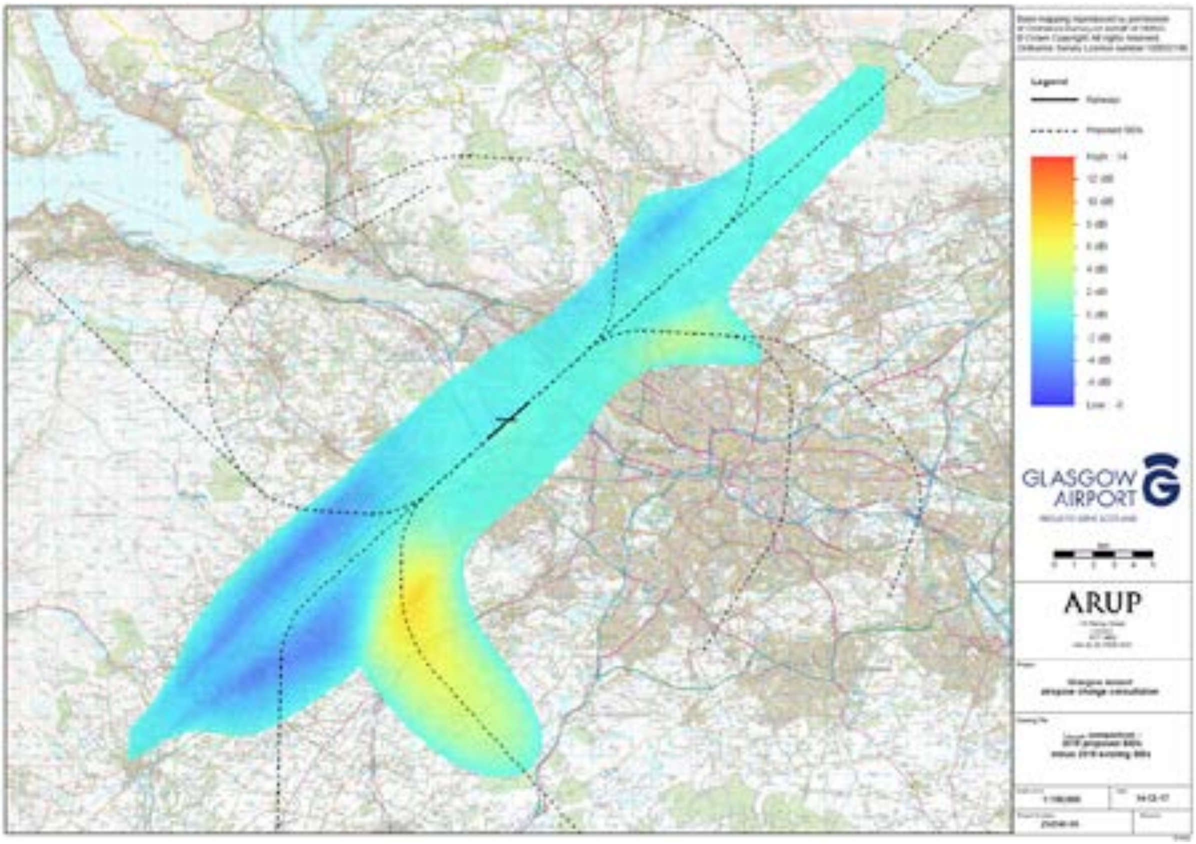


Figure 21: Night-time ($L_{Aeq,\ 8h}$) Difference Contours - 2019 Proposed SIDs minus 2019 existing SIDs

ⓘ More detailed maps available online at **glasgowairport.com/airspace**

3.19 Air Quality

3.19.1 Technical guidance material from the CAA does not require us to assess air quality as neither the airport nor the surrounding airspace lie within an Air Quality Management Area (AQMA).

3.19.2 Government guidance states that, owing to the effects of mixing and dispersion, emissions from aircraft above 1,000 feet are unlikely to have a significant effect on local air quality. There are no changes affecting flight paths below 1,000 feet in the proposed SID procedures.

3.20 Visual Intrusion and Tranquillity

3.20.1 Although difficult to measure, the potential visual intrusion and impact on tranquillity is recognised. Potential impacts on tranquillity can be portrayed by mapping out areas such as National Parks, National Scenic Areas (NSA) authorities and local communities as 'tranquil areas', 'quiet spaces' or 'green spaces'. ARUP has identified these places on an OS map and have overlaid the 51dBA $L_{Aeq,\ 16h}$, also known as the LOAEL to demonstrate its extent. As with the current scenario, the LOAEL does not include any National Parks, NSAs or Designated Quiet Areas. The contour map can be seen at **Figure 24** (overleaf).

3.20.2 Runway 05 departures overfly built-up areas below 4,000 feet, whereas off Runway 23 they typically overfly quieter, open countryside. **Figure 22** opposite depicts typical overflight of the city by departing aircraft during 1-7 May 2017. The magenta lines show the existing SID centre-lines. A significant portion of our traffic needs to depart to the south and this is currently split left and right as depicted below. Of note is the swathe of the populace that are affected by the wide distribution of the existing departure tracks.

3.20.3 As depicted in **Figure 23**, Runway 23 southbound departures currently overfly a broad swathe of Renfrewshire, North and East Ayrshire albeit much of that overflown is open countryside. The NTK sample was taken from departures from Runway 23 over 11-17 June 2017.

Figure 22: Existing SIDs Runway 05 with NTK departure data (1-7 May 2017)

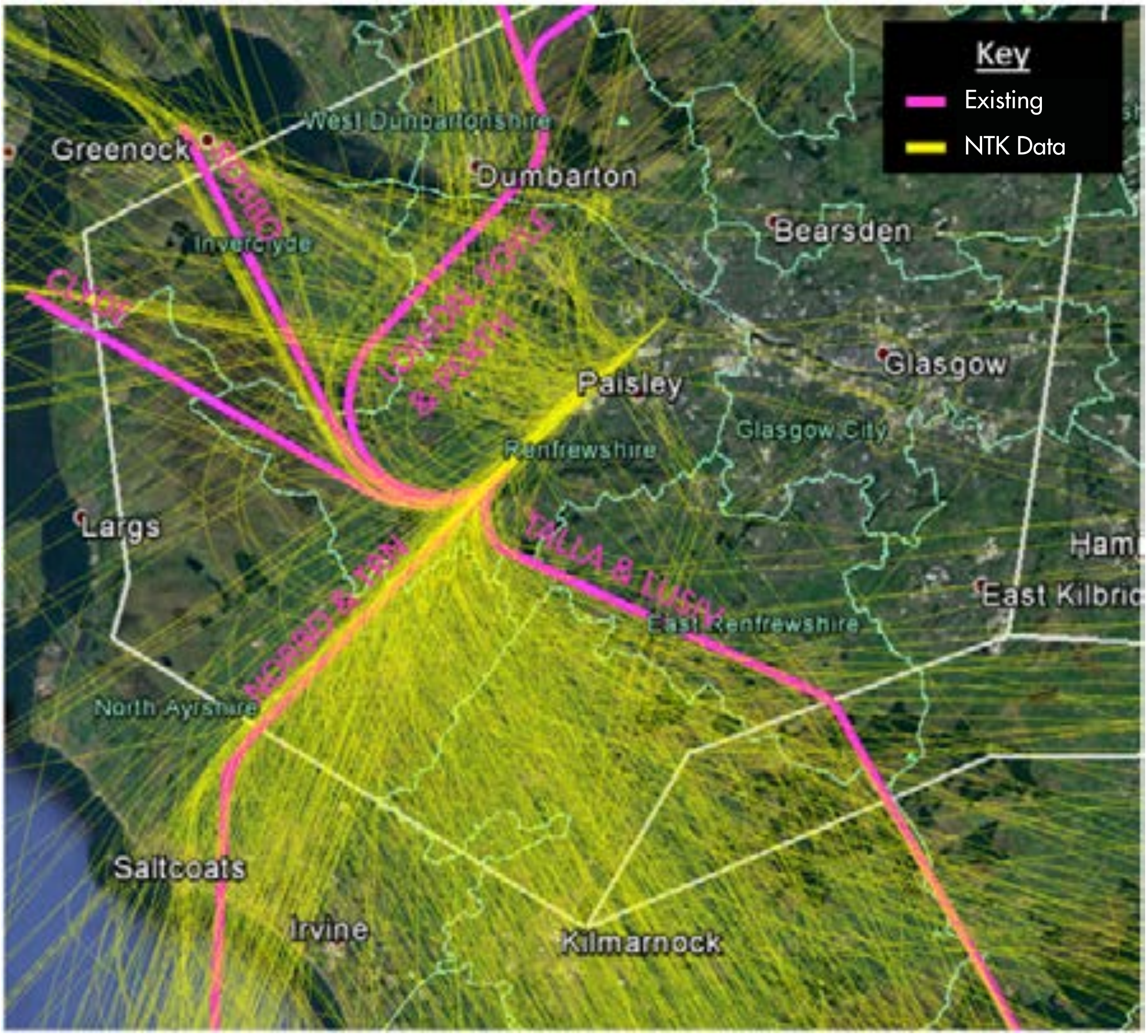


Figure 23: Existing SIDs Runway 23 with NTK departure data (11-17 June 2017)

3.21 Biodiversity

3.21.1 The CAA requires consideration, and assessment where necessary, of biodiversity, though accepts that most airspace change proposals are unlikely to have an impact. As with Visual Intrusion and Tranquillity, any potential impact on biodiversity has been portrayed against an OS background by plotting Sites of Special Scientific Interest (SSSI) and any locations designated or prized for their diversity within the vicinity of Glasgow Airport. ARUP has overlaid these with the 51dB $L_{Aeq,\ 16h}$ contour to demonstrate the limits of the LOAEL for the proposed procedures. As can be seen in **Figure 24,** the only areas contained within the contour are the Black Cart and the Inner Clyde Estuary Special Protection Areas (SPAs) and these are both contained already in the existing scenario. No SSSIs or Special Areas of Conservation (SACs) are contained within the contour.

3.22 CO_2 Emissions and Fuel Usage

3.22.1 We recognise that aviation is a contributor to greenhouse gas emissions that result in climate change and that we share the responsibility to reduce these emissions where possible.

Airspace design and operation is only one element in determining the quantity of aircraft emissions. The design of aircraft and engines, general growth of air traffic, capacity and load factors of aircraft, airline operating procedures and other factors will all have an influence on aircraft emissions, but these factors are outside the scope of the airspace change process.

3.22.2 The CAA requires that we demonstrate how the design and operation of airspace will impact on emissions and that we estimate the total annual fuel burn/mass of CO_2 in metric tonnes emitted for the current situation, the situation immediately following the airspace change and the situation after traffic has increased under the new arrangements, 10 years after implementation. Again, ARUP was commissioned to undertake this assessment for us.

3.22.3 The methodology used to estimate the differences in fuel burn and CO_2 emissions resulting from the airspace change was based on an analysis of the differences in distance between the current and proposed departure procedures. These differences were determined by comparing the distances of equivalent current and future SIDs, extended where necessary, to common end-points.

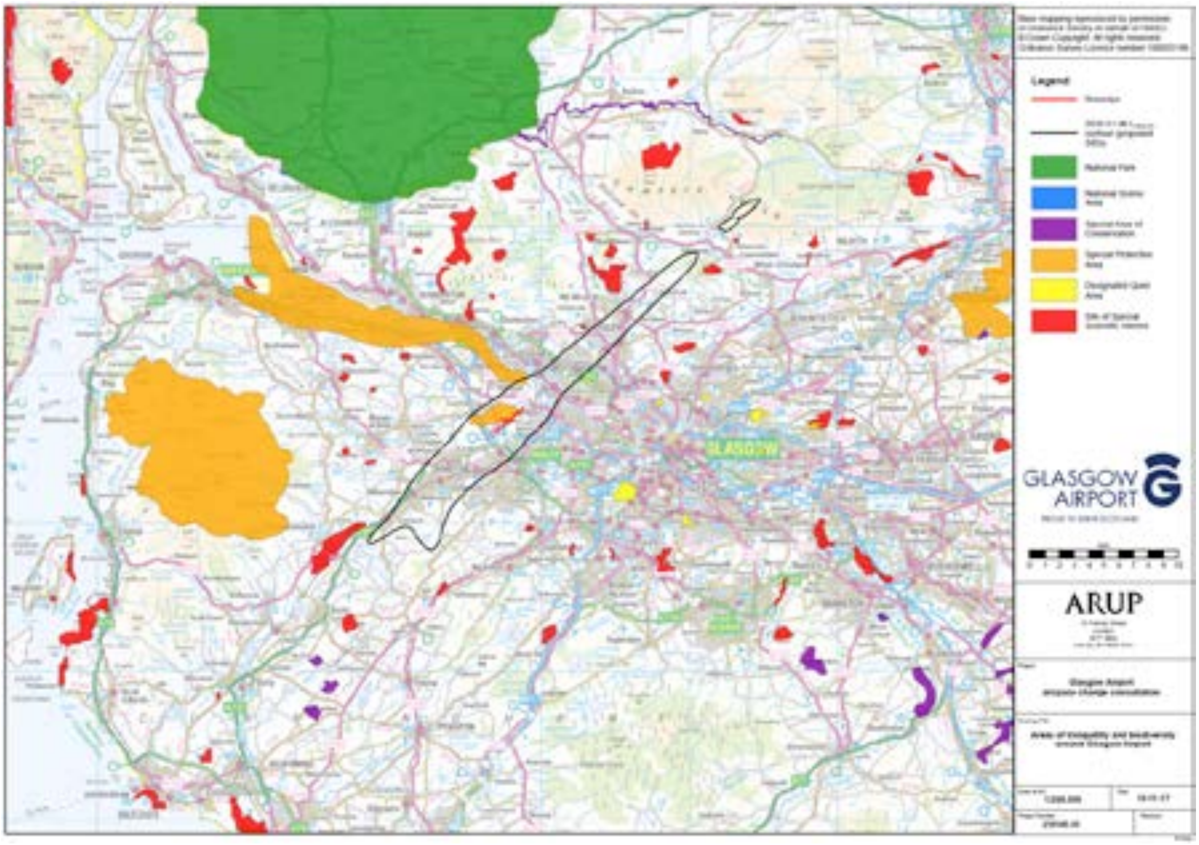


Figure 24: Areas of Tranquillity and Biodiversity around Glasgow Airport (2029 51dB $L_{Aeq,\ 16h}$ - Proposed)

3.22.4 The results of the analysis conducted by ARUP show a significant improvement (reduction) in both fuel burn, by over 4,000 tonnes, and carbon dioxide emissions, by almost 13,000 tonnes, for the proposed arrangements in the implementation year. This is due to an overall reduction in track mileage per flight as a result of the airspace change. These figures can be seen in **Table 8** below and reflect a 21% reduction in fuel and CO_2 emissions.

3.22.5 Should this proposal be accepted, it is estimated that implementation of the new SIDs will result in a reduction in fuel burn and CO_2 emissions relative to that experienced without the proposed airspace change. As with all our environmental metrics, we will provide the CAA with the input data for the calculations made by ARUP, including all modelling assumptions.

CURRENT SID	PROPOSED SID	IMPLEMENTATION YEAR (2019)		FORECAST YEAR (2029)		PERCENTAGE CHANGE (%)
		Annual Fuel Consumption difference	Annual CO_2 emissions difference	Annual Fuel consumption difference	Annual CO_2 emissions difference	
	2019 without change	2019 proposed change	2019 % difference	2029 without change	2029 proposed change	2029 % difference
NORBO 05	ROWLY FLEMN GALGA	-1,040	-3275	-1288	-4058	-26%
NORBO 23	BURNS ALEXE	-3,134	-9,871	-3,718	-11,712	-23%
LUSIV 05	FLEMN GALGA	-2	-5	-2	-6	-1%
LUSIV 23	ALEXE BURNS	-76	-238	-90	-284	-8%
TALLA 05	FLEMN GALGA	0	1	0	2	7%
TALLA 23	ALEXE	-1	-4	-2	-5	-7%
TURNBERRY 05	ROWLY	12	37	14	46	14%
TURNBERRY 23	BURNS	-5	-16	-6	-18	-2%
FOYLE 05	INLIS	2	6	2	7	25%
FOYLE 23	ERRIC	13	42	20	63	37%
LOMON 05	INLIS	8	24	9	30	56%
LOMON 23	ERRIC	37	116	55	174	50%
ROBBO 05	ROWLY	1	3	1	4	7%
ROBBO 23	DEWAR	6	19	7	23	15%
CLYDE 05	ROWLY	13	40	16	49	22%
CLYDE 23	DEWAR	50	158	61	193	30%
PERTH 05	HARIS	0	-1	0	-2	-1%
PERTH 23	ERRIC	18	56	26	83	12%
	TOTAL	-4,099	-12,910	-4,892	-15,412	-21%

Table 8: Estimated changes to annual fuel burn and CO_2 emissions with airspace change

ⓘ More detailed maps available online at glasgowairport.com/airspace

3.23 Summary of Part 3

3.23.1 The proposal is for the introduction of nine new RNAV-1 SID procedures to replace the existing 18 conventional SIDs, and in so doing:

- Reflect current CAA policies for the design and application of departure procedures and PBN in UK airspace;
- Reduce CO_2 emissions and fuel burn (by 21%);
- Ensure business continuity beyond the withdrawal of the GOW VOR; and
- Improve the overall efficiency of Glasgow Airport departure flight profiles.

3.23.2 The SID procedures detailed in this document have been designed in accordance with the ICAO PANS-OPS procedure design criteria, as required by the CAA. The procedures also reflect current environmental guidance for the design of departure procedures.

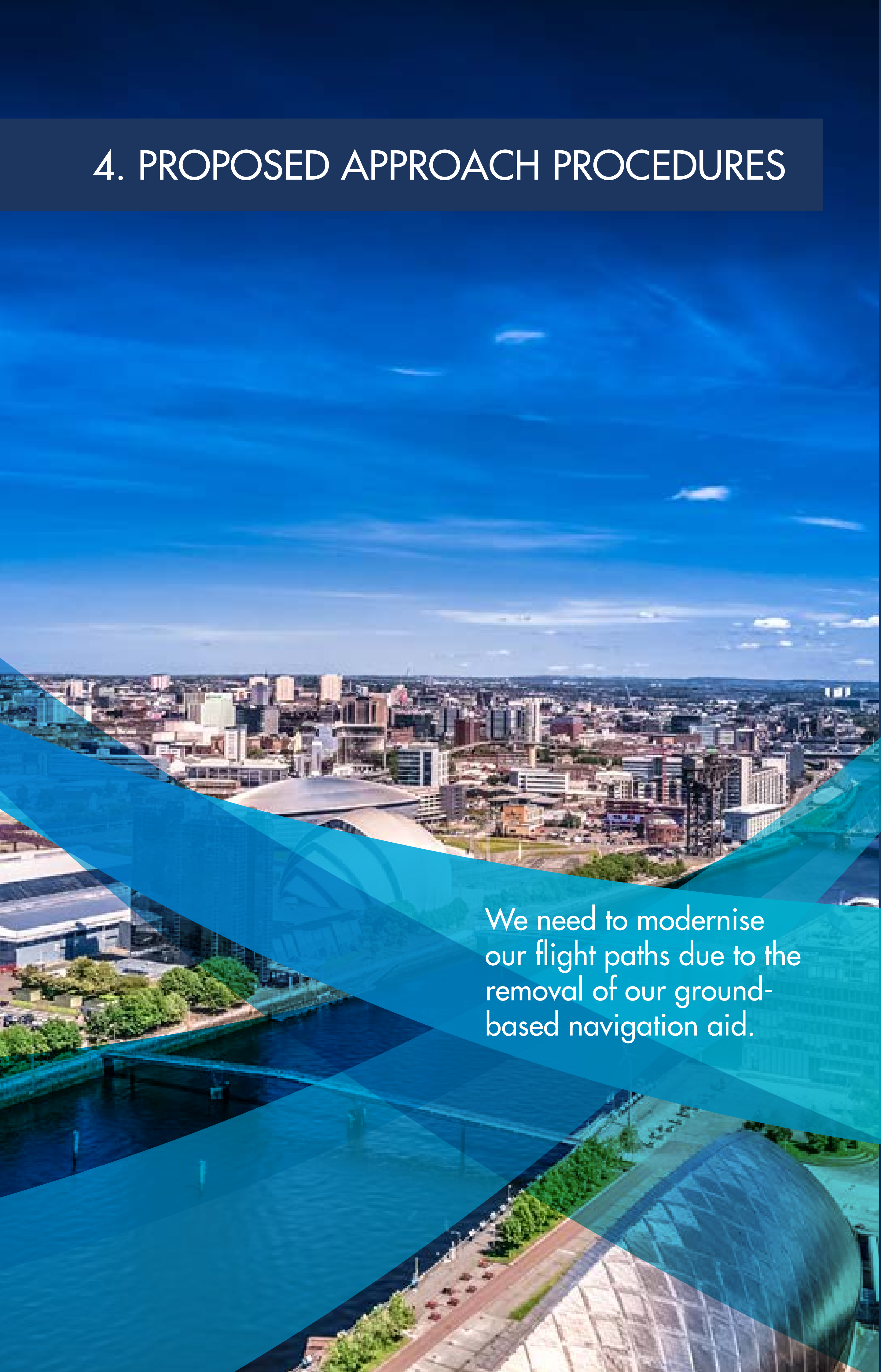
3.23.3 Although safety has been paramount in the development of these procedures, a great deal of importance has been placed on consideration of the environmental impact of departing aircraft on communities. In both 2019 and 2029 there is a reduction in the population falling within the 51dBA (daytime, (the LOAEL)) and the 45dBA (night-time) contour with the proposed changes as compared to keeping the existing procedures. There is also a reduction of those within the >10 N60 (night time) contour with the proposed changes.

3.23.4 The detailed departure procedure array for each runway can be found in Annexes A and B.

"We estimate that we could reduce fuel burn and CO_2 emissions by 21%"


PEOPLE
MAKE
GLASGOW

4. PROPOSED APPROACH PROCEDURES



We need to modernise our flight paths due to the removal of our ground-based navigation aid.

4. PROPOSED APPROACH PROCEDURES

4.1 Description of Procedures

4.1.1 We have no choice but to withdraw the VOR DME procedures as the GOW VOR will no longer be available for use. Although there are Non-Directional Beacon (NDB) procedures available, many modern aircraft no longer carry the equipment required to navigate using this. When combined with the withdrawal of the Surveillance Radar Approach (SRA) procedures the airport will be left with limited redundancy in the event of a failure of the ILS during poor weather conditions. There would be a potential increase in the likelihood that aircraft would have to divert to another airport.

4.1.2 ILS is a highly accurate and reliable approach aid which enables aircraft to make an approach and landing in very poor weather. The minimum visibility and/or cloud base available (or minima) for ILS approaches is lower than is currently available for RNAV approaches so the ILS will continue to be the primary instrument approach aid. In the event that the pilot cannot see the runway when he/she reaches his/her lowest permitted height (Decision Height) he must carry out a "Missed Approach" (this is explained further in Paragraph 4.4).

4.1.3 To provide the desired redundancy and to align with the UK FAS, we wish to introduce RNAV IAPs. The introduction of RNAV IAPs aligns with the global modernisation of navigation standards to reduce reliance on ground-based navigation aids and allows airlines to operate using the increased capability and accuracy of their respective FMS and the satellite-based navigational systems from which they take their data. RNAV IAPs have been in widespread use around the world for many years but have only been introduced in the UK in the last few years. The minima associated with RNAV IAPs is improving as the technology advances and operators are becoming increasing familiar with them.

4.1.4 Following research and engagement with our operators, it was determined that we should commission designs for Lateral Navigation (LNAV), Lateral Navigation with Vertical Guidance (LNAV/VNAV[22]) and Localiser Performance with Vertical Guidance (LPV200[23]) approaches for each runway.

4.2. RNAV versus Conventional Instrument Approaches

4.2.1 As with the SIDs, the proposed RNAV IAPs will utilise a navigation technique that uses modern on-board navigation technology in the aircraft FMS to take data from several internal and external navigation sources to work out where the aircraft is, where it needs to go to, and what it needs to do to follow the specified flight path.

4.2.2 As discussed in **Part 2**, RNAV is essentially replacing the existing navigation methodology (known as conventional navigation) whereby procedures were defined by tracks aligned between a network of ground-based navigational beacons.

4.2.3 To create a route which aircraft can follow onto the final approach for a runway, IFP designers generally utilise either a T-bar or a Y-bar (the name describes the design shape). Only the T-Bar method is being proposed for each runway at the airport, as opposed to a Y-Bar option, as this was seen as the optimal solution from both an environmental and an operational perspective. These approaches begin at the T-bar point called the Initial Approach Fix (IAF).

[22] Also known as Baro-VNAV owing to the method of obtaining the vertical guidance through use of a Barometric Altimeter. [23] Localiser Performance with Vertical Guidance (LPV) is similar in precision to the localizer and glideslope of an ILS approach. LPV200 has a minima of 200ft.

4.2.4 To fly an RNAV IAP, aircraft would be released to self-navigate direct to the IAF after which the aircraft would follow the T-bar approach, turn before the Intermediate Fix (IF) onto final approach before flying over the Final Approach Fix (FAF). As a rough guide, aircraft will be between 4,000 and 5,000 feet as they turn inside of the IAF and between 2,000 and 3,000 feet as they turn inside of the next point, the IF, which sits on the extended runway centreline. As seen in the example in Figure 25 below, an IF may be co-incident with an IAF for aircraft flying a straight-in approach.

Note: The blue tracks depict historical tracks of aircraft being radar vectored to the ILS and this will continue to be the "norm" when the ILS is in use.

4.2.5 The benefits of RNAV profiles are that they provide an element of predictability and consistency and allow pilots to plan continuous descent profiles by them knowing, ahead of schedule, the distance to touchdown and any level or speed restrictions that are in place.

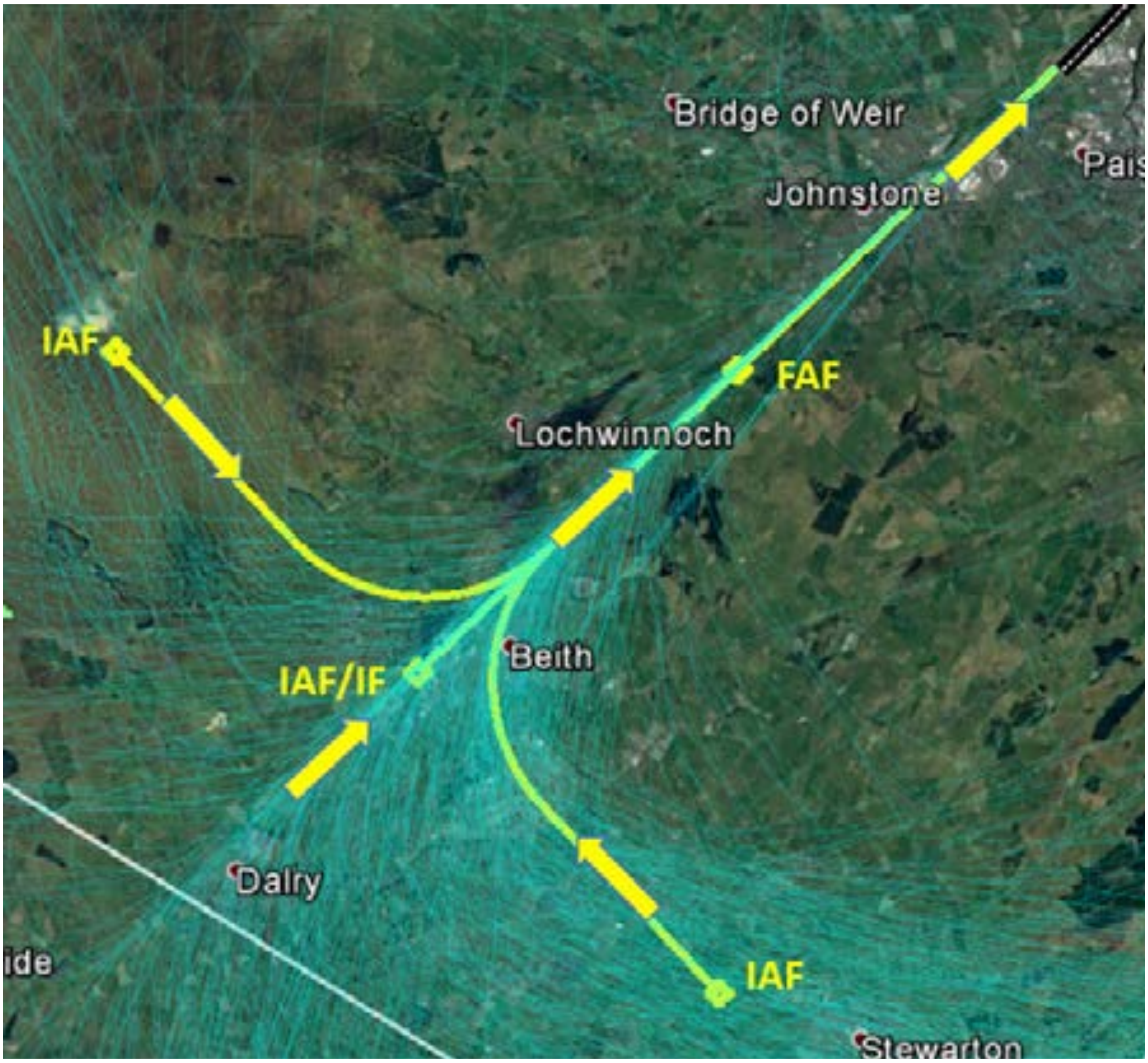


Figure 25: T-Bar Configuration

ⓘ More detailed maps available online at glasgowairport.com/airspace

4.2.6 **Figures 26 and 27** indicate the areas affected by the broad swathe of arrival tracks for each runway. The proposed RNAV IAPs (when flown) will closely follow the tracks as depicted in **Figures 28 and 29**. If the RNAV IAPs were to be used all the time, this concentration of traffic would result in fewer communities being overflown. It must be stressed that for the foreseeable future, radar vectoring to the ILS will remain the normal day-to-day operating technique; this may be reviewed in the future.

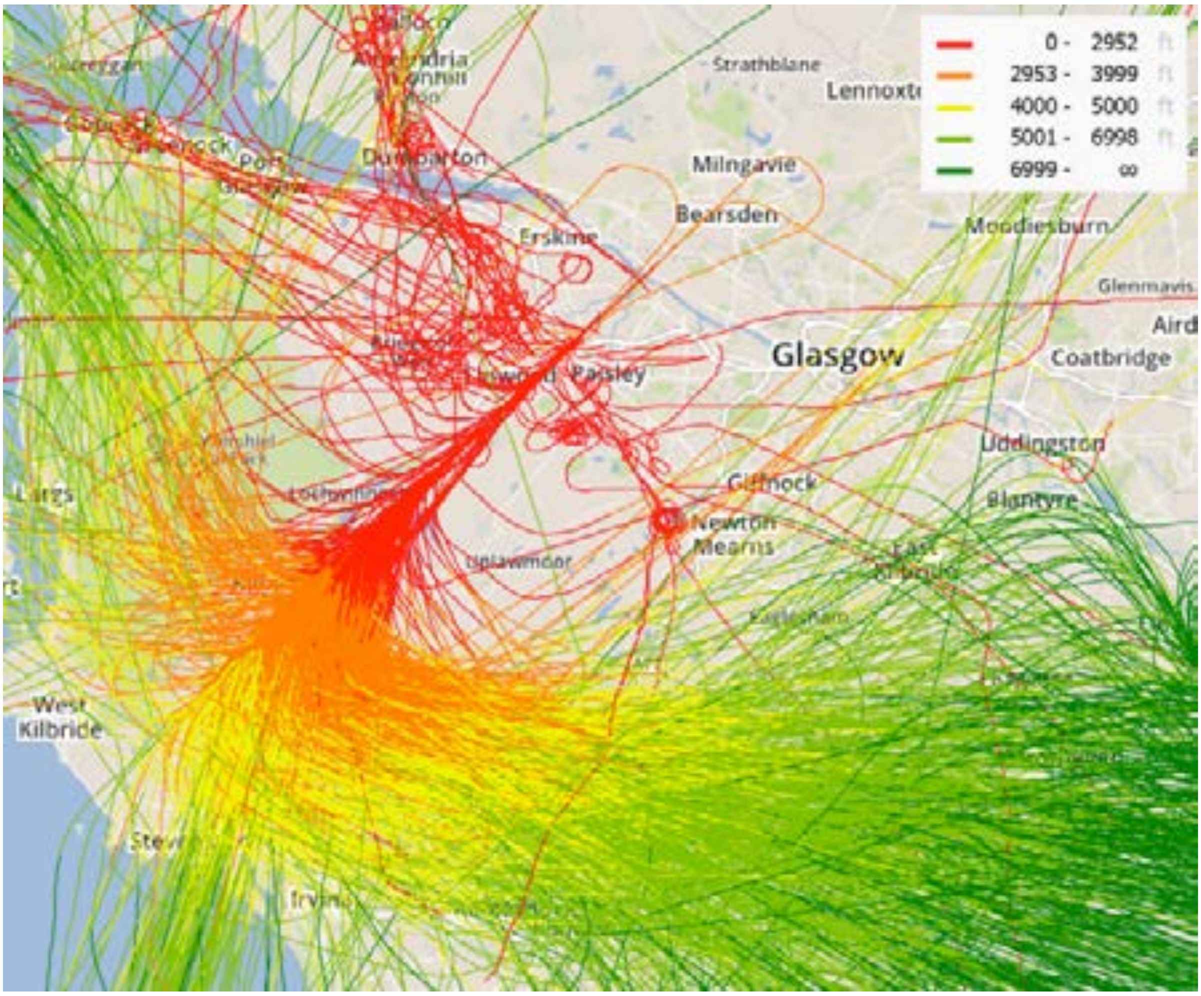


Figure 26: Runway 05 Arrival Swathe

ⓘ More detailed maps available online at glasgowairport.com/airspace

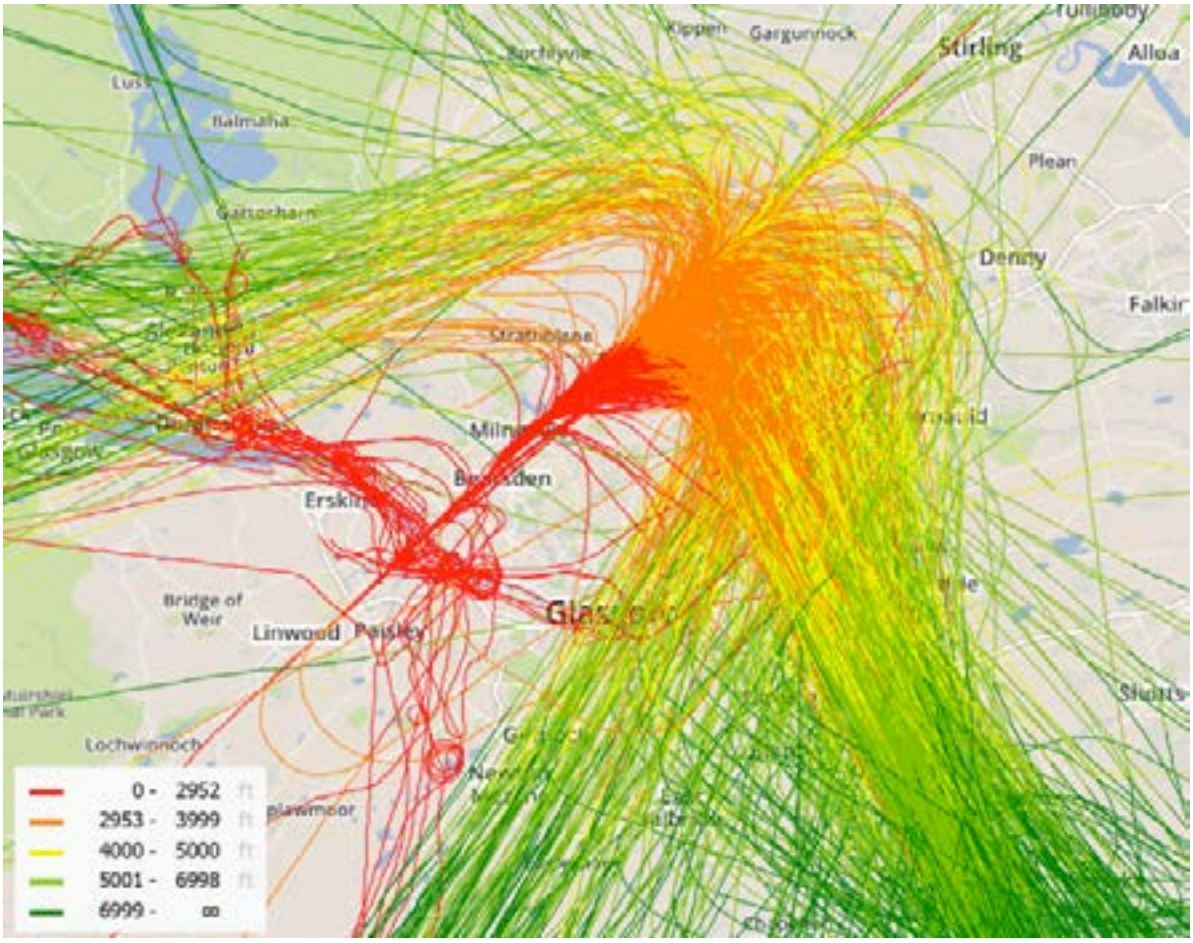


Figure 27: Runway 23 Arrival Swathe 1-7 May 2017

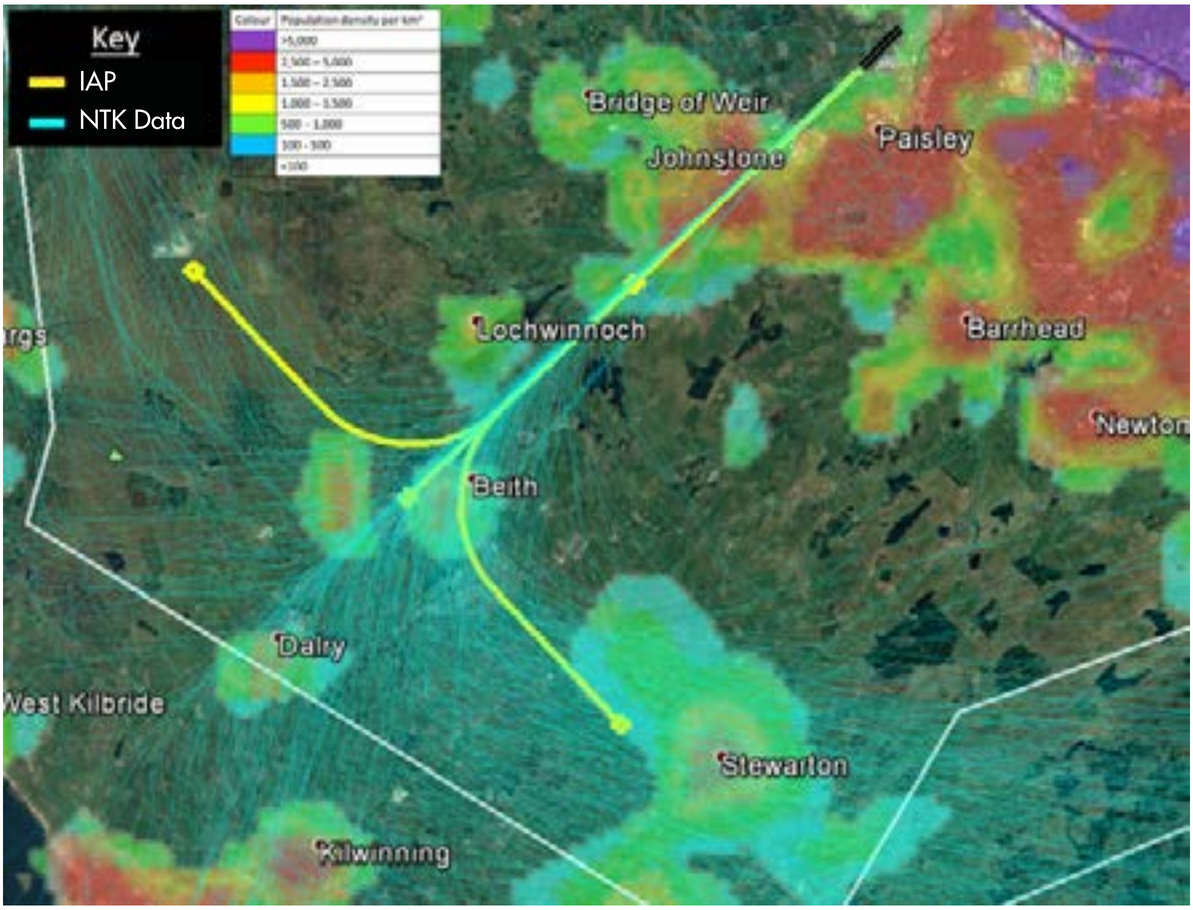


Figure 28: Proposed Runway 05 T-Bar with NTK from arrivals 1-7 May 2017

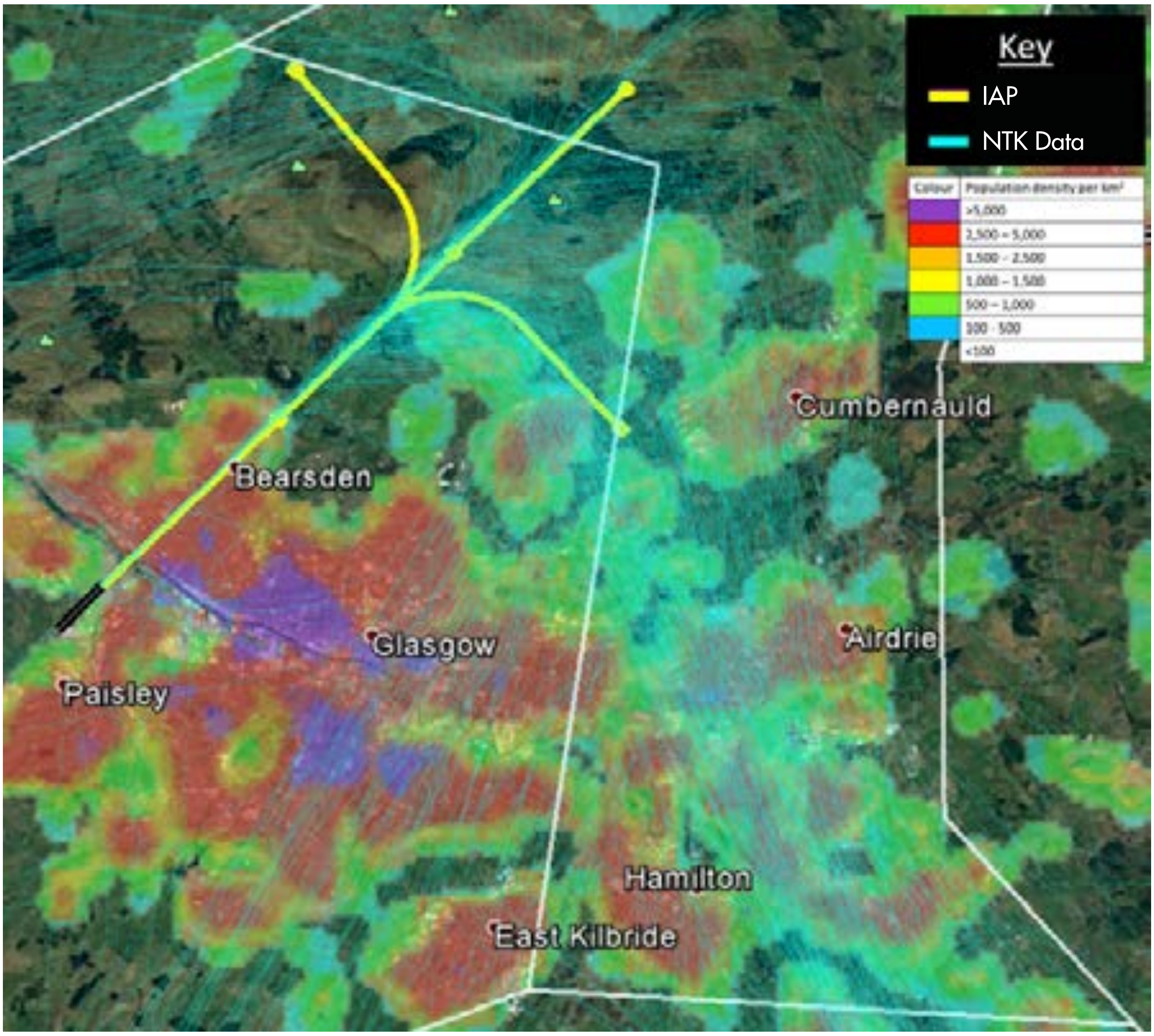


Figure 29: Proposed Runway 23 T-Bar with NTK from arrivals 11-17 June 2017

4.2.7 As with conventional procedures, the introduction of RNAV IAPs does not preclude ATC from vectoring[24] aircraft tactically, if required, on an individual basis and routing them directly to the IAF, for example, rather than routing them via the terminal hold at LANAK (as indicated in Figure 30 opposite). Radar vectoring is essential in order to allow ATC to marshal and sequence successive arriving flights into an orderly and correctly spaced landing stream and to reduce delays.

[24] Vectoring is a practice utilised by Air Traffic Controllers in which they use Surveillance Radar to assess a traffic situation and then issue radar headings for aircraft to follow.

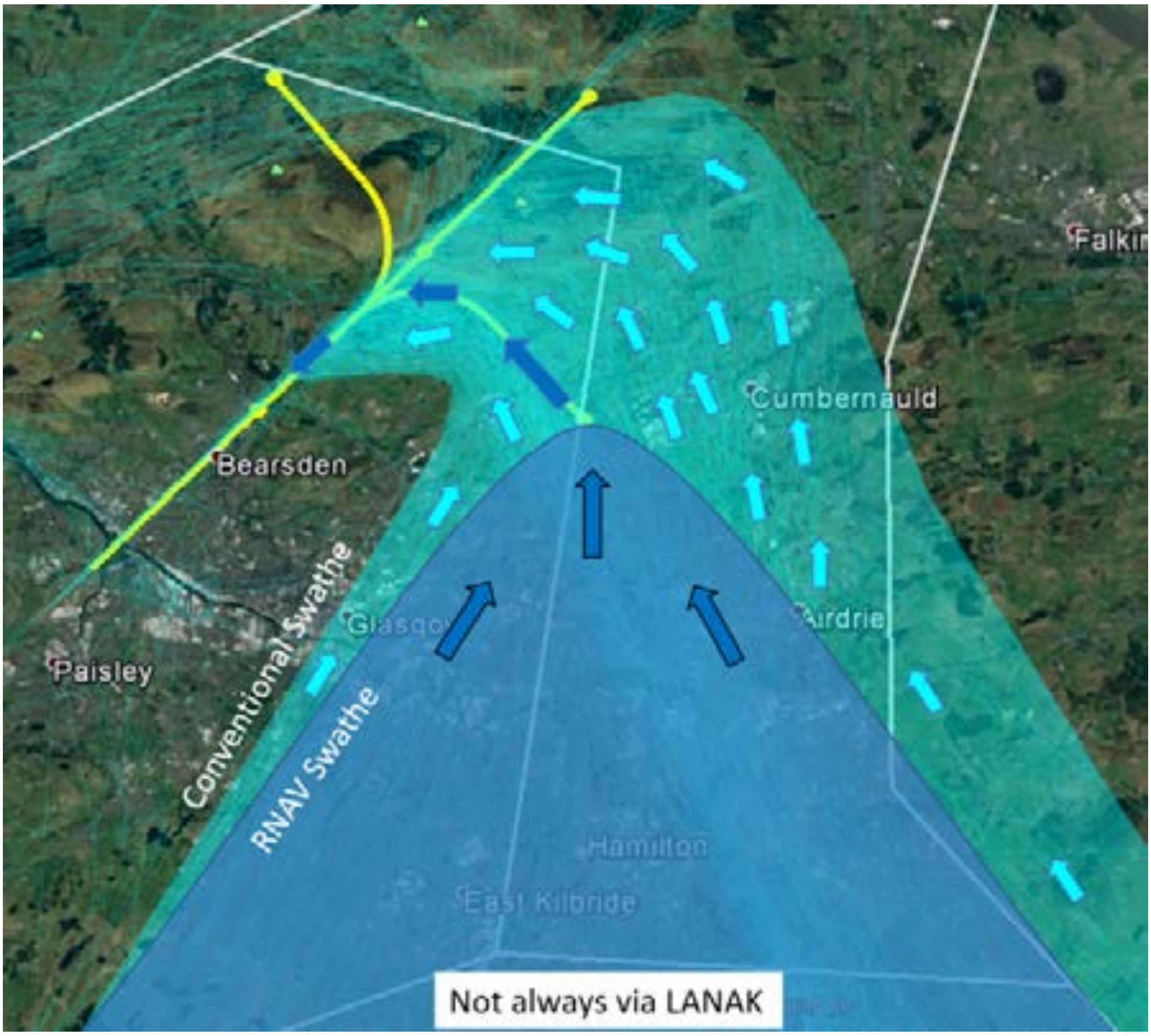


Figure 30: Indicative Arrival Swathe for Runway 23 for aircraft from the South (not always via LANAK)

ⓘ More detailed maps available online at glasgowairport.com/airspace

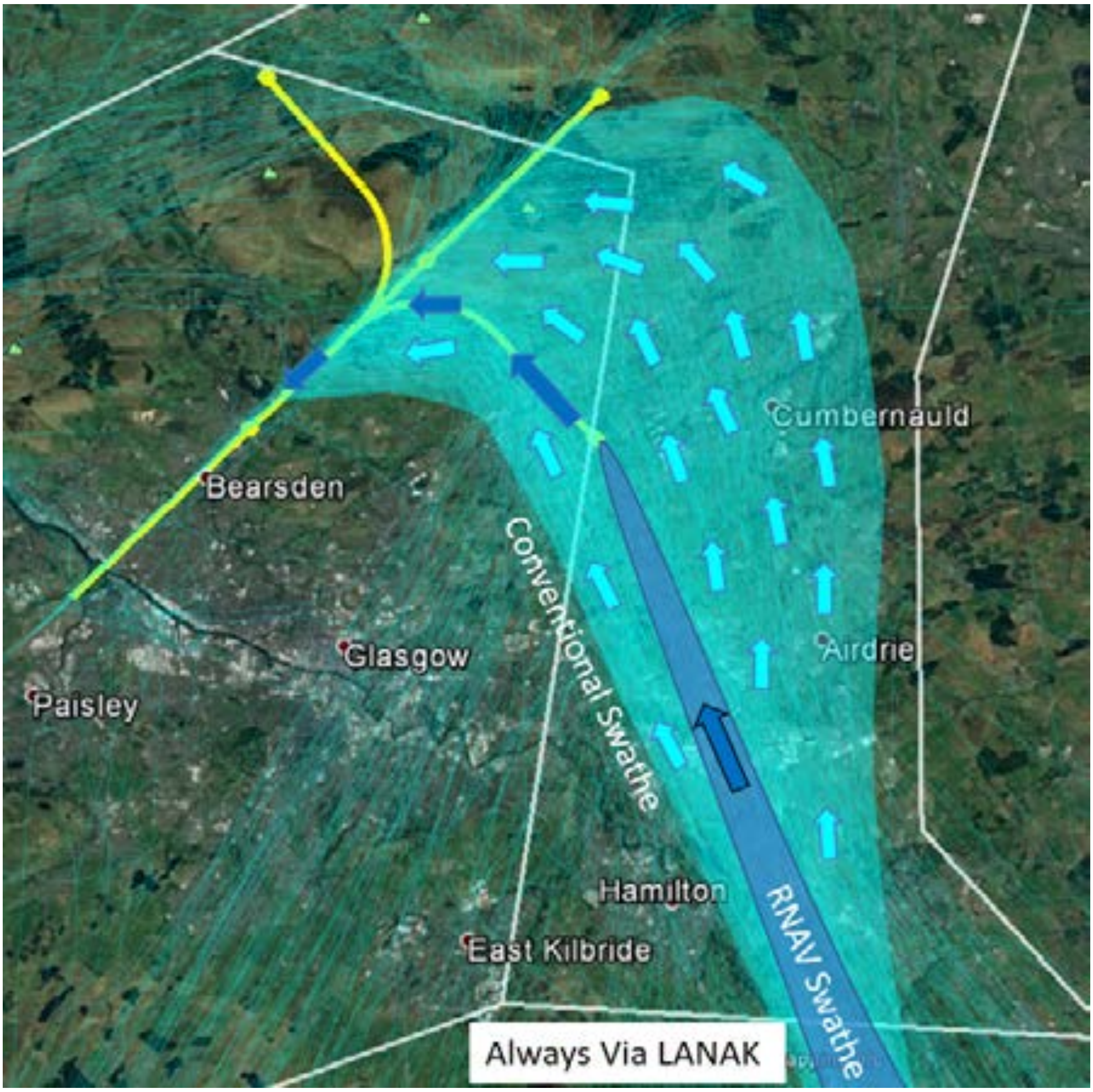


Figure 31: Indicative Arrival Swathe for Runway 23 for aircraft from the South (always via LANAK)

ⓘ More detailed maps available online at glasgowairport.com/airspace

4.2.8 Figure 31 gives an indication of the difference experienced were all approaches from the south always to be routed via LANAK. It is likely that the RNAV swathe would be a narrower corridor (provided aircraft were left to self-navigate to the IAF) whereas the conventional swathe would broaden depending on the tactical vectoring applied.

4.3 Terminal Hold

4.3.1 In our discussions with the ATM community (specifically PC and EDI) it became apparent that the terminal holding stack designated 'LANAK' may not be optimally situated. Development simulations were conducted by PC whilst this document was being written but it was likely that the results would support a case to move the LANAK Hold slightly further south and marginally re-orientated. Such a move will have little if any impact on the arrival routes from the Terminal Hold to the IAPs as there are no arrival transitions designed and the practice of radar vectoring will largely remain as it exists today. The only real difference would be seen close-in to the T-bar element if the RNAV IAPs were in use in isolation (i.e. there were no ILS approaches) and no radar vectoring was employed to deliver aircraft to the RNAV IAPs. In this unlikely event, the tracks would be more concentrated as shown in Figure 31 (previous page).

4.4 Missed Approach Procedure

4.4.1 A Missed Approach Procedure (MAP) is followed if an approach cannot be completed to landing. The IAP specifies a point where the missed approach begins, and a position or an altitude where it ends.

4.4.2 A MAP is specified for all airfield and runway Precision Approach and Non-Precision Approach procedures. The MAP takes into account obstacle clearance requirements and other instrument procedures in the vicinity. Only one MAP is established for each approach procedure.

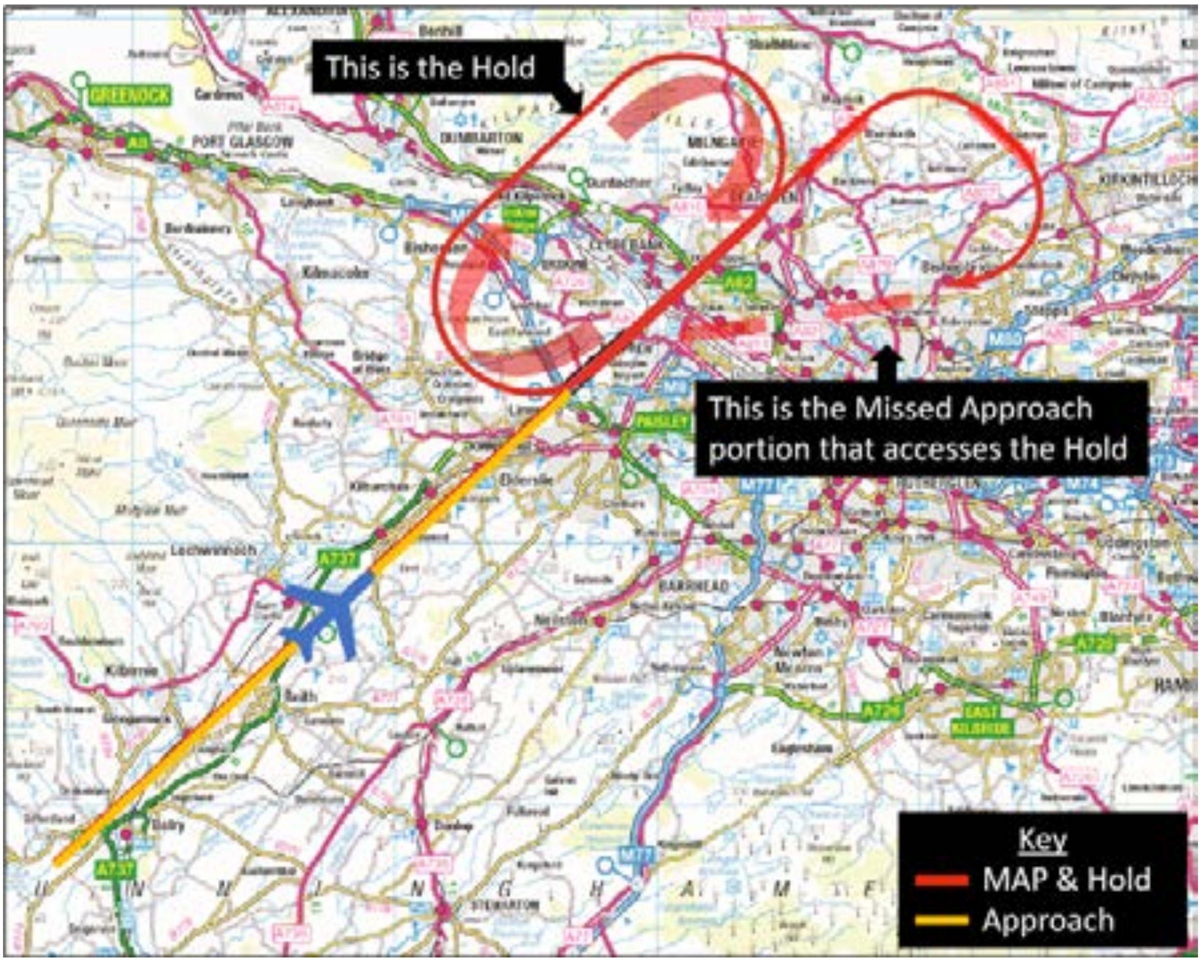


Figure 32: Existing Missed Approach Procedure Runway 05

4.4.3 The existing ILS procedures have a published conventional MAP. The existing procedures rely on a range and bearing from a conventional ground based facility (the NDB) that the aircraft can route towards. The existing procedures are depicted at **Figures 32 and 33**. The MAP ground track flown using RNAV will be changed as a consequence of this ACP, as the means by which the aircraft re-positions for the Missed Approach Hold (not to be confused with the LANAK Hold referred to on the previous page) will be different. The other aspect will be the elevation of the Lowest Hold Altitude (LHA) of the associated Missed Approach Hold by 1,000 feet from 3,000 feet to 4,000 feet for operational reasons.

4.4.4 The proposed procedures for each runway are depicted in **Figures 34 and 35** overleaf and are materially different in terms of the track that is flown. It is not possible to replicate the existing MAP with RNAV and unlike the arc back to the airfield seen in Figures 32 and 33, the proposed procedure is squarer or box-like.

4.4.5 It is important to stress though that carrying out a MAP is essentially not a normal situation. Most IAPs are completed successfully to a safe landing. However, the MAP represents a safe means of operation when the IAP cannot be completed successfully.

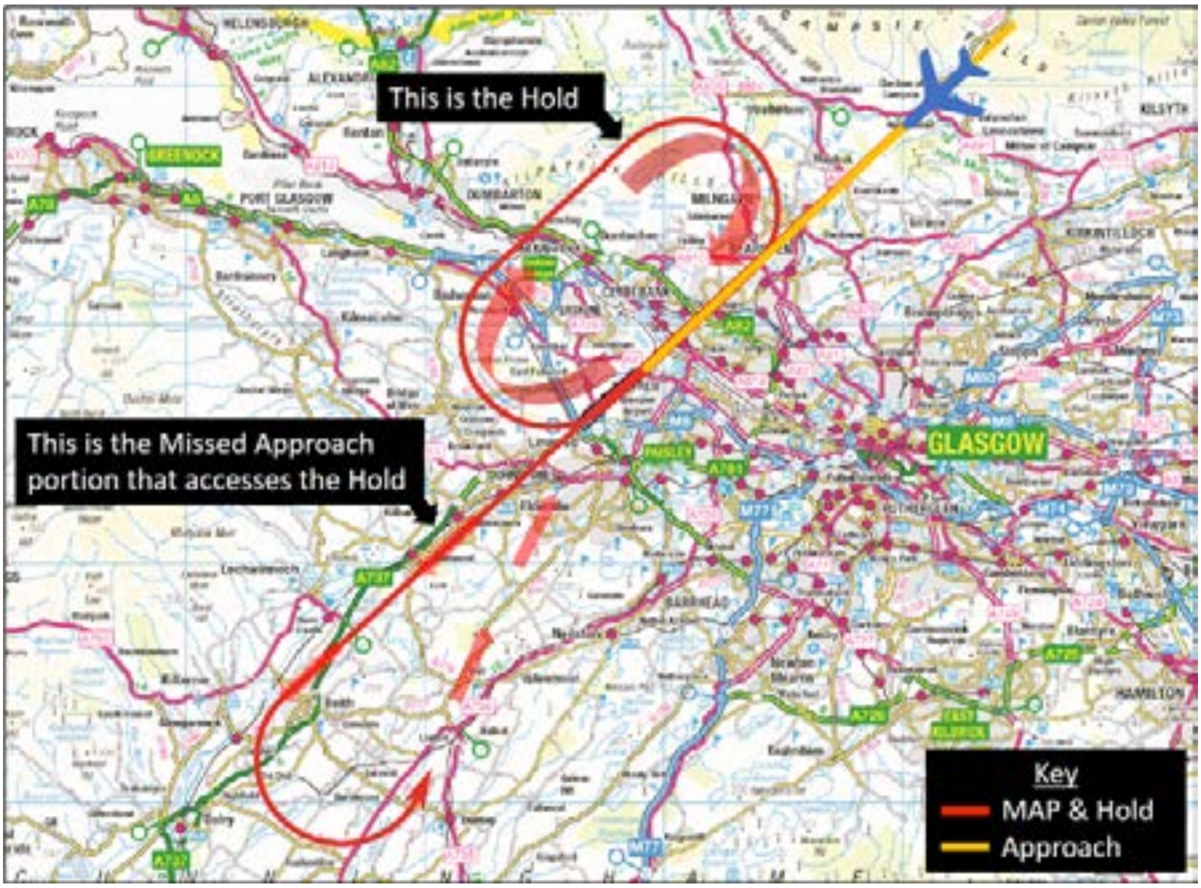


Figure 33: Existing Missed Approach Procedure Runway 23

ⓘ More detailed maps available online at **glasgowairport.com/airspace**

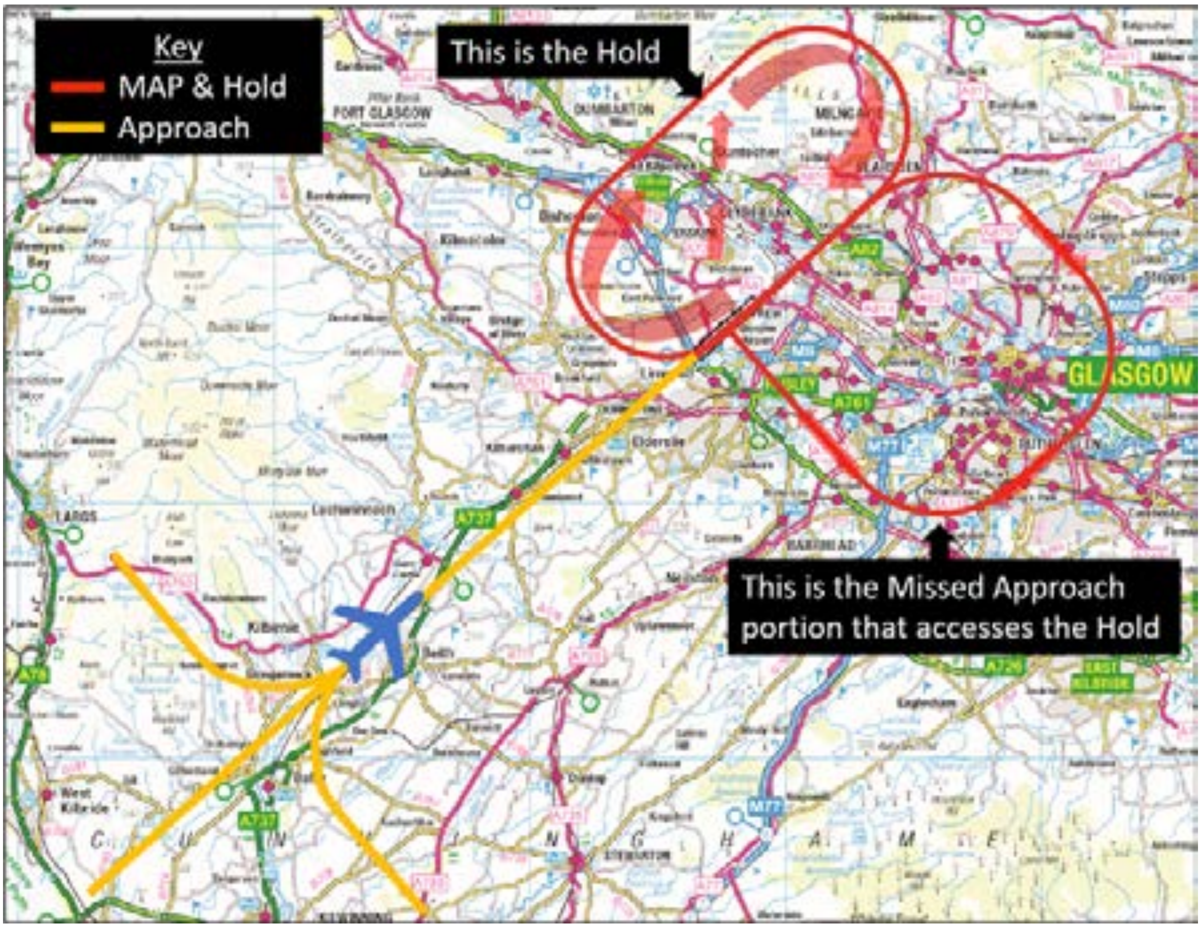


Figure 34: Proposed Missed Approach Procedure Runway 05

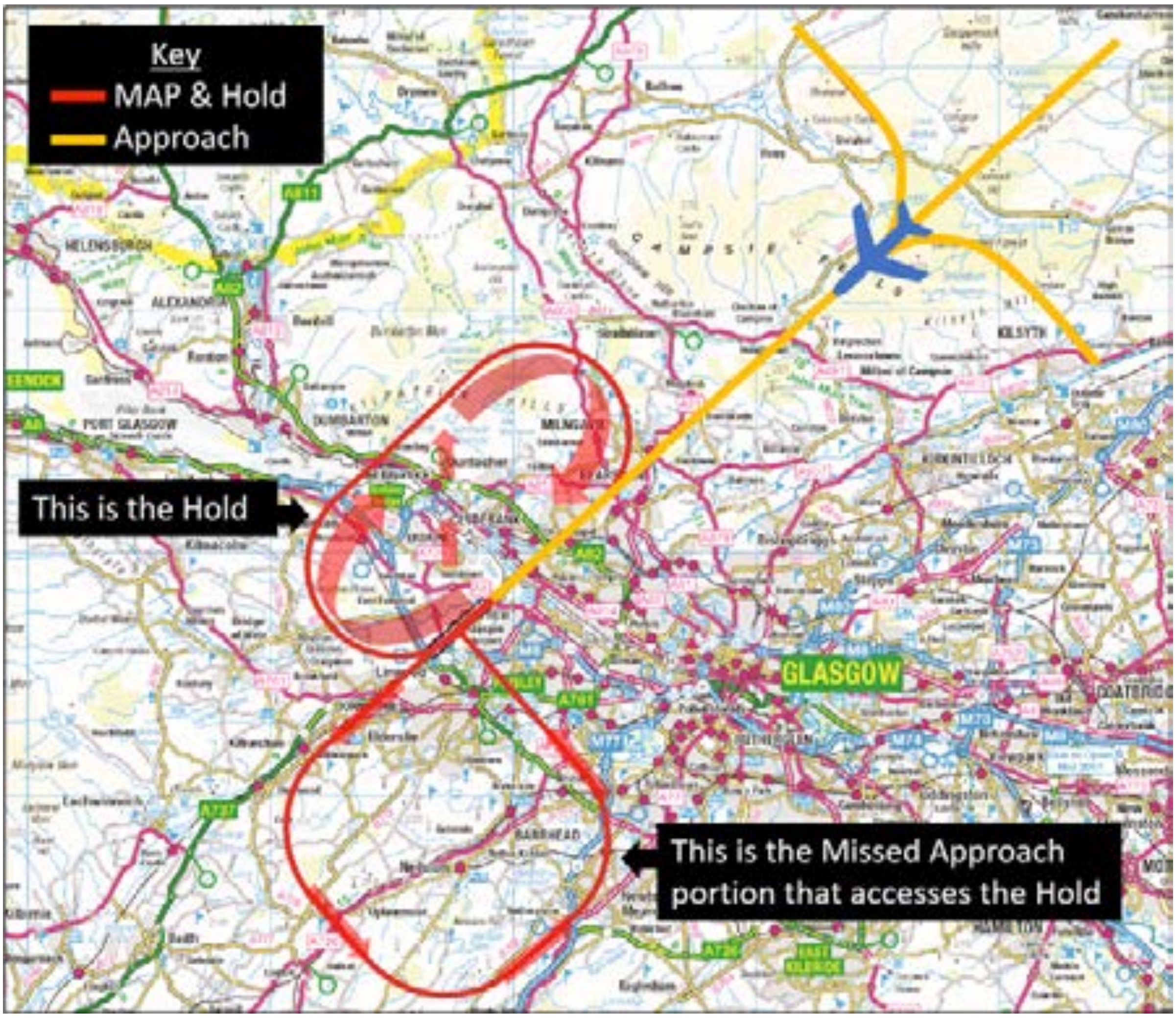


Figure 35: Proposed Missed Approach Procedure Runway 23

ⓘ More detailed maps available online at glasgowairport.com/airspace

4.5 Summary of Part 4

4.5.1 We are planning to introduce RNAV IAPs in line with the future airspace requirements detailed in the UK FAS. The RNAV IAPs will always be available for use but will be employed as a secondary (redundancy) approach to the existing ILS for the foreseeable future. The RNAV IAP final approach track replicates that of the existing ILS procedures with the additional element of a T-bar.

4.5.2 The anticipated accuracy and repeatability of the RNAV procedures, when they are in use, will see greater adherence (repeatability) to the T-Bar lines depicted on the procedure charts and thus the biggest change would be seen with-in the T-Bar element where vectoring today results in a greater variability of tracks.

4.5.3 When the RNAV IAPs are being employed, the arrival swathe should also be narrower than eperienced currently as when the aircraft track to the IAF there is less tactical intervention by ATC. The swathe is determined by where aircraft are released from the en-route phase of flight and whether they are told to route via the terminal hold or direct. Both the conventional and the RNAV MAP holds will have a LHA of 4,000 feet.

5. AIRSPACE

We are fully committed to growing the airport responsibly and modernising our airspace will help us achieve that.

5. AIRSPACE

5.1 Introduction

5.1.1 Airspace is a national asset and a finite resource. Consideration of flight procedures and the use made of the airspace by all elements of the aviation industry, together with any potential environmental impacts, are intrinsic to the overall development and design of any airspace configuration.

5.1.2 Different types of airspace are classified by a lettering system specified by ICAO. Class A to E airspace is known as "controlled airspace"; Classes F and G airspace are "uncontrolled airspace". The airspace classification type establishes the extent to which airspace users must comply with various regulations (embracing, for example, aircraft equipage, pilot qualification and applicable Rules of the Air) and the types of air traffic services that are provided in the airspace.

5.1.3 In the UK, controlled airspace is established primarily to protect commercial air transport passenger flights from other flights and is where Air Traffic Control (ATC) needs to have positive control over aircraft flying in the airspace in order to maintain safe separation between them. Uncontrolled airspace is airspace where aircraft are able to fly freely without being constrained by instructions from ATC, unless they request such a service.

5.1.4 Controlled airspace contains the network of corridors (known as Airways or the Route Network) which link the busy airspace surrounding the major airports. The controlled airspace around the major airports is designated variously as Control Zones (CTR), from the ground upwards to a specified upper limit; Control Areas (CTA), from a specified base level and Terminal Control Areas (TMA) which are larger CTAs normally encompassing a number of airports and extend from a specified base level above the ground to a specified upper limit. This can be seen in **Figure 36**.

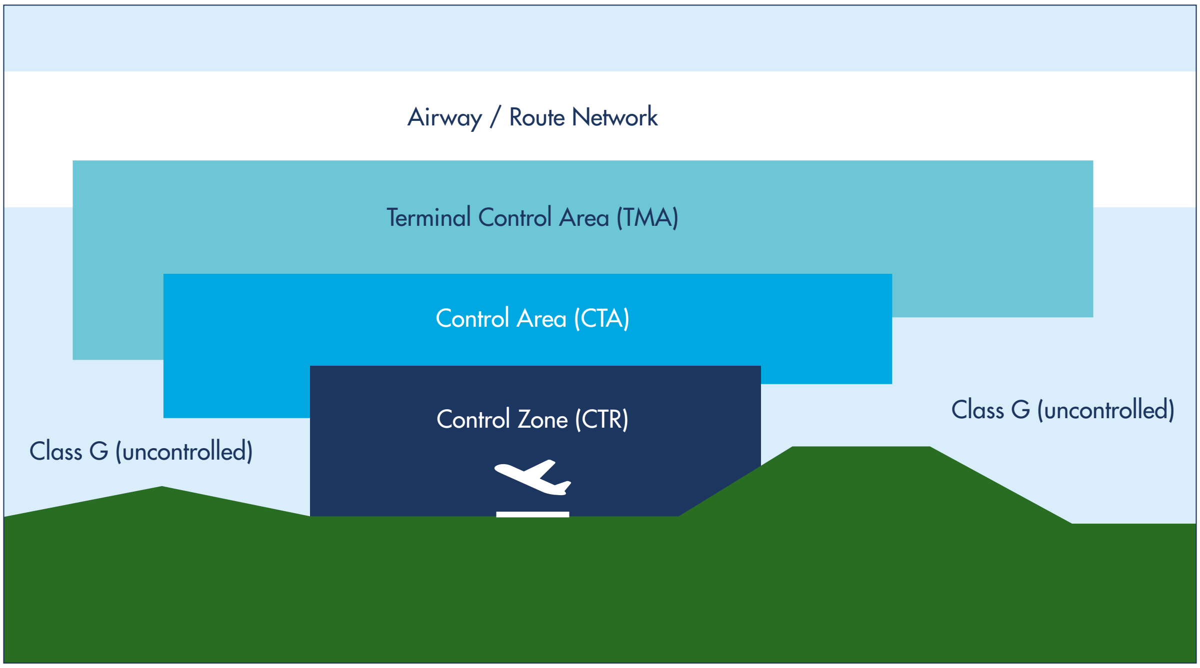


Figure 36: Typical Airspace Construct

[25] Details of the CAAs controlled airspace containment policies are detailed in CAP725 and Policy Statement "Controlled Airspace Containment Policy" (17 January 2014). [26] Further details of the wider application of the ICAO Airspace Classification System in the UK can be found in a CAA Policy Statement "The Application of ICAO Airspace Classifications in UK Flight Information Regions" (13 November 2014).

5.1.5 The CAA specifies that where controlled airspace is established around an airport the airspace should normally be designed to contain the IFPs, including the ICAO obstacle clearance navigational tolerance 'Primary Areas', within the controlled airspace unless there are overriding reasons (including mitigations) why this should not be applied. The airspace configuration should also make adequate provision for radar vectoring by ATC[25].

5.1.6 The CAA has a policy of keeping the volume of controlled airspace to the minimum necessary to meet the needs of UK airspace users and to comply with international obligations. The CAA Policy also specifies that the base level of CTAs should, wherever practicable, be a minimum of 1,500 feet above ground level (agl) (so that non-participating flights can safely fly below the CTA) and that in some cases larger CTRs may be preferable so that this objective can be met.

5.1.7 In general, the UK Policy[26] is that CTRs and CTAs around airports should be classified as Class D controlled airspace as this affords the most effective and flexible balance between the needs of all airspace users operating at the lower levels of the airspace. All classes of aircraft and types of flight operation are allowed to operate in Class D airspace, subject to obtaining an ATC clearance and complying with ATC instructions. Commercial Air Transport flights, together with other flights operating in the Route Network (which normally operate under the Instrument Flight Rules (IFR) typically utilise the IFP network of SIDs, STARs, IAPs and ATC radar vectoring, whilst General Aviation activities (comprising, in the main, recreational and flight training activity), normally operate under the Visual Flight Rules (VFR). All can co-exist and operate in the airspace provided the rules are adhered to. The requirement for all aircraft to operate under ATC clearance and to comply with instructions enables controllers to safely integrate all airspace operations with each other.

"In the UK, controlled airspace is established primarily to protect commercial air transport passenger flights from other flights."

5.2 The Current Airspace around Glasgow Airport

5.2.1 The current configuration of the airspace around Glasgow Airport is depicted in **Figure 37** (taken from the UK AIP (AD2-EGPF-4-1)) and comprises:

- **Glasgow CTR:** Surface to 6,000 feet amsl; Class D airspace; which encompasses the IAPs and the parts of the arrival procedures immediately before the IAPs, initial parts of the SIDs. It also encompasses some of the high ground around the airport so that the adjoining controlled airspace base level can be above 1,500 feet agl;
- **Glasgow CTA-1:** 3,000 feet to 6,000 feet amsl; Class D airspace; to the east and north east of the CTR which protects the further-out elements of arrival and departure procedures and radar vectoring. (Edinburgh CTA adjoins CTR-1 to the east.)
- **Glasgow CTA-2:** 3,500 feet to 6,000 feet amsl; Class D airspace; to the south and south-east of the CTR which protects the further-out elements of arrival and departure procedures and radar vectoring;
- **ScTMA-5:** 3,500 feet amsl to Flight Level (FL) 195; Class D airspace; to the south-west of the CTR, adjoining the Prestwick CTR and CTA to the south;
- **ScTMA-3:** 3,000 feet to 6,000 feet; Class E airspace; to the west of the CTR which was originally established to contain the Primary Area of a holding pattern which no longer exists and for radar vectoring aircraft to the IAPs for runway 05;
- **ScTMA-4:** 4,000 feet to 6,000 feet; Class E airspace; to the north-west, north and north east of the CTR, which protects SID procedures, parts of the holding and arrival procedures and IAPs and radar vectoring.

5.2.2 It should be noted that three of the segments listed above are designated as "Scottish TMA" notwithstanding that they are under the jurisdiction of Glasgow Airport ATC up to 6,000 feet amsl. Two of the ScTMA airspace segments are still designated as Class E airspace, notwithstanding the long-standing CAA policy which gives preference to Class D airspace designation. It is our intention to address these anomalies in our review of the airspace configuration.

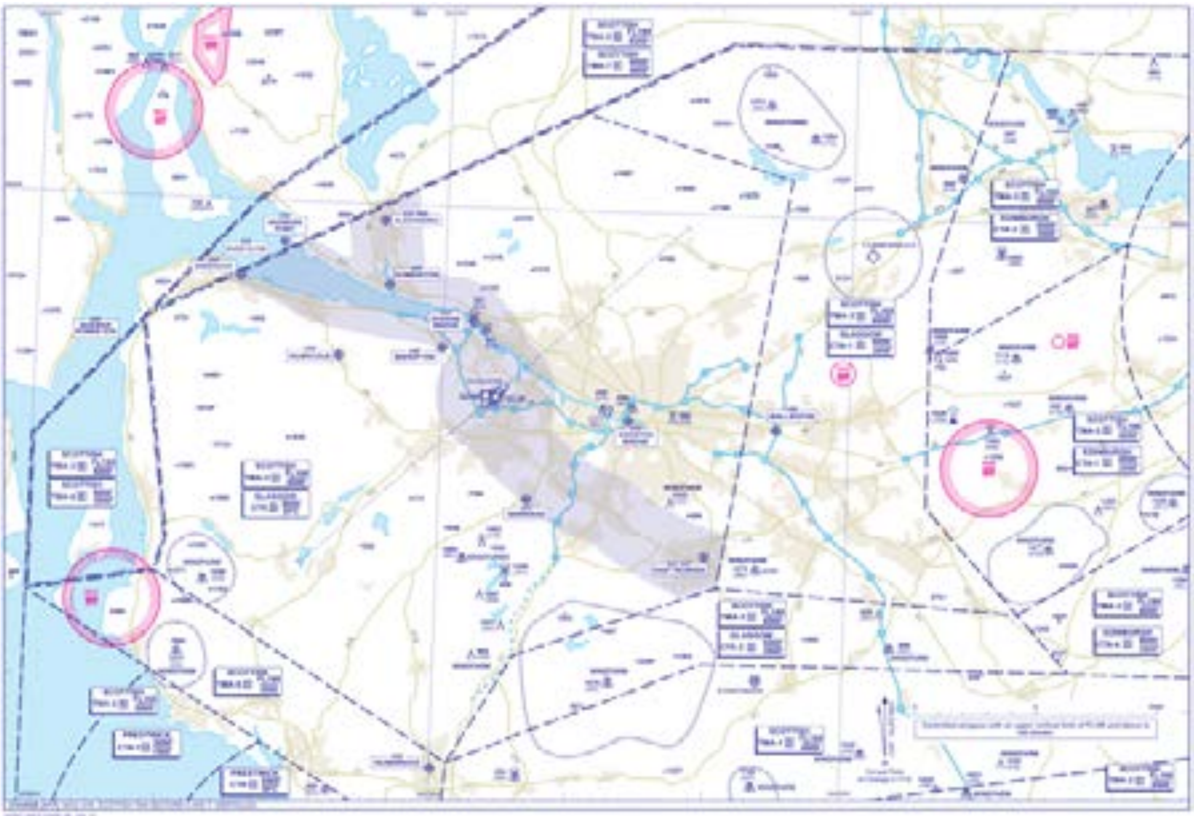


Figure 37: Glasgow Airspace as taken from UK AIP

ⓘ More detailed maps available online at glasgowairport.com/airspace

5.2.3 The upper limit of airspace under the direct jurisdiction of Glasgow Airport ATC is 6,000 feet amsl. The controlled airspace above 6,000 feet (i.e. ScTMA, Class D airspace) is under the jurisdiction of NATS Prestwick Centre. However, aircraft inbound to Glasgow Airport from the ScTMA route network will normally be transferred to Glasgow Airport ATC above 6,000 feet when clear of other ScTMA traffic.

5.2.4 The current airspace configuration has been in place, with only a few changes to classification or base levels, since the previous major reconfiguration of the ScTMA route structure for the three ScTMA Airports (Glasgow, Prestwick and Edinburgh) in 1987.

5.3 The Obligation to Review

5.3.1 All airspace arrangements are subject to routine review to ensure that they continue to meet the needs of airspace users and that the airspace capacity and operational requirements and the evolving environmental obligations can be met.

5.3.2 When any major change to the IFPs to or from an airport are made, such as the changes proposed in this ACP, it is essential that the airspace configuration is reviewed to ensure that the necessary containment of the new IFPs is met and also to ensure that any of the existing airspace configuration considered surplus to requirement can be deregulated back to uncontrolled airspace.

5.3.3 The CAA has specified that we should, as part of the IFP changes detailed in this consultation, review the existing airspace configuration to determine whether any changes could be made. We accept this obligation as we understand the responsibility we hold as an airspace custodian.

5.3.4 We will be reviewing the configuration and classification of all segments of controlled airspace under the jurisdiction of Glasgow Airport ATC against the regulatory requirements for IFP containment of the new SIDs and IAPs and radar vectoring requirements and also against the airspace user demand for the surrounding airspace. We have already started this process and are gathering information from airspace users and testing the procedures as detailed in this consultation against possible changes to the airspace configuration. We are focusing particularly on the base levels of the outer or fringe segments of the CTAs and TMA.

5.3.5 However, we are also cognisant that it may become necessary for us to make changes to some of the procedures on which we are consulting as a consequence of the consultation. Indeed, the CAA may require us to make some modifications should they deem it necessary. Therefore, we will defer our definitive review of the airspace configuration and procedure containment and any associated airspace change proposal until this consultation has concluded. No proposed airspace designs are given for this reason. We need input from aviation stakeholders on what form the changes should take.

5.3.6 We therefore seek your input on any issues you have with the existing Glasgow CTR/CTA arrangements and any suggestions you may have for how you would like it to look in the future.

5.4 Summary of Part 5

5.4.1 We have not put forward any formal change proposal to the airspace configuration as part of this consultation but we will consider these for implementation in tandem with our ultimate ACP submission.

5.4.2 We do know that the new SID and IAP procedures, as set out in this consultation document, will be safely and adequately contained within the existing airspace configuration but, ultimately, there is the possibility that some areas of the existing controlled airspace could also be de-regulated whilst meeting regulatory, safety and operational requirements.

5.4.3 Should you wish to make any comment on the airspace configuration in your response to this consultation we will take those comments forward into our subsequent evaluation.

LIST OF CONSULTEES

MPs

NAME	CONSTITUENCY
Hannah Bardell	Livingston
Mhairi Black	Paisley and Renfrewshire South
Alan Brown	Kilmarnock and Loudoun
Lisa Cameron	East Kilbride, Strathaven and Lesmahagow
Ronnie Cowan	Inverclyde
Angela Crawley	Lanark and Hamilton East
David Duguid	Banff and Buchan
Marion Fellows	Motherwell and Wishaw
Hugh Gaffney	Coatbridge, Chryston and Bellshill
Patricia Gibson	North Ayrshire and Arran
Patrick Grady	Glasgow North
Bill Grant	Ayr, Carrick and Cumnock
Neil Gray	Airdire and Shotts
Martin Docherty Hughes	West Dunbartonshire
Gerard Killen	Rutherglen and Hamilton West
David Linden	Glasgow East
Paul Masterton	East Renfrewshire
Stewart McDonald	Glasgow South
Stuart McDonald	Cumbernauld, Kilsyth and Kirkintilloch East
John McNally	Falkirk
Carol Monaghan	Glasgow North West
Gavin Newlands	Paisley and Renfrewshire North
Brendan O'Hara	Argyll and Bute
Chris Stephens	Glasgow South West
Paul Sweeney	Glasgow North East
Jo Swinson	East Dunbartonshire
Alison Thewliss	Glasgow Central
Philippa Whitford	Central Ayrshire

MSPs

NAME	CONSTITUENCY
George Adam	Paisley
Clare Adamson	Motherwell and Wishaw
Tom Arthur	Renfrewshire South
Jackie Baillie	Dumbarton
Claire Baker	Mid Scotland and Fife
Claudia Beamish	South Scotland
Neil Bibby	West Scotland
Donald Cameron	Highlands and Islands
Jackson Carlaw	Eastwood
Peter Chapman	North-East Scotland
Willie Coffey	Kilmarnock and Irvine Valley
Maurice Corry	West Scotland
Roseanna Cunningham	Perthshire South and Kinross-shire, (Cabinet Secretary for Environment, Climate Change and Land Reform)
Bob Doris	Glasgow Maryhill and Springburn
James Dornan	Glasgow Cathcart
Fergus Ewing	Inverness and Nairn, (Cabinet Secretary for the Rural Economy and Connectivity)
Linda Fabiani	East Kilbride
Mary Fee	West Scotland
Jeanne Freeman	Carrick, Cumnock and Doon Valley
Kenneth Gibson	Cunninghame North
Maurice Golden	West Scotland
Rhoda Grant	Highlands and Islands
Jamie Greene	West Scotland
Ross Greer	West Scotland
Mark Griffin	Central Scotland
Alison Harris	Central Scotland
Patrick Harvie	Glasgow
Clare Haughey	Rutherglen
Jamie Hepburn	Cumbernauld and Kilsyth
James Kelly	Glasgow
Bill Kidd	Glasgow Anniesland

NAME	CONSTITUENCY
Johann Lamont	Glasgow
Monica Lennon	Central Scotland
Richard Leonard	Central Scotland
Richard Lyle	Uddingston and Bellshill
Fulton MacGregor	Coatbridge and Chryston
Kenneth Macintosh	West Scotland
Derek Mackay	Renfrewshire North and West, Cabinet Secretary for Finance and Constitution
Rona Mackay	Strathkelvin and Bearsden
Ruth Maguire	Cunninghame South
John Mason	Glasgow Shettleston
Ivan McKee	Glasgow Provan
Stuart McMillan	Greenock and Inverclyde
Gil Paterson	Clydebank and Milngavie
John Scott	Ayr
Nicola Sturgeon	Glasgow Southside, First Minister
Sandra White	Glasgow Kelvin
Humza Yousaf	Glasgow Pollok, Minister for Transport and Islands

Scottish Government Officials and Other Stakeholders

NAME	ROLE
Katy Bowman	Special Adviser, Scottish Government
Liz Cameron	Chief Executive, Scottish Chambers of Commerce
Gary Cox	Transport Scotland
Bob Grant	Chief Executive, Renfrewshire Chamber of Commerce
John MacFarlane	Special Adviser, Scottish Government
Stuart MacKinnon	External Affairs Manager, Federation of Small Businesses
Stuart Patrick	Chief Executive, Glasgow Chamber of Commerce

Local Authorities

NAME	TITLE	COUNCIL
Cllr Douglas Reid	Leader	East Ayrshire Council
Fiona Lees	CEO	East Ayrshire Council
Alex McPhee	Depute CEO Economy and Skills	East Ayrshire Council
Cllr Gordan Low	Leader	East Dunbartonshire Council
Gerry Cornes	CEO	East Dunbartonshire Council
Thomas Glen	Depute Chief Executive - Place, Neighbourhood and Corporate Assets	East Dunbartonshire Council
Cllr Tony Buchanan	Leader	East Renfrewshire Council
Lorraine McMillan	CEO	East Renfrewshire Council
Andrew Cahill	Director of Environment	East Renfrewshire Council
Cllr Susan Aitken	Leader	Glasgow City Council
Annemarie O'Donnell	CEO	Glasgow City Council
George Gillespie	(Acting) Executive Director Land and Environmental Services	Glasgow City Council
Cllr Stephen McCabe	Leader	Inverclyde Council
Aubrey Fawcett	CEO	Inverclyde Council
Cllr Joe Cullinane	Leader	North Ayrshire Council
Elma Murray	CEO	North Ayrshire Council
Cllr Jim Logue	Leader	North Lanarkshire Council
Paul Jukes	CEO	North Lanarkshire Council
Cllr Iain Nicolson	Leader	Renfrewshire Council
Sandra Black	CEO	Renfrewshire Council
Mary Crearie	Director of Development and Housing Services	Renfrewshire Council
Cllr John Ross	Leader	South Lanarkshire Council
Lindsay Freeland	CEO	South Lanarkshire Council
Cllr Jonathan McColl	Leader	West Dunbartonshire Council
Joyce White	CEO	West Dunbartonshire Council
Richard Cairns	Director Regeneration, Environment and Growth	West Dunbartonshire Council

Community Councils (258 in total)

GLASGOW (79 ACTIVE)		
Anderston	Garthamlock and Craigend	Parkhouse
Auchenshuggle and Tollcross	Gartloch	Partick
Baillieston	Govan	Pollokshaws and Eastwood
Blairdardie and Old Drumchapel	Hillhead	Pollokshields
Bridgeton and Dalmarnock	Hillington, North Cardonald and Penilee	Possilpark
Broomhill	Hurlet and Brockburn	Robroyston
Broomhouse	Hutchesontown	Ruchill
Cadder	Ibrox Cessnock	Sandyhills
Calton	Jordanhill	Scotstoun
Barrowfield and Camlachie	Kelvindale	Shawlands and Strathbungo
Carmunnock	Kings Park	Simshill and Old Cathcart
Carmyle	Kinning Park	South Cardonald and Crookston
Castlemilk	Knightswood	Springburn Central
Cathcart and District	Lambhill and District	Swinton
Claythorn	Langside, Battlefield and Camphill	Thornwood
Craigton	Laurieston	Toryglen
Cranhill	Levern and District	Townhead and Ladywell
Crosshill and Govanhill	Mansewood and Hillpark	Wallacewell
Dennistoun	Maryhill and Summerston	Wellhouse and Queenslie
Dowanhill, Hyndland and Kelvinside	Merchant City and Trongate	Whiteinch
Drumchapel	Milton	Woodlands and Park
Drumoyne	Molendinar	Woodside
Dumbreck	Mosspark and Corkerhill	Yoker
Easterhouse North	Mount Florida	Yorkhill and Kelvingrove
Garnethill	Newlands and Auldhouse	High Knightswood and Anniesland
Garrowhill	North Kelvin	
Gartcraig	Parkhead	

INVERCLYDE (6 ACTIVE)		
Gourock	Greenock West and Cardwell Bay	Kilmacolm
Greenock Southwest	Inverkip and Wemyss Bay	Larkfield, Braeside and Branchton

RENFREWSHIRE (21 ACTIVE)		
Bishopton	Hawkhead and Lochfield	Linwood
Bridge of Weir	Houston	Lochwinnoch
Brookfield	Howwood	Paisley East and Whitehaugh
Ferguslie	Inchinnan	Paisley North
Elderslie	Johnstone	Paisley West and Central
Erskine	Kilbarchan	Ralston
Foxbar and Brediland	Langbank	Renfrew

NORTH AYRSHIRE (10 ACTIVE)		
Arran	Irvine	Skelmorlie
Cumbrae	Kilbirnie and Glengarnock	West Kilbride
Dalry	Kilwinning	Fairlie
Largs		

EAST RENFREWSHIRE (9 ACTIVE)		
Barrhead	Crookfur, Greenfarm and Mearns Village	Neilston
Busby	Eaglesham and Waterfoot	Thornliebank
Broom, Kirkhill and Mearnskirk	Giffnock	Uplawmoor

EAST DUNBARTONSHIRE (12 ACTIVE)		
Baldernock	Bishopbriggs	Milngavie
Bearsden East	Campsie	Milton of Campsie
Bearsden North	Kirkintilloch	Torrance
Bearsden West	Lenzie	Waterside

EAST AYRSHIRE (35 ACTIVE)		
Auchinleck	Galston	New Farm Loch
Bellfield	Gatehead	Newmilns and Greenholm
Bonnyton	Grange/Howard Kilmarnock	Northwest Kilmarnock
Catrine	Hurlford and Crookedholm	Ochiltree
Crosshouse	Kilmaurs	Patna
Cumnock	Knockentiber	Piersland-Bentinck
Dalmellington	Lugar and Logan	Riccarton Kilmarnock
Dalrymple	Mauchline	Shortlees Kilmarnock
Darvel and District	Moscow and Waterside	Sorn
Drongan, Rankinston and Stair	Muirkirk	Southcraigs-Dean
Dunlop and Lugton	Netherthird and District	Stewarton and District
Fenwick	New Cumnock	

WEST DUNBARTONSHIRE (13 ACTIVE)		
Balloch and Haldane	Dumbarton East and Central	Old Kilpatrick
Bonhill and Dalmonach	Duntocher and Hardgate	Parkhall, North Kilbowie and Central
Bowling and Milton	Faifley	Silverton and Overtoun
Clydebank East	Kilmaronock	Dalmuir and Mountblow
Linnvale and Drumry		

SOUTH LANARKSHIRE (32 ACTIVE)		
East Mains	Biggar	Quothquan and Thankerton
Jackton and Thorntonhall	Blackmount	Pettinain
Auldhouse and Chapelton	Carluke	Symington
Murray	Carnwath	Tarbrax
Sandford and Upper Avondale	Carstairs	The Royal Burgh of Lanark
St. Leonards	Coalburn	Blantyre
Strathaven	Crawford and Elvonfoot	Bothwell
Burnside	Douglas	Hillhouse
Cambuslang	Duneaton	Stonehouse
HalfwayLeadhills	Uddingston	Rutherglen
Lesmahagow		

STIRLING (41 ACTIVE)		
Arnprior	Causewayhead	Logie
Balfron	Cornton	Mercat Cross
Balquhidder	Cowie	Polmaise
Bannockburn	Croftamie	Port of Menteith
Borestone	Drymen	Raploch
Braehead and District	Dunblane	Riverside
Bridge of Allan	Fintry	Strathard
Broomridge	Gargunnock	Strathblane
Buchanan	Gartmore	Strathfillan
Buchlyvie	Killearn	Thornhill and Blairdrummond
Callander	Killin	Throsk
Cambusbarron	Kilmadock	Torbrex
Cambuskenneth	Kings Park	Trossachs
Carron Valley	Kippen	

NATMAC (Trade and Industry Bodies)

ORGANISAITON	ORGANISATION
Airfield Operators Group	FASVIG
Airlines UK	GAA
Airport Operators Association	GATCO
AOA	HCGB
AOPA	Heavy Airlines
AOPA UK	Honourable Company of Air Pilots
Aviation Environment Federation	HQ Navy Cmd
BA	Isle of Man
BAE Systems	Isle of Man CAA
BALPA	LAA
BATA	Light Airlines
BBAC	Low Fares Airlines
BBGA	MAA
BGA	NATS
BHPA	PPL/IR (Europe)
BMAA and GASCo	SARG
BMFA	UAVS
BPA	UKAB

ORGANISATION	ORGANISATION
British Helicopter Association	UKFSC
DAATM	3 AF-UK/A3

AIRLINES

AIRLINE	AIRLINE
Air Canada	Icelandair
Air Contractors (FEDEX)	Jet2.com
Air Malta	KLM
Air Transat	Loganair
American Airlines	Lufthansa
BA	Ryanair
BA CityFlyer	Stobart
BH Air	Swiftair (FEDEX)
Blue Air	Thomas Cook
Citywing	Thomson
Easyjet	United
Emirates	Virgin
Eurowings	Westjet
Flybe	Wizzair

LOCAL AVIATION

ORGANISATION	ORGANISATION
PDG Helicopters	ACS Aviation
Signature	Heli Air Scotland
Gama	Leading Edge Flight Training
NetJets	Glasgow Flying Club
Flair Jet	Cormack Aviation
RAF (6 Flying Training School)	Prestwick Flying Club
RAF (4 Air Experience Flight)	Edinburgh Airport
Glasgow City Heliport	Prestwick Airport
Strathaven Airfield and Flying Club	Cumbernauld Airport
Air Ambulance - Babcock MCS Onshore	Highlands and Islands Airports Ltd (HIAL)

ORGANISATION	ORGANISATION
Air Ambulance - Scottish Ambulance Service	NATS Prestwick Centre
Police Air Support Unit - Police Scotland	NATS Prestwick Centre
Border Air	SDDG/NDDG

ENVIRONMENTAL

ORGANISATION	ORGANISATION
Society of Chief Officers of Environmental Health in Scotland	RSPB
Royal Environmental Health Institute of Scotland	Scottish Wildlife Trust
Scottish Natural Heritage	