

# Glasgow Airport FASI-N Airspace Change Proposal Step 2B Initial Options Appraisal

Date:	April 2022
Document Version:	Draft V0.4
Status:	Final document for CAA Submission (Public)

# Contents

FIGURES AND TABLES	4
1. Introduction	6
Airspace Modernisation Strategy	
Performance Based Navigation (PBN)	
Airspace Change Organising Group (ACOG) and the Masterplan	
Our Airspace Change	
1.1. CAP1616	
1.2. Glasgow Airspace Change Proposal	
2. Overview of options under assessment	10
2.1. RUNWAY 23 WESTERLY DEPARTURES	
2.2. Runway 05 Easterly Departures	
2.3. RUNWAY 23 WESTERLY ARRIVALS	
2.4. Runway 05 Easterly Arrivals	
3. Initial Options Appraisal Methodology	15
3.1. BASELINE AND YEAR OF IMPLEMENTATION	
Year of Implementation	
Movement numbers and schedule	
Fleet Mix	
Planned developments	
3.2. INITIAL OPTIONS APPRAISAL CATEGORIES AND CRITERIA	
3.3. INITIAL OPTIONS APPRAISAL: METHODOLOGY	
4. Initial Options Appraisal	23
4.1. RUNWAY 23 WESTERLY DEPARTURES BASELINE	
4.2. RUNWAY 23 WESTERLY DEPARTURE OPTION A	
4.3. RUNWAY 23 WESTERLY DEPARTURE OPTION B	
4.4. RUNWAY 23 WESTERLY DEPARTURE OPTION C	
4.5. RUNWAY 23 WESTERLY DEPARTURE OPTION D	
4.6. RUNWAY 23 WESTERLY DEPARTURE OPTION E	
4.7. RUNWAY 05 EASTERLY DEPARTURES BASELINE	
4.8. Runway 05 Easterly Departure Option A 4.9. Runway 05 Easterly Departure Option B	
4.9. RUNWAY 05 EASTERLY DEPARTURE OPTION B	
4.10. KUNWAY OD EASTERLY DEPARTURE OPTION C	

4.11. RUNWAY 05 EASTERLY DEPARTURE OPTION D	
4.12. RUNWAY 05 EASTERLY DEPARTURE OPTION E	
4.13. RUNWAY 05 EASTERLY DEPARTURE OPTION F	
4.14. RUNWAY 05 EASTERLY DEPARTURE OPTION G	
4.15. RUNWAY 05 EASTERLY DEPARTURE OPTION H	
4.16. RUNWAY 05 EASTERLY DEPARTURE OPTION I	
4.17. RUNWAY 23 WESTERLY ARRIVALS BASELINE	
4.18. RUNWAY 23 ARRIVAL OPTION C	
4.19. RUNWAY 23 ARRIVAL OPTION D	
4.20. RUNWAY 23 ARRIVAL OPTION E	
4.21. RUNWAY 23 ARRIVAL VECTORS ONLY	
4.22. RUNWAY 23 ARRIVAL VECTORS AND PBN HYBRID	
4.23. RUNWAY 05 EASTERLY ARRIVALS BASELINE	
4.24. RUNWAY 05 ARRIVAL OPTION A	
4.25. RUNWAY 05 ARRIVAL OPTION B	
4.26. RUNWAY 05 ARRIVAL OPTION C	
4.27. RUNWAY 05 ARRIVAL OPTION D	
4.28. RUNWAY 05 ARRIVAL VECTORS ONLY	
4.29. Runway 05 Arrival Vectors and PBN hybrid	
5. IOA Summary and Conclusion	
Discounting Methodology	
5.1. RUNWAY 23 WESTERLY DEPARTURES	
5.2. Runway 05 Easterly Departures	
5.3. Runway 23 Westerly Arrivals	
5.4. RUNWAY 05 EASTERLY ARRIVALS	
5.5. PREFERRED OPTION AND INFORMATION TO COLLECT AS PART OF THE FULL OPTIONS APPRAISAL	
5.6. Impacted Audiences	

# Figures and Tables

Figure 1 CAP1616 7 Stages	
Figure 2 Planned Developments around Glasgow Airport	15
Figure 3 737-800 departure profile.	20
Figure 4 737-800 arrival profile.	20
Figure 5 Potential Scottish TMA GLA EDI Interactions (From ACOG Masterplan)	
Figure 6 Runway 23 Departure Vectoring Swathe 2019.	23
Figure 7 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details)	
Figure 8 Westerly Option A Overflight and 2019 baseline NTK data	27
Figure 9 Westerly Option B Overflight and 2019 baseline NTK data	31
Figure 10 Option C Rest of the day	35
Figure 11 Option C Peak Hours	35
Figure 12 Westerly Option C Overflight and 2019 baseline NTK data	35
Figure 13 Westerly Option D Overflight and 2019 baseline NTK data	39
Figure 14 Westerly Option E Overflight and 2019 baseline NTK data	
Figure 15 Runway 05 Departure Vectoring Swathe 2019	47
Figure 16 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details) .	49
Figure 17 Easterly Option A Overflight and 2019 baseline NTK data	51
Figure 18 Easterly Option B Overflight and 2019 baseline NTK data	55
Figure 19 Easterly Option C Overflight and 2019 baseline NTK data	
Figure 20 Easterly Option D Overflight and 2019 baseline NTK data	
Figure 21 Easterly Option E Overflight and 2019 baseline NTK data	
Figure 22 Easterly Option F Overflight and 2019 baseline NTK data	71
Figure 23 Easterly Option F Overflight and 2019 baseline NTK data	75
Figure 24 Easterly Option H Overflight and 2019 baseline NTK data	
Figure 25 Easterly Option I Overflight and 2019 baseline NTK data	
Figure 26 Runway 23 Departure Vectoring Swathe 2019	
Figure 27 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details) .	
Figure 28 Westerly Arrivals Option C Overflight and 2019 baseline NTK data	
Figure 29 Westerly Arrivals Option D Overflight and 2019 baseline NTK data	
Figure 30 Westerly Arrivals Option E Overflight and 2019 baseline NTK data	
Figure 31 Runway 23 Departure Vectoring Swathe 20191	
Figure 32 Runway 23 PBN (All potential options) and Vectoring. Note only one PBN opti	
would be proposed alongside vectoring1	04
Figure 33 Runway 23 Departure Vectoring Swathe 20191	07
Figure 34 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details) 1	
Figure 35 Easterly Arrivals Option A Overflight and 2019 baseline NTK data1	
Figure 36 Easterly Arrivals Option B Overflight and 2019 baseline NTK data1	
Figure 37 Easterly Arrivals Option C Overflight and 2019 baseline NTK data1	
Figure 38 Easterly Arrivals Option D Overflight and 2019 baseline NTK data1	
Figure 39 Runway 23 Departure Vectoring Swathe 20191	
Figure 40 Runway 05 PBN (All potential options) and Vectoring. Note only one PBN opti	
would be proposed alongside vectoring	
Figure 41 All Options for Stage 3 (Overflight Contours)1	34

Table 1 ACP progress to date	9
Table 2 Runway 23 Westerly Departure Options	
Table 3 Runway 05 Easterly Departure Options	
Table 4 Runway 23 Westerly Arrival Options	13
Table 5 Runway 05 Easterly Arrival Options	14
Table 6 GLA 2019 92 day summer movements	15
Table 7 Planned Developments around Glasgow Airport	16
Table 8 Initial Options Appraisal Assessment Criteria (Based on CAP1616 Appendix E)	17
Table 9 IOA Methodology	18
Table 10 Westerly departures baseline overflight data	23
Table 11 Runway 23 Departures Baseline LAMax Data	23
Table 12 Westerly departure baseline – Indicative track miles	24
Table 13 Westerly departure baseline - Tranquillity overflown	24
Table 14 Biodiversity – baseline areas overflown	
Table 15 Westerly SID Track Mileage	
Table 16 Westerly departures option A overflight data	
Table 17 60dB and 65dB LAMax Data – Rwy23 Dep Option A	
Table 18 RWY 23 Westerly Departures Option A – Tranquillity overflown	29
Table 19 Runway 23 Departure Option A - Biodiversity - areas overflown between 0-70	
Table 20 Westerly departures option B overflight data	
Table 21 60dB and 65dB LAMax Data – Rwy23 Dep Option A	
Table 22 RWY 23 Westerly Departures Option B – Tranquillity overflown	
Table 23 Track Length Calculations – Fuel Burn Option B.	33
Table 24 Westerly departures option C overflight data	36
Table 25 60dB and 65dB L <sub>AMax</sub> Data – Rwy23 Dep Option C	36
Table 26 RWY 23 Westerly Departures Option C – Tranquillity overflown	37
Table 27 Track Length Calculations – Fuel Burn Option C	
Table 28 Westerly departures option D overflight data	
Table 29 60dB and 65dB LAMax Data – Rwy23 Dep Option D	
Table 30 RWY 23 Westerly Departures Option D – Tranquillity overflown	. 41
Table 31 Track Length Calculations – Fuel Burn Option D	
Table 32 Westerly departures option E overflight data	
Table 33 60dB and 65dB L <sub>AMax</sub> Data – Rwy23 Dep Option E	
Table 34 RWY 23 Westerly Departures Option E – Tranquillity overflown	45
Table 35 Track Length Calculations – Fuel Burn Option E	45
Table 36 Easterly departures baseline overflight data	47
Table 37 Easterly departure baseline – Indicative track miles	48
Table 38 Easterly departure baseline - Tranquil areas overflown	48
Table 39 Biodiversity – areas overflown	49
Table 40 Easterly SID Track Mileage	49
Table 41 Easterly departures option A overflight data	52
Table 42 60dB and 65dB L <sub>Amax</sub> Data – Rwy05 Dep Option A	52
Table 42 60dB and 65dB L <sub>Amax</sub> Data – Rwy05 Dep Option A         Table 43 Easterly departure – Tranquil areas overflown	53
Table 44 Biodiversity – areas overflown	53
Table 45 Track Length Calculations - Fuel Burn RWY 05 Easterly Departure Option A	53
Table 46 Easterly departures option B overflight data	56
Table 47 60dB and 65dB L <sub>Amax</sub> Data – Rwy05 Dep Option B	56
Table 48 Easterly departure – Tranquil areas overflown	57

Table 49 Biodiversity – areas overflown	.57
Table 50 Track Length Calculations - Fuel Burn RWY 05 Easterly Departure Option B	.57
Table 51 Easterly departures option C overflight data	.60
Table 52 60dB and 65dB LAmax Data – Rwy05 Dep Option C	.60
Table 53 Easterly departure - Tranquil areas overflown	.61
Table 54 Biodiversity – areas overflown	.61
Table 55 Track Length Calculations - Fuel Burn RWY 05 Easterly Departure Option C	.61
Table 56 Easterly departures option D overflight data	.64
Table 57 60dB and 65dB L <sub>Amax</sub> Data – Rwy05 Dep Option D	.64
Table 58 Easterly departure - Tranquil areas overflown	.65
Table 59 Biodiversity – areas overflown	.65
Table 60 Track Length Calculations - Fuel Burn RWY 05 Easterly Departure Option D	.65
Table 61 Easterly departures option E overflight data	.68
Table 62 60dB and 65dB L <sub>aMax</sub> Data – Rwy05 Dep Option E	.68
Table 63 Easterly departure – Tranquil areas overflown Option E	.69
Table 64 Biodiversity - areas overflown Option E	.69
Table 65 Track Length Calculations - Fuel Burn RWY 05 Easterly Departure Option E	.69
Table 66 Easterly departures option F overflight data	.72
Table 67 60dB and 65dB LaMax Data – Rwy05 Dep Option F	.72
Table 68 Easterly departure - Tranquil areas overflown Option F	.73
Table 69 Biodiversity - areas overflown Option F	.73
Table 70 Track Length Calculations Fuel Burn RWY 05 Easterly Departure Option F	.73
Table 71 Easterly departures option G overflight data	.76
Table 72 60dB and 65dB L <sub>aMax</sub> Data – Rwy05 Dep Option G	.76
Table 73 Easterly departure - Tranquil areas overflown Option G	.77
Table 74 Biodiversity areas overflown Option G	.77
Table 75 Track Length Calculations Fuel Burn RWY 05 Easterly Departure Option G	.78
Table 76 Easterly departures option H overflight data	.81
Table 77 60dB and 65dB L <sub>aMax</sub> Data – Rwy05 Dep Option H	.81
Table 78 Easterly departure – Tranquil areas overflown Option H	.82
Table 79 Biodiversity areas overflown Option H	.82
Table 80 Track Length Calculations Fuel Burn RWY 05 Easterly Departure Option H	.83
Table 81 Easterly departures option I overflight data	.85
Table 82 60dB and 65dB L <sub>aMax</sub> Data – Rwy05 Dep Option I Table 83 Easterly departure – Tranquil areas overflown Option I	.85
Table 83 Easterly departure – Tranquil areas overflown Option I	.86
Table 84 Biodiversity areas overflown Option I	.86
Table 85 Track Length Calculations Fuel Burn RWY 05 Easterly Departure Option I	.86
Table 86 Westerly arrivals baseline overflight data 0-7000ft	. 88
Table 87 Westerly arrivals baseline LAMax data	.89
Table 88 Westerly arrival baseline - Tranquillity overflown 0-7000ft	.89
Table 89 Westerly Arrival Track Mileage	.90
Table 90 Westerly arrivals option C overflight data	.92
Table 91 60dB LAMax Data - Rwy23 Arrival Option C	.93
Table 92 Westerly arrival option C – Tranquil areas overflown 0-7000ft	.93
Table 93 Westerly arrivals option D overflight data	.95
Table 94 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option D	.96
Table 95 Westerly arrival Option D - Tranquil areas overflown 0-7000ft	.96
Table 96 Westerly arrivals option E overflight data	
Table 97 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option E	.99
Table 98 Westerly arrival Option E - Tranquil areas overflown 0-7000ft	.99
Table 99 Westerly arrivals baseline overflight data 0-7000ft	101
Table 100 Westerly arrivals baseline LAMax data	102

Table 101 Westerly vectors only - Tranquil areas overflown 0-7000ft	102
Table 102 Westerly Arrival Track Mileage	
Table 103 Westerly arrivals Vectors and PBN hybrid overflight data	105
Table 104 Easterly arrivals baseline overflight data 0-7000ft	107
Table 105 Westerly arrivals baseline LAMax data	108
Table 106 Westerly arrival baseline – Tranquillity overflown 0-7000ft	108
Table 107 Easterly Arrival Track Mileage	
Table 108 Easterly arrivals option A overflight data	110
Table 109 60dB L <sub>AMax</sub> Data – Rwy05 Arrival Option A	111
Table 110 Easterly arrival A – Tranquil areas overflown 0-7000ft	111
Table 111 Easterly arrivals option B overflight data	113
Table 112 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option B	114
Table 113 Easterly arrival B – Tranquil areas overflown 0-7000ft	
Table 114 Easterly arrivals option C overflight data	
Table 115 60dB L <sub>AMax</sub> Data – Rwy05 Arrival Option C	
Table 116 Easterly arrival C – Tranquil areas overflown 0-7000ft	
Table 117 Easterly arrivals option D overflight data	
Table 118 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option B	
Table 119 Easterly arrival D – Tranquil areas overflown 0-7000ft	
Table 120 Easterly arrivals baseline overflight data 0-7000ft	
Table 121 Westerly arrivals baseline LAMax data	
Table 122 Easterly arrival vectors only – Tranquil areas overflown 0-7000ft	
Table 123 Easterly Arrival Track Mileage	
Table 124 Easterly arrivals Vectors and PBN hybrid overflight data	
Table 125 IOA Summary Table Key	128

# 1. Introduction

#### **Airspace Modernisation Strategy**

Following the publication of the strategic rationale for airspace modernisation<sup>1</sup>, the Government directed the Civil Aviation Authority (CAA) to "prepare and maintain a coordinated strategy and plan for the use of UK airspace up to 2040, including its modernisation". As a result, in 2018 the CAA published the Airspace Modernisation Strategy (AMS)<sup>2</sup>, which replaced the earlier 2011 Future Airspace Strategy. The AMS sets out the initiatives required to modernise the existing Airspace System by upgrading the airspace design, technology, and operations. The CAA is in the process of reviewing the AMS and expects to publish an updated version of the strategy in early 2022.

One of the most important initiatives required to achieve the AMS objective is known as FASI (Future Airspace Strategy Implementation). 21 airports in the UK comprise FASI and Glasgow Airport is one of them. This FASI initiative is considered the UK's Airspace Change National Infrastructure Programme (the Programme). The Programme encompasses the requirement to fundamentally redesign the National Airspace System at lower altitudes and in the terminal airspace that serves commercial air transport across the busiest regions of the UK, making the most of the capabilities of modern aircraft and satellite-based navigation technology. These airspace design projects are sponsored by the 21 airports (for the local arrival and departure routes below 7000ft) and by NERL (for the airspace structures and route network above 7000ft).

#### Performance Based Navigation (PBN)

Today's national route network is designed with reference to a grid of ground navigation beacons distributed across the UK. Some of these beacons are outdated and reaching their end of life. Meanwhile, 99% of the current commercial air transport fleet operates almost exclusively using avionics that rely on satellite navigation. Aircraft are able to follow routes designed to satellite navigation standards (known as Performance-based Navigation or PBN) with greater precision than conventional ground navigation. The widespread deployment of routes designed to satellite navigation standards is a cornerstone of airspace modernisation. The opportunity to design a new network of PBN routes with far greater accuracy and flexibility offers the potential to address many of the issues set out in the Government's strategic rationale. Significant improvements in airspace capacity and efficiency can be achieved by positioning routes so that they are safely separated and optimised by design.

Whilst more precise routes can be used to avoid noise sensitive areas, they may also concentrate the impacts of overflight. For this reason, the use of multiple route options that can distribute the impacts more equitably, or be configured to offer predictable relief from noise, must be considered in consultation with local stakeholders when routes are being developed for deployment at lower altitudes.

#### Airspace Change Organising Group (ACOG) and the Masterplan

The number, complexity and overlapping scope of the individual Airspace Change Proposals (ACPs) needed to deliver the Programme requires a strategic coordination mechanism in the form of a single joined up implementation plan or Masterplan.

Given the large number of organisations involved (21 airports and NATS EnRoute Limited (NERL)), the CAA and Department for Transport (DfT) also required NERL to set up an impartial body, The Airspace Change Organising Group (ACOG) to develop a Masterplan, coordinate the Programme and lead the necessary engagement with external stakeholders. In this context, ACOG was established in 2019 as a unit within NERL, separate and impartial from the organisation's other functions.

Masterplan Iteration 2<sup>3</sup> was accepted by CAA on 27<sup>th</sup> January 2022. The purpose of Iteration 2 is to provide a system-wide view of the scope of the constituent ACPs and identify the potential interdependencies between the proposals. Collectively, the ACPs that are included in the Masterplan are referred to as the 'constituent airspace change proposals'. Each individual ACP is developed following the same detailed process steps laid out in the CAA's guidance for changing the airspace design – known as CAP1616<sup>4</sup>. The CAA evaluates the progress of every ACP through each stage of the process, via a series of (seven) regulatory gateways and make decisions on whether to approve further development and ultimately the implementation of the proposed changes. A summary of the CAP1616 process is available in the <u>next section</u>.

Iteration 2 places Glasgow Airport in the 'STMA regional cluster' alongside Edinburgh and Aberdeen Airports and the NATS Scottish TMA.

#### **Our Airspace Change**

Glasgow Airport Limited (GAL) began their ACP to modernise their airspace in June 2019 and passed through Stage 1 of CAP1616 in December 2019. Shortly after this, the project and much of the wider Programme was paused due to COVID-19 pandemic whilst the aviation industry focussed on managing the pandemic and its recovery from it. The Programme was remobilised in March 2021 following the provision of DfT grant funding, allowing GAL to recommence their ACP in May 2021.

This document forms part of the GAL Stage 2 submission to the CAA. It takes the options that progressed from the Design Principle Evaluation at Step2A and undertakes a more rigorous qualitative appraisal of their benefits and impacts as part of what's called an Initial Options Appraisal (IOA). The IOA is the first of three appraisals that will take place as part of the Airspace Change Process with each appraisal increasing in quantitative analysis.

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

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

## 1.1. CAP1616

In December 2017 the Civil Aviation Authority (CAA) published CAP1616<sup>5</sup> Airspace Design: Guidance on the regulatory process for changing airspace design, including community engagement requirements. The guidance sets out the process for the airspace change process, which a change sponsor of any permanent change to the published airspace design must follow. The airspace change process is split into 7 Stages;



# 1.2. Glasgow Airspace Change Proposal

This Airspace Change Proposal is required to follow the CAP1616 process detailed in the section above. Table 1 below summarises the CAP1616 stages already undertaken for this ACP and the stage where we are at now, providing links to previous submission documents with further information.

#### Table 1 ACP progress to date

Airspace Change Stage	Summary	Link to Documents (Also available on the ACP portal)
	In June 2019, Glasgow Airport submitted their following statement of need (SoN) to the CAA	Statement of Need on CAA's Airspace Change Portal
Stage 1A	Glasgow Airport participated in an assessment meeting with the CAA on the 18 <sup>th</sup> June 2019 as part of Step 1A of the CAP1616 process. The purpose of the assessment meeting is for the change sponsor to present and discuss their SoN and to enable the CAA to consider whether the proposal falls within the scope of the formal airspace change process.	Assessment meeting minutes
	At Stage 1B Glasgow developed a set of design principles with identified Stakeholders.	
Stage 1B	The aim of the design principles is to provide high-level criteria that the proposed airspace design options should meet. They also provide a means of analysing the impact of different design options and a framework for choosing between or prioritising options. The final design principles outlined within the Stage 1B submission.	Stage 1B Design Principle Submission Report
	Stage 2A requires change sponsors to develop and assess options for the airspace change.	
Stage 2A	In Stage 2A, the change sponsor develops a comprehensive list of options that address the Statement of Need and that align with the design principles from Stage 1. We then share those options with our Stakeholder representatives (the same ones engaged with on the Design Principles). Feedback from the engagement may then be used to refine and/or generate further options where feasible at this stage or later in the process. Finally, we qualitatively assess all options developed against the Design Principles and produce a Design Principle Evaluation (DPE). Our comprehensive list of options is then shortlisted before progressing to Stage 2B.	Stage 2A DPE Submission Document
	Our Stage 2A document provides details of this process, and our shortlisted options following the DPE. Our shortlist is also shown in the 'Overview of options under assessment' part of this document.	
Stage 2B	At Stage 2B an Airspace Change Sponsor is required to undertake an Initial Options Appraisal (IOA) of the airspace change options which proceed from Stage 2A. This is where we are now. The following sections of the document initially describe the options under assessment and the baseline option, followed by explaining the methodology used to assess each option, and then the IOA outcome. At the end of the document we explain, based on the IOA, the options which we intend to take forward to Stage 3 and our preferred option(s).	This document

# 2. Overview of options under assessment

Our comprehensive list of options included 32 options. These are split into easterlies and westerlies, arrivals, and departures.

As part of Stage 2A, we undertook a <u>Design Principle Evaluation</u> where we evaluated each option against each Design Principle. This was the first opportunity to shortlist options before we progress to this IOA. The outcome of our Stage 2A Design Principle Evaluation was that some options were discontinued including the baseline 'Do Nothing' options.

Although the 4 baseline 'do nothing' scenarios (easterly departures, easterly arrivals, westerly departures, and westerly arrivals) did not progress as options, CAP1616 requires the baseline scenario to be appraised in this IOA as it provides a means of testing the options against the current day operations to better understand and highlight the benefits and impacts of each new option. The baseline will also continue to be appraised as part of the Full Options Appraisal and Final Options Appraisal at Stage 3 and Stage 4.

Use of pure PBN for arrivals into Glasgow did not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. However, the option of a mix of PBN and vectoring does come through very favourable. In this scenario, we would want to use the best performing PBN routes, so we have taken the remaining PBN arrival options into the Initial Options Appraisal for further assessment.

The following sections summarise the airspace change options we have taken through to this IOA. More information about how we have developed and evaluated these options is available in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>. The <u>Initial Options Appraisal section</u> of this document and technical appendix A also contain larger images and a more details of each option.

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

# 2.1. Runway 23 Westerly Departures

## Table 2 Runway 23 Westerly Departure Options

Option name	Summary	Image
RWY 23 Dep Option A	Offset right departures with turns at 2nm and 7nm from the runway. Offset left departures with turns at 1nm from the runway. NORBO traffic is shared between a left turn departure route and the departure route that offsets right and then turns left at 7nm with both routes available at the same time.	
RWY 23 Dep Option B	Offset right departures with turns at 2nm from the runway. Offset left departures with turns at 1nm and 5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until 5nm from the runway.	
RWY 23 Dep Option C	This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use different flight path which offsets to the left, with the rest of the routes remaining the same.	
RWY 23 Dep Option D	This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure periods. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different flight path which follows a straight line from the runway until splitting at 5nm, with the rest of the routes remaining the same. This option is similar to Option C except that the non-peak NORBO route is different.	
RWY 23 Dep Option E	Straight ahead departures only (no offsets) with turns at 1nm and 9nm from the runway NORBO is traffic is shared between a route that turns left at 1nm and one that doesn't turn until 9nm from the runway.	



# Further information around our Options can be found in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>

# 2.2. Runway 05 Easterly Departures

Table 3 Runway 05 Easterly Departure Options

Option name	Summary	Image
RWY 05 Dep Option A	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 3nm from the runway.	
	NORBO is offset left with turn at 1nm	
RWY 05 Dep Option B	Offset right departures with turns at 2nm from the runway. Offset left departures with turns at 1nm and 5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until 5nm from the runway.	
RWY 05 Dep Option C	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 4nm from the runway.	
RWY 05 Dep Option D	Straight ahead departures only (no offsets) with turns at 1nm, 4nm and 6nm from the runway.	
RWY 05 Dep Option E	Offset left departures with turns at 1nm from the runway. Straight ahead departures with turns at 2nm and 6.5nm from the runway. NORBO is straight ahead to 2nm with a right turn.	
RWY 05 Dep Option F	This option shares NORBO traffic between a left and right turn with only one of those routes in use at a time. The rest of the routes remain in the same configuration. When turning left, the NORBO would offset left then turn further left at 1nm When turning right, the NORBO would go straight ahead to 2nm then a right turn	
RWY 05 Dep Option G	This option has two, quite different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between a left turn departure and a right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a single flight path turning right, but that path could be different to the one used for the peak periods.	
RWY 05 Dep Option H	This option was generated as a result of Community and ATC feedback in our engagement. They proposed that ROBBO/CLYDE/LOMON SIDs could also turn left immediately, together with the left turn NORBO SID. Predictable respite is not a feature.	
RWY 05 Dep Option I	This option is the same as Option H except that track adjustments do not feature. This is due to a concern that a track adjustment followed by an immediate left 180° turn for the NORBO/ROBBO/CLYDE/LOMON departure could be too technically challenging. This has a knock-on impact in that the PERTH/FOYLE would also not feature a track adjustment.	

# 2.3. Runway 23 Westerly Arrivals

## Table 4 Runway 23 Westerly Arrival Options

Option	Querra and a second	Image
name	Summary	
RWY 23 Arrival Option C	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 8nm.	
RWY 23 Arrival Option D	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 9nm.	
RWY 23 Arrival Option E	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 10nm.	
RWY 23 Arrival Vectors only	This option would see all arrivals continuing to be vectored with no PBN paths available for routine use. Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet, so there is not an illustration for this option. For the Design Principle Evaluation and this Initial Options Appraisal, we will assume similar impacts as the baseline however for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-	Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known, alongside more information about departures and CAS arrangements.
RWY 23 Arrival Vectors and PBN hybrid	7000ft with more negligible changes below c.5000ft. This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing. The PBN arrival(s) would likely be the 'best performing' of Options C-E above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.	Note: Image shows existing vectoring swathe alongside the centrelines for Options A-D. Visualisation of option to be developed at Stage 3 once PBN shortlist is known and there is further information around vectoring arrangements.

Further information around our Options can be found in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>

# 2.4. Runway 05 Easterly Arrivals

#### Table 5 Runway 05 Easterly Arrival Options

PBN hybrid

Option name	Summary	Image
RWY 05 Arrival Option A	PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway.	
RWY 05 Arrival Option B	PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm.	
RWY 05 Arrival Option C	PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway. Slightly different track to Option A above 5000ft.	
RWY 05 Arrival Option D	PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm. Slightly different track to Option B above 5000ft	
RWY 05 Arrival Vectors only	<ul> <li>This option would see all arrivals continuing to be vectored with no PBN paths available for routine use.</li> <li>Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet so there is not an illustration for this option.</li> <li>For the Design Principle Evaluation and Initial Options Appraisal we will assume similar impacts as the baseline however, for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft.</li> </ul>	Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known, alongside more information about departures and CAS arrangements.
	This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final	Note: Image shows existing vectoring swathe alongside the overflight contours for Options A-D. Visualisation of option to be developed at Stage 3

for ATC to still vector arrivals when required to provide the required final RWY 05 approach sequence and spacing. Arrival The PBN arrival(s) would likely be the 'best performing' of Options A-D above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through Vectors and

stakeholder engagement and consultation.

of option to be developed at Stage 3 once PBN shortlist is known and there is further information around vectoring arrangements.

Further information around our Options can be found in our Stage 2A submission document on the CAA Airspace Change Portal

# 3. Initial Options Appraisal Methodology

The Initial Options Appraisal (IOA) is the first stage in a three-phase appraisal of airspace change options. It involves the mainly qualitative appraisal of the airspace change options that have proceeded from Stage 2A (outlined in <u>Section 2</u> of this document). As options progress through the airspace change process, the two following appraisals, the Full Options Appraisal and Final Options Appraisal undertaken at Stage 3 and 4, will quantitively evaluate options in further detail. The following sections outline the methodology we have followed whilst appraising our airspace change options as part of this IOA.

### 3.1. Baseline and Year of Implementation

As part of this IOA, CAP1616 requires airspace change sponsors to set a baseline which is used for environmental evaluation of the options. CAP1616 explains that this will be a 'do nothing' scenario and will largely reflect the current-day scenario, although taking due consideration of known or anticipated factors that might affect that baseline, for example a planned housing development close to an airport, forecast growth in air traffic, or expected changes in airlines' fleet mix. Therefore, all environmental assessments must illustrate the difference between a pre-implementation ('do nothing') scenario and a post-implementation scenario, ensuring that the periods are comparable.

Owing to the impact of COVID-19 on the aviation industry throughout 2020 and 2021, we have selected to use 2019 movement data as the baseline data that we will use as the basis for the environmental assessment as part of this initial appraisal, as this is most representative of a recovered COVID-19 scenario. We will qualitatively describe the growth of this baseline to the year of implementation (see below).

#### Year of Implementation

At present the exact implementation date for the FASI-S airspace changes is unknown as the timeline for implementation will be dependent on a number of factors, including the airspace changes above 7000ft which form part of a separate ACP sponsored by NATS NERL. Current deployments of the Scottish-TMA within Masterplan Iteration 2 suggest to expect an implementation date of around 2025, however this will be subject to alignment with masterplan iteration 3. For the purpose of this IOA, we will qualitatively describe the anticipated factors that are expected to impact the baseline, such as any forecast growth, fleet mix changes and planned developments based on implementation in 2025.

#### Movement numbers and schedule

For the purposes of environmental assessment, Airspace Change sponsors are required to use a 92-day summer period between 16 June to 15 September inclusive. In 2019, there were 25,275 movements during this 92-day period to/from Glasgow Airport. A movement is considered either an arrival or a departure.

Runway	Number of operations	Percentage
23 (Westerly Operations)	20,658	81.7
05 (Easterly Operations)	4,617	18.3
Total	25,275	

#### Table 6 GLA 2019 92-day summer movements

When reviewing the movement data in table 6, in 2019 82% of flights operated on runway 23 (westerly operations when aircraft take off and land towards the south-west), and 18% of flights operated on runway 05 (easterly operations when aircraft take off and land towards the north-east). This modal split will be used for this IOA. We have also analysed the 92-day 2019 data to find out information about SID usage and existing departure directions.

2019 is considered the year that most reflects a scenario where Glasgow airport has recovered from the impacts of COVID-19. We expect this recovery to have occurred by 2025 and therefore, as part of this IOA, we do not currently expect any fundamental changes to the movement numbers outlined above at the year of implementation. As part of our Stage 3 Full Options Appraisal, we will fully quantitatively appraise the pre-implementation baseline for the year of implementation and future scenarios (plus 10 years).

#### Fleet Mix

In 2019 Turbo prop aircraft made up around 25% of traffic arriving and departing from Glasgow Airport. Due to factors such as the change in aircraft operators and passenger habits, Glasgow Airport expect to see a shift towards more jet aircraft going forward than was the norm in 2019 and preceding years. This will be considered as part of our qualitative appraisal of the options. In Stage 3 we will quantify the changes to the baseline as a result of the expected fleet mix at the year of implementation.

#### Planned developments

As part of our preparation of the baseline, we have identified planned developments in the area surrounding Glasgow airport so that these can be considered as part of appraisal of the benefits and impacts of each option:

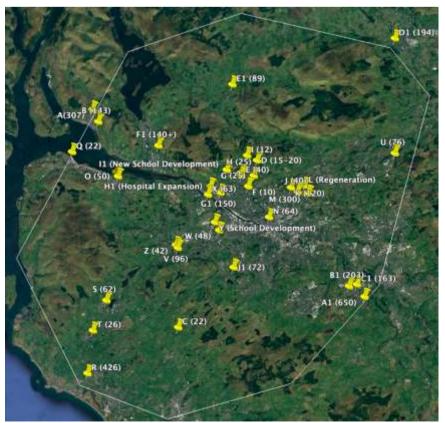


Figure 2 Planned Developments around Glasgow Airport

## Table 7 Planned Developments around Glasgow Airport

Ref	Local Authority	Location	Type of Development	Size of Development	Status (if known)	Further information
А	Argyll & Bute	Helensburgh Golf Course	Housing	307	Approved (Feb 21)	Planning Page
В	Argyll & Bute	Hermitage Academy, Helensburgh	Housing	143	Nearly complete	Developer
С	East Ayrshire	KA3 4BD	Housing	23	Registered (Mar 22)	Planning Page
D	East Dunbartonshire	G62 8BY	Housing	15-20	Awaiting decision (Mar 22)	Planning Page
Е	East Dunbartonshire	Bearsden Golf Course	Housing	40	Unknown	Planning Page
F	East Dunbartonshire	Crarae Avenue, Bearsden	Housing	10	Decided	Planning Page
G	East Dunbartonshire	Milngavie Road, Bearsden	Housing	25	Awaiting decision (Mar 22)	Planning Page
Н	East Dunbartonshire	Nithsdale Crescent, Bearsden	Housing	26	Awaiting decision (Mar 2020)	Planning Page
I	East Dunbartonshire	Craigton Road, Milngavie	Housing	120	Unknown	_ <sup>1</sup>
J	East Dunbartonshire	Auchinairn, Bishopbriggs	Housing	40	Unknown	_ <sup>1</sup>
Κ	East Dunbartonshire	Bishopbriggs Town Centre	Housing	220	Public Consultation (2021)	Article
L	East Dunbartonshire	Westerhill, Bishopbriggs	Regeneration	TBC	Public Consultation (2021)	Article
М	Glasgow City	G33 1TG	Housing	300	Awaiting Approval (Feb 22)	Developer
Ν	Glasgow City	Finnieston	Flats	64	Submitted (Nov 21)	Planning Page
0	Inverclyde	PA14 6PP	Housing/Flats	50	Nearly complete (Apr 22)	Planning Page
Ρ	Inverclyde	PA14 6PR	Housing/Flats	40	Nearly complete (Apr 22)	Planning Portal
Q	Inverclyde	PA16 8DA	Flats	22	Pending consideration (Mar 22)	Planning Page
R	North Ayrshire	Byrehill Place, Kilwinning	Housing	426	Pending consideration (Feb 22)	Planning Page
S	North Ayrshire	Knoxville Road, Kilbirnie	Housing	62	Pending consideration (Feb 22)	Planning Page
Т	North Ayrshire	Bridgene Mill, Dalry	Housing	26	Approved (Dec 21)	Planning Page
U	North Lanarkshire	Kildrum, Cumbernauld	Flats	76	Unknown	Planning Page
V	Renfrewshire	PA5 0SP	Housing	96	Awaiting Decision (Mar 22)	Planning Page
W	Renfrewshire	East Lane, Paisley	Flats	48	Awaiting Decision (Mar 22) Awaiting Decision (Mar 22)	Planning Page
Х	Renfrewshire	Erskine	Housing/Flats	59/24	Awaiting Decision (Mar 22)	Planning Page
Y	Renfrewshire	Renfrew Road, Paisley	New School	-	Approved	Article
Z	Renfrewshire	Elm Drive, Johnstone	Housing/Flats	36/6	Awaiting Decision (Mar 22)	Planning Page
A1	South Lanarkshire	Strathaven Road, Hamilton	Housing	650	Registered (Oct 21)	Planning Page
B1	South Lanarkshire	Earnock Road, Hamilton	Housing	203	Awaiting Decision (Jul 21)	Planning Page
C1	South Lanarkshire	ML3 9BZ	Housing	163	Approved (Sep 21)	Planning Page
D1	Stirling	Cambusbarron	Housing	194	Under construction	Website
E1	Stirling	Killearn	Housing	89	Under construction	Website
F1	West Dunbartonshire	Bellsmyre	Housing	140+	Under construction	Regeneration Plan
G1	West Dunbartonshire	Queens Quay	Housing/Flats	150	Under construction	Website
H1	West Dunbartonshire	Clydebank	Golden Jubilee Hospital Expansion	-	Permission issued	
11	West Dunbartonshire	Faifley	New School	-	Post consultation (Sep 21) period	Article
J1	East Renfrewshire	Lyoncross Farm, Barrhead	Housing	72	Registered (Jan 22)	Planning Page

<sup>&</sup>lt;sup>1</sup> Information provided by email from East Dunbartonshire council – no information available online

## 3.2. Initial Options Appraisal Categories and Criteria

At Stage 2B CAP1616 requires sponsors to carry out an initial qualitative assessment of the benefits and impacts of each option, tested against the 'do nothing' baseline scenario. The purpose of this initial appraisal is to highlight the change to sponsors, stakeholders and the CAA and the relative differences between the impacts, both positive and negative, of each option.

Our assessment criteria shown in table 8 below have been categorised based on the example in CAP1616 Appendix E, however we have added an additional category called 'Interdependencies, conflicts and trade-offs' to satisfy the requirements to outline potential interdependencies with other FASI-N ACPs, and 'Airspace Modernisation Strategy' to satisfy the 7 confirmed indicators that the CAA will use to assess whether this Stage 2 submission accords with the AMS including iteration 2 of the Masterplan. We will follow this table structure across the appraisal of all of our options.

#### Table 8 Initial Options Appraisal Assessment Criteria (Based on CAP1616 Appendix E)

Group	Impact				
Communities	Noise impact on health and quality of life				
Communities	Air Quality				
	Greenhouse gas impact				
Wider Seciety	Capacity / resilience				
Wider Society	Tranquillity				
	Biodiversity				
General Aviation	Access				
General Aviation / Commercial airlines	Economic impact from increased effective capacity				
General Aviation / Commercial arrines	Fuel burn				
Commercial airlines	Training costs				
Commercial armies	Other costs				
	Infrastructure costs				
Airport / Air navigation service provider	Operational costs				
	Deployment costs				
All	Safety				
All	Interdependencies, conflicts, and trade-offs				
All	Airspace Modernisation Strategy (AMS) (CAP1711)				

17

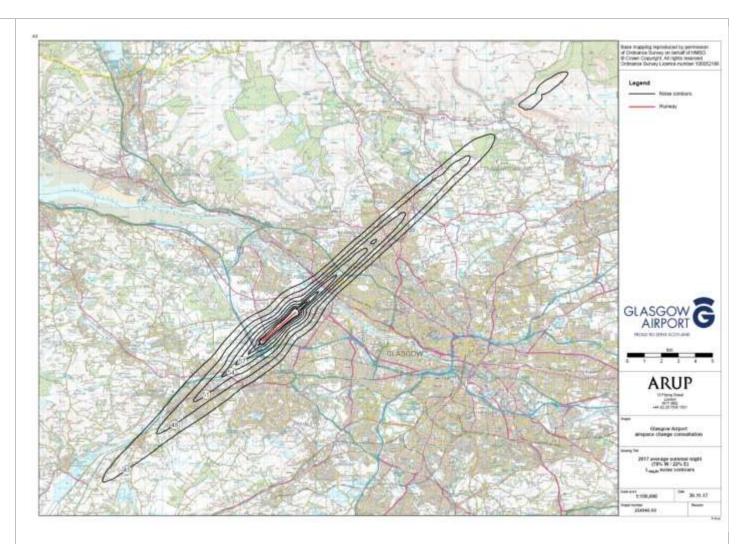
# 3.3. Initial Options Appraisal: Methodology

Table 9 below presents the IOA methodology that will be followed. This methodology will be used to compare the airspace change options against the baseline.

Table 9 IOA Methodology

iroup	Impact	Qualitative Assessment
Sroup	Impact Noise impact on health and quality of life	Qualitative Assessment         Our noise assessment for each airspace change option includes a qualitative description of the expected benefits ar impacts of noise on health and quality of life, supported by some proportionate quantitative analysis:         Larg Contours         51dB Laeq.terr         61dB Laeq.terr         (dytime noise) and 45dB Laeq.terr         (night the benefits and impacts of airspace changes. These contours form part of the primary CAP1616 metric         used to evaluate the benefits and impacts of airspace changes. These contours represent the daytime and night tim         lowest observable adverse effect level (LOAEL) contour defined in UK airspace policy. Law contours, are the equivale         sound level of aircraft noise in dBA. This is based on the daily average movements that take place in the 16-hour perid         (07.00-23:00 local time) or 8-hour perid         This metric is the measure of noise exposure adopted by Government for the purposes of considering adverse effect from aircraft noise. It forms the basis of the Government's policies in relation to aircraft noise.         To determine the size of the forecast contours based on the new airspace design options, requires noise modelling a system level. This requires a complete system design of arrivals and departures modelled with a forecast schedu and complex work. At this stage in the process, given the number of arrival ar departure options and the subsequent permutations when combining these, it is not proportionate to quantify the LA metrics. We will however make a qualitative assessment of the anticipated benefits or impacts to the daytime Laeq as evest tof each option. Full quanti

18



#### WebTAG

The data from LAeq,16hr (daytime noise) and LAeq,8hr (night time noise) contours form part of a key input into WebTAG. WebTAG is the Department for Transport's suite of guidance on how to assess the expected impacts of transport policy proposals and projects. These workbooks can be used to monetise certain aspects of the noise impact, given the correct inputs are available.

As explained above, owing to the number of permutations and the complexity of the noise modelling, we will qualitatively describe the expected changes to the LAeq contours as part of this IOA. As we do not have the quantitative information, we are unable to use the WebTAG workbook at this stage, however this analysis will be undertaken as part of our Stage 3 Full Options Appraisal.

#### **Overflight Contours**

Technical Appendix A includes images and data tables of overflight information which we have used to inform our qualitative assessment of each option. There are two types of overflight information that we have termed 'centreline' and 'vectoring'.

#### **Centreline Overflight Data**

The centreline overflight contours are based on a single event, i.e. one departure or one arrival using the CAA's 48.5 degree definition of overflight as defined in CAP1498. This departure is assumed to follow the SID route from 0-7000ft therefore this data does not take into account any vectoring. This is particularly important to note when considering the baseline data, as we know that the majority of aircraft today are typically vectored rather than following the full SID centreline.

The contours are generated using a standard AEDT (Aviation Environmental Design tool) profile of an 737-800 aircraft and we have added qualitative statements as part of this IOA assessment (particularly for departures) about how the overflight contours may change when considering Glasgow's fleet mix. We chose the B738 as it is one of the largest and noisier aircraft that regularly flies at GLA and therefore tends towards the worst case.

The contour images shown in this IOA and in Technical Appendix A include an indication of the anticipated use of each route which has been based on actual 2019 data, with adjustments made on an option-by-option basis (for example where the option introduces a respite route).

The data-tables use the latest available CACI population data for 2021, PointX data to identify noise sensitive buildings (schools, hospitals, and places of worship). National Parks, National Scenic Areas, Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest have been collected from the Scottish Government's catalogue of spatial data (https://www.spatialdata.gov.scot/geonetwork/srv/eng/catalog.search#/home). In addition, designated quiet areas in Glasgow City were mapped using information taken from the Glasgow City Development Plan (http://www.glasgow.gov.uk/CHttpHandler.ashx?id=35882&p=0)

It's important to note that the overflight contours only look at a single overflight along the PBN centreline, and therefore at this stage the data does not take into account frequency of overflight. This will be qualitatively described as part of this IOA and then fully quantified at Stage 3 Full Options Appraisal.

Data includes overflight counts and areas (km<sup>2</sup>) of: Population, National Scenic Areas (NSA), Parks and gardens, special areas of conservation (SAC), sites of special scientific interest (SSSI), special protection areas (SPA), national parks, designated quiet areas (DQA), schools, hospitals, and places of worship.

At this stage, owing to the complexity of modelling vectoring, we have modelled each option based on aircraft flying the PBN centreline however vectoring below 7000ft may still occur. We have noted throughout the IOA where this applies and added a qualitative assessment alongside the data. As part of our Stage 3 Full Options Appraisal noise modelling of the vectoring will be investigated.

When considering the centreline data for the arrivals baseline, it's important to note that a centreline for the existing arrivals does not actually exist in reality; we created one based on the area's most frequently overflown by arrivals in today's airspace arrangement for comparative purposes.

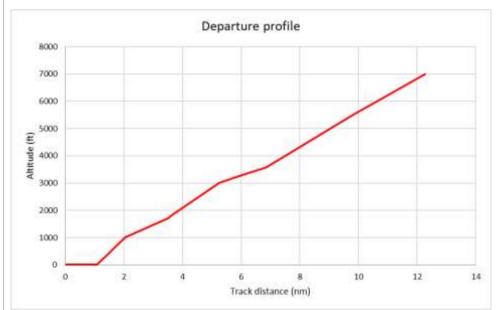
Vectoring (Baseline) Overflight data

As described above, owing to the nature of vectoring, it is very complex to model and at this stage of the process, given the number of options, it is not proportionate to undertake full modelling.

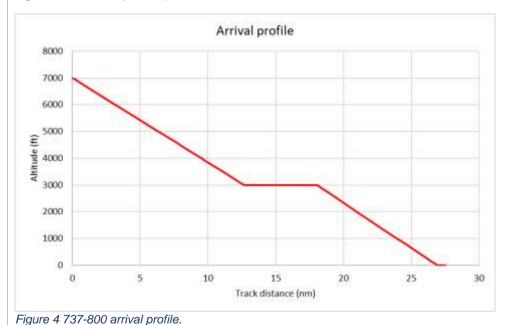
In order to illustrate the difference between the today's baseline flight tracks over the ground (also known as a vectoring swathe) and the PBN options, we have included some information about the baseline vectoring scenario. This has been generated using noise track keeping (NTK) data for the 92-day period, and therefore is not generated in the same way as the overflight contours which use a standard vertical profile of one aircraft. We have however applied the CAA's 48.5 degree overflight cone to the NTK data. The outcome are the baseline heatmaps, which are shown in Technical Appendix A, which help us to articulate the current vectoring swathe and any areas of concentration which occur today. Alongside the images, we have included overflight data as part of our Technical Appendix and IOA. This data does not consider frequency of overflight but instead takes account of any areas that are overflown at least once, based on the NTK data; this allows some preliminary comparison to be drawn between the option's overflight contours and what happens today.

#### 60dB and 65dB LAMax

As part of this IOA, we have calculated 65dB L<sub>Amax</sub> (day) and 60dB L<sub>Amax</sub> (night) contours and data using an Airspace Optioneering Tool. The indicative noise calculations in the tool are based on the methods set out in ECAC Doc 29 (https://www.ecac-ceac.org/images/documents/ECAC-Doc\_29\_4th\_edition\_Dec\_2016\_Volume\_1.pdf) and have been verified against calculations using the FAA's Aviation Environmental Design Tool (AEDT) (<u>https://aedt.faa.gov/</u>). The optioneering tool is not a full noise model complying to the standards required by CAP2091, but we have agreed with the CAA that it is a proportional method to use at this stage of the analysis. The optioneering tool does not take airport specific atmospheric conditions into account and assumes standard atmospheric attenuation rates set out in SAE-AIR-1845. The source of the acoustic data used in the tool is the international Aircraft Noise and Performance (ANP) database (<u>https://www.aircraftnoisemodel.org/</u>). Arrival and departure flight profiles for a Boeing 737-800 have been calculated as a function of track distance using the default departure / arrival procedural steps for Aircraft ID 737800 in the ANP database. The procedure for maximum take-off weight has been used as this is the most conservative profile in noise terms due to the low climb rate. The departure and arrival profiles are shown as a function of track distance in the figures below.







Similar to the overflight contours, these are based on a single noise event i.e. based on one departure or one arrival.

60dB and 65dB L<sub>Amax</sub> contours are an indication of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. These are required by the CAA to help with engagement on noise and airspace change, and to further differentiate between airspace options which have a similar impact with respect to the L<sub>Aeq</sub> metrics.

The 60dB and 65dB L<sub>AMax</sub> data contained within the Technical Appendix is based only on centreline data and assumes no dispersion around the centreline; this means that for the baseline, it does not reflect the vectoring that occurs today. As explained above, to model vectoring is complex and something that we will do as part of our Stage 3 Full Options Appraisal. As part of this IOA, we will use the data as a starting point for comparison between the baseline and the options and we will also provide some additional qualitative analysis.

#### CAP2091

At this stage in the airspace change process, we have not calculated  $L_{Aeq}$  contours (see section above) and instead we will qualitatively describe anticipated changes based on the most recent contours generated for Glasgow's 2017 noise action plan. The contours in the noise action plan were generated to CAP2091 category D/E standards however the output shows that the airport should move to category C for future noise modelling as there were 83,200 people within the 51dB<sub>LAeq,16h</sub> contour which is above the mandated minimum threshold of 25,000 (and below the maximum threshold of 200,000) for category C. In Stage 3, when the L<sub>Aeq</sub> contours are fully quantified, all noise modelling will therefore be undertaken to category C standards. When considering future forecast 10 years from implementation, it is expected that the contours will remain within the category C threshold however this will be confirmed at Stage 3 when the noise modelling takes place.

		Continuous Climb As part of some of the departure options, we describe how they are anticipated to continuously climb to above 6000ft. The scope of this Level 1 ACP is up to 7000ft and therefore typically we would seek continuous climb to 7000ft. As discussed in our Stage 2A document, even with a redesign and modernisation of the airspace there is another significant and fixed constraint that requires consideration when looking at continuous climb up to 7000ft. This is the Transition Altitude (TA), which is 6000ft in the Scottish TMA. In summary, any SIDs that climb above 6,000ft need to climb continuously from the runway, to at least FL90 in order to guarantee continuous climb above 7000ft. As the NATS NERL ACP, which looks at the airspace above 7000ft, is not yet at the stage to be able to inform whether climb to FL90 is achievable, for the basis of this IOA we have assumed that aircraft will be able to continuously climb to 7000ft for the purposes of the noise modelling at this stage. We will revisit this as part of our Full Options Appraisal when we have further information from NERL around the upper airspace network.
	Air Quality	Due to the effects of mixing and dispersion, emissions of NOx, PM10 and PM2.5 from aircraft travelling from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality. The DfT's Air Navigation Guidance (2017) states that: "Studies have shown that NOx emissions from aviation related operations reduce rapidly beyond the immediate area around the runway. Due to the effects of mixing and dispersion, emissions from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality. Therefore, the impact of airspace design on local air quality is generally negligible compared to changes in the volume of air traffic and that of the local transport infrastructures feeding the airport." ICAO's Airport Air Quality Manual (International Civil Aviation Organization. Doc 9889 Airport Air Quality Manual. Second Edition, 2020. ICAO, Canada.) similarly states that 1,000ft is the typical limiting altitude for ground-level NO2 impacts from aircraft emissions.  Assessment of Arrival Options As part of this IOA we will qualitatively describe any expected changes below 1000ft. Aircraft arriving at Glasgow fly a standard 3-degree angle of approach. It's therefore very unlikely that any arrivals options will offer any significant impact air quality however we will review each option for changes below 1000ft.  Assessment of Departure Options Aircraft departing Glasgow have varying climb performance depending on aircraft type and therefore different aircraft reach 1000ft at different locations. Today, virtually all Glasgow departures climb straight ahead for 5nm and during this they climb above 1000ft; whilst a change in route will not impact the totality of emissions, it may result in a change in location of the emissions which we will qualitatively describe.
	Greenhouse gas impact	As emissions of greenhouse gases arise from the combustion of aviation fuel and fuel burn is linked to track mileage, for this IOA we have estimated the differences in track miles between the baseline and each route which forms part of the options. We have then applied a percentage weighting, based on the anticipated usage of the routes, to understand the overall performance of the option. This weighting is based on 2019 movement data. A table with full details is shown in Technical Appendix A. As part of the Full Options Appraisal (Stage 3A), we appraise track mileage, fuel burn and the associated greenhouse gas impact in further detail.
	Capacity / resilience	Subject matter experts will qualitatively assess any impacts to capacity and/or resilience against the baseline scenario.
Wider Society	Tranquillity	CAP1616 outlines the consideration of impacts upon tranquillity is with specific reference to National Parks and Areas of Outstanding Natural Beauty (AONB), plus any locally identified 'tranquil' areas that are identified through community engagement and are subsequently reflected within an airspace change proposal's design principles. In Scotland, the equivalent of AONB are National Scenic Areas (NSA) and we've therefore included overflight data around these, National Parks, and designated quiet areas (DQA) as part of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the option differs from current day and whether this has the potential to impact tranquility with regards to noise and AONB.
	Biodiversity	The effects of airspace change on ecology or biodiversity are expected to be minimal. CAA guidance states that "In general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not involve ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the Birds or Habitats legislation." Though there is limited research available on the effects of aircraft noise on wildlife, there is some evidence that disturbance effects associated with aircraft can occur during take-off and landing where aircraft are below around 500m (~1,640ft). [Drewitt, A. (1999) Disturbance effects of aircraft on birds. English Nature Birds Network Information Note]. Consideration will therefore be given to the effects on ecology and biodiversity where aircraft overfly Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interest, particularly at altitudes below 2,000ft.
General Aviation	Access	As part of this IOA, we will qualitatively describe the potential impacts and benefits to general aviation access as a result of each option. This will be partially informed by the engagement undertaken with GA users during Stage 2. At the full options appraisal stage, we will have detailed plans for CAS and will quantify any increase or decreases in CAS volume.

General Aviation /	Economic impact from increased effective capacity	The IOA will qualitatively estimate the differences between the option and the baseline. As part of the FOA at Stage 3 we will quantitively appraise any economic benefits or impacts in further detail.
Commercial airlines	Fuel burn	As the combustion of aviation fuel is linked to track mileage, for this IOA we have estimated the differences in track miles between the baseline and each route which forms part of the options. We have then applied a percentage weighting, based on the anticipated usage of the routes, to understand the overall performance of the option. This weighting is based on 2019 movement data. Tables with full details are shown in Technical Appendix A. Alongside the estimated quantitative information, we will provide a qualitative statement around continuous climb and continuous descent operations which also have the potential to impact fuel burn.
Commercial	Training costs	The IOA will qualitatively estimate whether any training costs would be incurred by Commercial airlines in order to implement the option.
airlines	Other costs	The IOA will qualitatively estimate whether any other costs would be incurred by Commercial airlines in order to implement the option.

	Infrastructure costs	The IOA will qualitatively estimate whether any infrastructure costs would be incurred by the airport or ANSP in order to implement the option.
Airport / Air navigation service	Operational costs	The IOA will qualitatively estimate whether any operational costs would be incurred by the airport or ANSP in order to implement the option.
provider	Deployment costs	The IOA will qualitatively estimate whether any deployment costs would be incurred by the airport or ANSP in order to implement the option.
All	Safety	A qualitative safety assessment of each option will be undertaken which compares against the baseline.
All	Interdependenci es, conflicts, and trade-offs	An airspace change proposal at a Stage 2 gateway in the CAP 1616 process should specify any interdependencies with other airspace changes identified in Iteration 2 of ACOG's Airspace Change Masterplan. This IOA will take the information contained within the masterplan document around potential areas of conflict / interdependencies and identify if the option falls within these areas. This will give an indication of whether there is the potential for trade-offs with other airspace change sponsors required during Stage 3. The figure below shows the illustration provided within the masterplan that outlines Glasgow's potential interdependencies. <i>Figure 5 Potential Scottish TMA GLA EDI Interactions (From ACOG Masterplan)</i>
		Cottish TMA Interactions       Note of the sector of the sec
		Although not part of the FASI-N programme, Glasgow airport also share interdependencies with Prestwick Airport (located to the south-west of Glasgow). We will consider this and qualitatively describe potential interdependencies as part of our IOA.
		Our IOA will include a qualitative, high level, assessment of how the design options perform against the vision and parameters/strategic objectives of the <u>Airspace Modernisation Strategy</u> . CAP1711 describes the objective as: <i>Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.</i>
AII	Airspace Modernisation Strategy	<ul> <li>And the parameters as:</li> <li>create sufficient airspace capacity to deliver safe and efficient growth of commercial aviation</li> <li>progressively reduce the noise of individual flights, through quieter operating procedures and, in situations where planning decisions have enabled growth which may adversely affect noise, require that noise impacts are considered through the airspace design process and clearly communicated</li> <li>use the minimum volume of controlled airspace consistent with safe and efficient air traffic operations</li> <li>in aiming for a shared and integrated airspace, facilitate safe and ready access to airspace for all legitimate classes of airspace users, including commercial traffic, General Aviation, and the military, and new entrants such as drones and spacecraft</li> <li>not conflict with national security requirements (temporary or permanent) specified by the Secretary of State for Defence.</li> </ul>

# 4. Initial Options Appraisal

The following tables outline our Initial Options Appraisal for each option and provide an assessment of the four baseline scenarios.

#### 4.1. Runway 23 Westerly Departures Baseline

# **Runway 23 Westerly Departures Baseline** This option represents the do-nothing scenario for Glasgow Westerly SIDs. Today, all Glasgow SIDs climb straight ahead to 5nm before turning. This means that the minimum departure interval between successive departing aircraft is at least 2 minutes. The result is that during peak departure times, aircraft are held on the runway and at the runway holding points, leading to increased emissions and delay. Beyond 5nm, aircraft are typically vectored off the SID centrelines by ATC, resulting in broad swathes. Some aircraft less than 5700kg MTWA do not have to depart via the SIDs. These are usually non-jet aircraft and therefore slower than jet aircraft. These aircraft are vectored by ATC which helps them turn towards their destination early, reduces track miles and reduces departure delays. Glasgow Airport's current SIDs are dependent on conventional ground-based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is an interim measure that only can only be used to bridge the gap ahead of FASI implementation. The AMS mandates airports implement IFPs based on PBN and doing nothing does not meet that national requirement. For more information on our do-nothing scenario, which was discontinued as part of the Design Principle Evaluation, please see our Stage 2A document on the CAA's Airspace Change Portal. Group **Qualitative Assessment** Impact Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. Aircraft above 5700kg departing from Glasgow climb straight ahead to 5nm before turning. Beyond 5nm, aircraft are typically vectored off the SID centrelines by ATC resulting in dispersion. These swathes can be seen in the vectoring heatmaps below which have been generated using NTK data: 2019 baseline average ummer day overflight Noise impact on Figure 6 Runway 23 Departure Vectoring Swathe 2019 Communities health and quality of The Technical Appendix to this document includes a larger version of this map along with overflight data. It's life important to note that this vectoring data is not modelled in the same way as the centreline overflight contours, however it does provide a preliminary means of comparison between this baseline and the airspace change options. Table 10 below includes data based on this NTK vectoring map and data output from the optioneering tool for if aircraft were to follow the centreline of the current published SID: Table 10 Westerly departures baseline overflight data

System	Area (km²)	Population
RWY 23 Baseline – Vectoring (NTK data)	547.32	163216

141.18

29838

The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline.

In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals, and places of worship; the full data around these is shown in Technical Appendix A, and as part of this IOA we will provide a qualitative statement around this data.

#### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours and data for the centreline baseline, to aid comparison between the baseline and the options. 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal.

#### Table 11 Runway 23 Departures Baseline LAMax Data

	60dE	B L <sub>Amax</sub>	65dB L <sub>Amax</sub>			
System	Area (km²)	Population	Area (km²)	Population		

Baseline (Centroline 1)         285.37         99120         95.69           Bineticine (Centroline 1)         285.37         99120         95.69           The data from these tables will be used to compare the westerly departure options against the dor The westerly departures make up a component of the overall Las, daytime and night time contour the overall contous from 2017, as an indicative contour for 2025 as it is expected that contours the departure option of the option of the analysis of the option of the analysis of the option of the option of the asset option of the option of the analysis of the option of the asset option of the option of the analysis of the option of the asset option of the option of the analysis of the option of the asset option of the option of the analysis of the option of the option of the option of the option of the option of the option										
Use The worked comparitures make up a component of the overal Log daytime and high time contour bayes and size.           Noise Absement Procedures As the baseline reflects current day, there would be no changes to NAPs as a result of this option Noise Mingrainon The existing SIDs configuration does not offer any coportunities for predictable respit. Furtherm underneath final approach within 50m of the aignoriz currently expendence all departures and aignori.           Air Quality         Impacts to air quality are considered for changes below around 1000tk (200m), Aircraft (lying above to have a significant impact on local ground air quality.           Air Quality         Air Quality of the product of the overall local ground air quality.           Air Quality         Air Quality are considered for changes below around 1000tk (200m), Aircraft (lying above to have a significant impact on local ground air quality.           Air Quality         Air Quality         Air Quality are considered to changes below around 1000tk (200m), Aircraft (lying above to have a significant impact on local ground air quality.           Air Quality         Air Quality are considered to changes below around 1000tk (200m), Aircraft (lying above to have a significant impact on local ground air quality.           Air Quality         Air Quality are considered to changes below around 1000tk (200m), Aircraft (lying above to have a significant impact on local ground air quality.           Air Quality         Forther and the different to calors in fact, of as the combustio is linked to track length, we have initially all disagove display the significant impact is a substance. Novelog and the dinference baseline and the option, io underated if					37	99120	95.69	)	53704	
Greenhouse         gas         The investry departures make up a component of the overall Cux_d daytime and right that contours shape and size.           Wider Society         Noise Abstrament Procedures         As this baseline reflects current day, there would be no changes to NAPs as a result of this option.           Noise Abstrament Procedures         As this baseline reflects current day, there would be no changes to NAPs as a result of this option.           Noise Abstrament Procedures         As this baseline reflects current day, there would be no changes to NAPs as a result of this option.           Noise Abstrament Procedures         As this baseline reflects current day, there would be no changes to NAPs as a result of this option.           Noise Abstrament Procedures         In country         As this baseline reflects current day, there would be no changes to NAPs as a result of this option.           Air Ouality         Aircraft departing Glasgow have varying climb performance depending on aircraft tay they and the aircraft reach robust of 1000th cuber to 1000th.         Aircraft tay they are and the aircraft reach robust of 1000th cuber to the total and path, and they observe to 1000th.           Air Ouality         Aircraft departure baseline - Indicative track miles         The Normal State Sta			The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline.							
As this baseline reflects current day, there would be no changes to NAPs as a result of this option Noise Mitigation The axisting SDs configuration does not offer any opportunities for pradictable respite. Furtherm unconstruct this source is the source of the aligned transfer of the aligned			The westerly depar the overall contours							
Offention         The existing SIDe configuration does not offer any opportunities for predictable resple. Furthermundementh final approach within 5mm of the airport currently experience all departures and an airport.           Air Quality         Air and approach within 5mm of the airport currently experience all departures and an airport.           Air Quality         Air and the airport of the airport currently experience all departures and an airport.           Air Quality         Air and the airport and the airport and the airport and the airport and the advert 1000th difference departure departures dimb straight and during this they dimb above 1000th. Currently visually all disease departures dimb straight and during this they dimb above 1000th. Currently departures dimb straight and during this they dimb above 1000th. Currently departure during the stress the combusion is linked to track length, we have initially looked at the track length we the task length, we have initially looked at the track length we the sector Table 12 Westerly departure baseline – Indicative track miles           WV 23         Baseline (Centrellin)         The assessment is therefore linked to the fuel burn assessment detailed in the sector Table 12 Westerly departure baseline – Indicative track miles           WV 23         Baseline (Centrellin)         Scon         Scon           The ASSE and the ASSE assessment is therefore linked to the fuel burn assessment detailed in the sector Table 12 Westerly departure baseline – Indicative track miles         Scon           WV 23         Baseline (Centrellin)         Scon         Scon           The ASSE assessment is therefore inked to the fuel					would be	no changes to I	NAPs as a result of t	his option.		
Nice Society <ul> <li>Transition impact on local ground air quality.</li> <li>Air Quality</li> <li>Aircraft departing Glasgow have varying climb performance depending on aircraft type and the aircraft tree of 1000ft at different locations. Today, vitually all Glasgow departures climb straight at during this they climb above 1000ft. Curr IGA will qualitatively describe any changes to the lateral paths which could occur between 1000ft.</li> </ul> <li> <ul> <li></li></ul></li>			The existing SIDs c underneath final ap							
Bircraft reach 1000ft at different locations. Today, virtually all Claisgow departures climb straight at during this they climb above 1000ft. CUI CAW will qualitatively describe any changes to the lateral paths which could occur below 1000tt.           Emissions of greenhouse gases arise from the confluxition of aviation fuel, and as the combusito is linked to track length, we have initially looked at the track length for the baseline vester/y greenhouse gas assessment is therefore linked to the fuel bum assessment detailed in the section Table 12 Westerly departure baseline – Indicative track miles           Regention         Regention         Interfore linked to the fuel bum assessment detailed in the section Table 12 Westerly departure baseline – Indicative track miles           Regention         Regention         Interfore linked to the fuel bum assessment detailed in the section NORBO – LUKEY         93.40         26.2           NORBO – SUBUK         93.40         26.2         10.66           DEPS         PERTH         69.80         12.3           FOYLE         33.00         0.42         10.66           LUNON         26.70         2.05         10.80           Ves will estimate the differences between this baseline and the option, to understand if there ar advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical filliot today. A COC emissions are linked to the difference in aviation fuel built in Technical Appendix A.           Wider Society         Greapoly of summaton the airport in linease in port, a sirraft are only able							ft (200m). Aircraft fly	ing above thi	s are unlike	
Wider Society         Emissions of greenhouse gases arise from the combustion of aviation fuel, and as the combustion is limited to that leads length thor the baseline vesselity greenhouse gas assessment is therefore the ubur assessment detailed in the section Table 12 Westerly departure baseline – Indicative track length thor the baseline vesselity greenhouse gas assessment is therefore linked to the total burn assessment detailed in the section Table 12 Westerly departure baseline – Indicative track miles                Greenhouse gas             gas             impact               TRN             38.50             3.69             TAA             54.70             0.41             permissions of greenhouse gases                 greenhouse gase               TRN             38.50             3.69             TAA             54.70             0.41             TAA                 DEPS               TLA               54.70                 DEPS               TLA               54.70                 DEPS               TCL               20.00                 UVINDOS               30.00               0.25                 USIN-DOS               24.7               20.5                 USIN-DOS               24.7               20.5                 USIN	A	Air Quality	aircraft reach 1000f during this they clim	t at different locations. hb above 1000ft. Our IC	Today, virt	ually all Glasgov	v departures climb s	traight ahead	l for 5nm ar	
Greenhouse gas impact       RWY 23       Impact       Baseline (Centrelline) mm       ////////////////////////////////////			Emissions of green is linked to track le	house gases arise fron ength, we have initially	looked at	the track leng	th for the baseline	westerly dep	artures. Th	
Wider Society       Capacity / resilience       Greenhouse gas impact       mm       //w Weighting       Score         Wider Society       Greenhouse gas impact       TRN       38.50       3.69       3.69         NORBO – SUBUK       33.40       26.2       100000       32       1000000       32       1000000000000000000000000000000000000			Table 12 Westerly	departure baseline – In	dicative tra	ack miles				
Greenhouse gas impact       TRN       38.50       3.69       Status         DEPS       TRN       38.50       3.69       Status         DEPS       TLA       54.70       0.41       Status       Stat			RWY 23			· · · · · · · · · · · · · · · · · · ·				
Greenhouse gas impact         gas impact         NORBO - SUBUK         93.40         26.2           DEPS         TLA         93.40         32           LUSIV-DCS         84.80         10.66           TLA         54.70         0.41           PERTH         69.80         1.23           FOYLE         33.00         0.82           LOMON         26.70         2.05           CLYDE         19.50         2.87           ROBBO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircaft tracks shorter than a typical fight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircaft are only able to depart with at least 2- This leads to holding on the ground which results in increased inscissions and delays. An fut movement numbers at the airport will results in increases for orces the Scottish TMA are anticipated to result in capacid disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and the additional complexity and workoad. Flow requalutions stabilise the number of movements unit is sub				TDN	nm				42.065	
Greenhouse gas impact       gas impact       DEPS       NORBO - LAKEY       93.40       32         DEPS       TLA       54.70       0.41         PERTH       69.80       1.23         FOYLE       33.00       0.82         LOMON       26.70       2.05         CLYDE       19.50       2.87         ROBBO       19.60       2.05         Total       82%         We will estimate the differences between this baseline and the option, to understand if there are advantages/disavantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fluel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.         Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2- This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.         In future, increased forecast movements across the Scottish TMA are anticipated to result in capac disbenefits. As traffic increases, flow restinctions are likely to be put in place in order for ATC and the additional complexity and Workola. Flow reguations stabilise the number of movements until subsides, however									42.065	
Greenhouse impact         gas impact         LUSIV-DCS         84.80         10.66           TLA         54.70         0.41           PERTH         69.80         1.23           FOYLE         33.00         0.82           LOMON         26.70         2.05           CLYDE         19.50         2.87           ROBEO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical light today. As CO2 emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2 This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will result in increase in ground holding and delay and therefor existing configuration are not if for purpose for future growth at the airport.           ROBe/ up / resilience         In future, increased forecast movements across the Scottish TMA are anticipated to result in iccapac disbenefits. As traffic increases, flow regulations tabilises the number of movements until subsides, however in doing so they generate ground holding and delay and therefor exist										
Greenhouse impact       gas impact       DEPS       TLA       54.70       0.41         PERTH       69.80       1.23         PERTH       69.80       1.23         FOYLE       33.00       0.82         LOMON       26.70       2.05         CLYPE       19.50       2.87         ROBBO       19.60       2.05         Total       82%									988.8	
impact         DEPS         IDA         54.70         0.41           PERTH         69.80         1.23         FOYLE         33.00         0.82           LOMON         26.70         2.05         CLYDE         19.50         2.87           ROBEO         19.60         2.05         Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical light today. As COc emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.         Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increase demissions and delays. Any ful movement numbers at the airport will result in increase in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capac disbenefits. As traffic increases, flow regulations stabilise the number of movements until subides, however in doing so they generate ground delay for Glasgow.           Lis therefore possible that, with future traffic levels, this baseline scenario would result in increase decommissiones are itkely to be put in place.         TC and the addition to this, no change to	G	Greenhouse das							03.968	
Ider Society         Capacity / resilience         PERTH         69.80         1.23           FOYLE         33.00         0.82		0	DEPS						2.427	
LOMON         26.70         2.05           CLYDE         19.50         2.87           ROBBO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m reveales in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capace disbenefits. As traffic increases, flow regulations stabilise the number of movements until subides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increase delay at Glasgow aiport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.           This baseline is dependent on conventional ground-based navigation aids called VORs, witrical operational issues and sig				PERTH		69.80	1.23	8	5.854	
CLYDE         19.50         2.87           ROBBO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data' in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           Capacity / resilience         In future, increased forecast movements across the Scottish TMA are anticipated to result in capac disease, flow results in stabilise the number of movements until it subsides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increase delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.           This baseline is dependent on conventional ground-based navigation aids called VORs. This eque be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pr is cur				FOYLE		33.00	0.82	:	27.06	
ROBBO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today, As CO2 emissions are linked to the difference in aviation fuel buus us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5mr results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport ill results in increased emissions and delays. Any fut movement numbers at the airport will results in increased emissions and delays. Any fut movement numbers at the airport will results in increases in ground holding and delays. Any fut movement numbers at the airport will results in increased emissions and delays. Any fut movement numbers at the airport will results in a capacity constraint on the airport at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capace disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and the additional complexity and workload. Flow regulations stabilise the number of movements until subsides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increase delay at Glasgow argut on the associated with the programme.           This baseli				LOMON		26.70	2.05	5	4.735	
ROBBO         19.60         2.05           Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today, As CQ2 emissions are linked to the difference in aviation fuel buus us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5mr results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will results in increased emissions and delays. Any fut movement numbers at the airport will results in increased emissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capace disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and the additional complexity and workload. Flow regulations stabilise the number of movements until subsides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increase delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.           This ba				CLYDE		19.50	2.87	5	5.965	
Image: Transport         Total         82%           We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical llight today. As C02 emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A.           Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increase demissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capac disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and the additional complexity and workload. Flow regulations stabilise the number of movements until i subsides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increase fASI programme of change and AMS benefits associated with the programme.           This baseline is dependent on conventional ground-based navigation aids called VORs. This equ be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pr is currently no long term? resilience of Glasgow's Sub when NERL decommissions the VORs, w critical operational issues and significant loss of revenue.				ROBBO			2.05		40.18	
We will estimate the differences between this baseline and the option, to understand if there are advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks shorter than a typical flight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fuel bu us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data in Technical Appendix A. <i>fider Society</i> Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5m results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-This leads to holding on the ground which results in increased emissions and delays. Any fut movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.           In future, increased forecast movements across the Scottish TMA are anticipated to result in capace disbenefits. As traffic increases, flow vestrictions are likely to be put in place in order for ATC and the additional complexity and workload. Flow regulations stabilise the number of movements until i subsides, however in doing so they generate ground delay for Glasgow.           It is therefore possible that, with future traffic levels, this baseline scenario would result in increas delay at flasgow airport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.           This baseline is dependent on conventional ground-based navigation aids called VORs. This equ be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pr is currently no long term? resultince for Glasgow's SUS when NERL decommissions the VORs, w critical operational iss									68.134	
Tranquillity       movement numbers at the airport will result in increases in ground holding and delay and therefor existing configuration are not fit for purpose for future growth at the airport.         In future, increased forecast movements across the Scottish TMA are anticipated to result in capace disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and the additional complexity and workload. Flow regulations stabilise the number of movements until it subsides, however in doing so they generate ground delay for Glasgow.         It is therefore possible that, with future traffic levels, this baseline scenario would result in increated delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.         This baseline is dependent on conventional ground-based navigation aids called VORs. This equipe decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pris currently no long term <sup>2</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs, we critical operational issues and significant loss of revenue.         CAP1616 outlines the consideration of impacts upon tranquillity with specific reference to National of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic , we've therefore included overflight data around these, National Parks, and designated quiet area of our Tranquillity and whether this has the potential to impact tranquillity with regards to noise and AOI Table 13 shows data on the overflight of these areas, based on the NTK vectoring baseline and follow Glasgow's existing SID centrelines. The data from this table will be used to compare the will	r Societv		<ul> <li>We will estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks will be longer of shorter than a typical flight today. As CO<sub>2</sub> emissions are linked to the difference in aviation fuel burnt, this will allow us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data tables are shown in Technical Appendix A.</li> <li>Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5nm before turning results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-minute intervals. This leads to holding on the ground which results in increased emissions and delays. Any future increases in</li> </ul>							
It is therefore possible that, with future traffic levels, this baseline scenario would result in increat delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also FASI programme of change and AMS benefits associated with the programme.This baseline is dependent on conventional ground-based navigation aids called VORs. This equ be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pr is currently no long term² resilience for Glasgow's SIDs when NERL decommissions the VORs, w critical operational issues and significant loss of revenue.CAP1616 outlines the consideration of impacts upon tranquillity with specific reference to National of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic / we've therefore included overflight data around these, National Parks, and designated quiet area of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the o current day and whether this has the potential to impact tranquillity with regards to noise and AOI Table 13 shows data on the overflight of these areas, based on the NTK vectoring baseline and follow Glasgow's existing SID centrelines. The data from this table will be used to compare the work		Capacity / resilience	existing configuration are not fit for purpose for future growth at the airport. In future, increased forecast movements across the Scottish TMA are anticipated to result in capacity at disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and pilot the additional complexity and workload. Flow regulations stabilise the number of movements until the p					and resilien ts to mana		
be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation pris currently no long term² resilience for Glasgow's SIDs when NERL decommissions the VORs, we critical operational issues and significant loss of revenue.CAP1616 outlines the consideration of impacts upon tranquillity with specific reference to National of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic A we've therefore included overflight data around these, National Parks, and designated quiet area of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the o current day and whether this has the potential to impact tranquillity with regards to noise and AOI Table 13 shows data on the overflight of these areas, based on the NTK vectoring baseline and follow Glasgow's existing SID centrelines. The data from this table will be used to compare the weight of the section of the sectio			It is therefore possible that, with future traffic levels, this baseline scenario would result in increases in departur delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also inhibit the wide							
of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic A we've therefore included overflight data around these, National Parks, and designated quiet area of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the o current day and whether this has the potential to impact tranquillity with regards to noise and AOI Table 13 shows data on the overflight of these areas, based on the NTK vectoring baseline and follow Glasgow's existing SID centrelines. The data from this table will be used to compare the weat			This baseline is dependent on conventional ground-based navigation aids called VORs. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>2</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs, which will result in critical operational issues and significant loss of revenue.							
Tranquillity follow Glasgow's existing SID centrelines. The data from this table will be used to compare the we			CAP1616 outlines the consideration of impacts upon tranquillity with specific reference to National Parks and Area of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic Areas (NSA) and we've therefore included overflight data around these, National Parks, and designated quiet areas (DQA) as part of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the option differs from current day and whether this has the potential to impact tranquillity with regards to noise and AONB.							
Table 13 Westerly departure baseline – Tranquillity overflown	Т	「ranquillity	follow Glasgow's ex baseline.	xisting SID centrelines.	The data f	rom this table w				
System NSA area NSA count National National DOA area						National			QA count	
RWY 23 Baseline –						Parks area	Parks count		_	
Vectoring (NTK data)0.0211.6810						1.68	1	U	0	

<sup>&</sup>lt;sup>2</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		RWY23 Baseline (Centrel Optioneering to		0	0		0	0		0	0		
			In addition to the data tables, Technical Appendix A contains maps which show NSAs, National Parks and DQAs alongside the departure options overflight contours.										
	The effects of airspace change on ecology or biodiversity are expected to be minimal. CAA guidance "In general, airspace change proposals are unlikely to have an impact upon biodiversity because they de ground-based infrastructure. As such they are unlikely to have a direct impact that would engage Habitats legislation." Though there is limited research available on the effects of aircraft noise on wild some evidence that disturbance effects associated with aircraft can occur during take-off and landing w are below around 500m (~1,640ft). Consideration will therefore be given to the effects on ecology and where aircraft overfly Special Protection Areas, Special Areas of Conservation, National Parks, Nati 										v do not in le the Bir vildlife, th ly where a nd biodiv lational S aircraft we	volve rds or ere is ircraft rersity scenic ere to	
	Biodiversity	System	SAC count	SAC area	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area	
		RWY 23 Baseline – Vectoring (NTK data)	3	1.42	32	65.82	12	58.95	1	1.68	1.00	0.02	
		RWY 23 Baseline (Centreline – Optioneering tool)	0	0	3	23.69	1	21.89	0	0	0	0	
		Below 2000ft based Conservation, Natio of aircraft. Lower an Barr Lochs SSSI, ho to follow the NAP ar	nal Parks d slower wever th	s, National S aircraft, clin is is likely to	Scenic Are mbing at b o be infreq	eas, and S pelow a 6% juently as	ites of Spe % climb gra lower and	ecial Scier adient, ma slower air	ntific Intereases overfly	est for the the Cast	e vast ma le Semple	ajority e and	
		This baseline scena place today. The op								(CAS) ar	rangeme	nts in	
General Aviation	Access	Figure 7 Clascow Airpo		Zone and Co		Chart (See	AIP for ful						
		Figure 7 Glasgow Airpo Within c.35nm of Gl	asgow ai	rports are f	Edinburgh	and Glase	gow Prestv	vick Airpo					

Within c.35nm of Glasgow airports are Edinburgh and Glasgow Prestwick Airport each with their own Controlled Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports' airspace which generates the volumes shown in Figure 5. The controlled airspace at Glasgow has varying lower and upper limits with the volume closest to the airport going down to ground level. This is the Glasgow CTR shown in red outline. Also, in this figure can be seen Cumbernauld Airport approximately 15nm to the east of Glasgow airport which sits outside CAS where the base of the CTA is 3000ft. This is indicated with a yellow dot.

		It is apparent from previous continual GA engagement by Glasgow and CAA's Airspace Classification Review that the CAS structures to support Glasgow Airport's operation are out of date and the CTR itself can likely be reduced in size. Whilst the existing baseline scenario will not result in the requirement for more airspace, this option offers no opportunity to simplify the airspace boundaries or reduce the size of CAS which is something Glasgow has been specifically working with GA stakeholders to try to achieve.
	Economic impact from increased effective capacity	There will be no change from today as a result of this option; later in this IOA we will qualitatively estimate the differences between this, and the airspace change options.
General Aviation / Commercial airlines	Fuel burn	As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline westerly departures. When departing from Glasgow, the majority of aircraft fly straight ahead until 5nm and then are vectored by air traffic control, this means that track length is varied from flight to flight. For the purposes of comparing our westerly SID options against the baseline scenario, we have taken the track length of the SID centerlines as an initial indication of 'do nothing' track length. We have then applied a weighting based on SID usage to provide an overall total track mileage for the system. At the Stage 3 full options appraisal track length and fuel burn will be modelled

		in further detail.						
		Table 15 Westerly SID Track Mileage						
				Baseline (Centreline)				
		RWY 23		nm	Score			
			TRN	38.50	% Weighting 3.69	142.065		
			NORBO – SUBUK	93.40	26.2	2447.08		
			NORBO – LAKEY	93.40	32	2988.8		
			LUSIV-DCS	84.80	10.66	903.968		
			TLA	54.70	0.41	22.427		
		DEPS	PERTH	69.80	1.23	85.854		
			FOYLE	33.00	0.82	27.06		
			LOMON	26.70	2.05	54.735		
			CLYDE	19.50	2.87	55.965		
			ROBBO	19.60	2.05	40.18		
			Т	otal	-	6768.134		
		Aircraft departing from Glasgow are sometimes prevented from continuously climbing due to the tac coordination with other traffic in the airspace. We will qualitatively estimate the differences between this baseline and the option, to understand if there are anticipated advantages/disadvantages of the option against current day. This estimation will consider whethe aircraft tracks will be longer or shorter than a typical flight today and will also consider the opportunity for contin climb.						
Commercial	Training costs	As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
airlines	Other costs	As this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
	Infrastructure costs	As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
Airport / Air navigation service provider	navigation service Operational costs Glasgow Airport's current SIDs are dependent on conventional ground-based navigation equipment substitution to mitigate VOR rationalisation programme by NATS NERL. Glasgow is currently invest					on equipment (VORs) which urrently investigating RNAV y can only be used to bridge alisation in the long term will		
	Deployment costs		Iready in operation, there estimate the difference			nere will be no change; later		
All	Safety	growth could how	ever result in increased o	complexity and workl	oad for Air Traffic Conti	s at Glasgow. Future traffic rollers and pilots, which may ng on the ground, in order to		
All	Interdependencies, conflicts, and trade- offs	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with Westerly departures which are separated from Prestwick's airspace and do not conflict with Edinburgh's traffic below 7000ft. The existing ScTMA route structure shares airways for use by both Edinburgh and Glasgow results in higher ATC workload and less efficient profiles in the airspace above 7000ft.						
All	AMS	Deliver quicker, qu by UK airspace.			-	se who use and are affected		
		Doing nothing with Westerly departures will not align with the AMS. It will not enable any environmental benefits or maximise benefits from NERL's re-design of the ScTMA. No change and therefore no ACP submission will not enable any reduction in the volume of controlled airspace.						

## 4.2. Runway 23 Westerly Departure Option A

Runway 23 Westerly Departures (Do	Nothing Baseline)
	Offset right departures with turns at c.2nm and c.7nm from the runway. Offset left departures with turns at c.1nm from the runway. NORBO traffic is shared between a left turn departure route and the departure route that offsets right and then turns left at c.7nm with both routes available at the same time. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group Impact 0	Qualitative Assessment
Communitie Noise impact on health and quality of life	Due to wind direction, westerly operations on rurway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.

future would be expected to concentrate traffic, albeit at comparatively low percentages compared to other routes such as NORBO. At higher altitudes the CLYDE/LOMON/FOYLE SIDs overfly areas not currently overflown by westerly departures and this occurs over areas with lower population density.

mainly route over areas already overflown today, however there is currently broad dispersion, whereas PBN routes in

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the Highlands and Islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, it is not expected that the contours would increase in size to overfly any additional dense areas of population with the exception of the CLYDE/LOMON/FOYLE routes, which may overfly Cardross although they are currently positioned over the River Clyde where possible.

The Technical Appendix to this document includes images and data which illustrate the NTK vectoring baseline data, the baseline centreline overflight contour data and the option's centreline overflight contour data. It's important to note that the vectoring baseline data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between the baseline, and the airspace change option.

#### **Overflight data**

Table 16 gives an overview of the Option A overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown

more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is an increase in the area of the overflight contours and the number of population overflown which can be attributed to introducing an additional NORBO SID to split the traffic; the benefits and impacts of this will be quantified at Stage 3 should this option progress.

#### Table 16 Westerly departures option A overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option A	262.55	58671

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number overflown compared to the baseline centreline data. Compared to the vectoring data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

#### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option A against the baseline. 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 17 shows an increase in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour. This is due to the earlier divergence of SIDs compared to the baseline, however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

#### Table 17 60dB and 65dB LAMax Data – Rwy23 Dep Option A

	60dE	3 L <sub>Amax</sub>	65dB L <sub>Amax</sub>			
System	Area (km²)	Population	Area (km²)	Population		
RWY23 Baseline (Centreline – Optioneering tool )	285.37	99120	95.69	53704		
RWY 23 Dep Option A	493.41	143425	178.62	77760		

#### $L_{Aeq}$

The westerly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall shape of the  $L_{Aeq}$  contours. The offset departures deviate from current day, and it is expected that this change will result in the daytime  $L_{Aeq}$  contours shortening compared to current day, however also extending further north-west and south-east to reflect the offset tracks. Review of the population density suggests that this may reduce the shape/size over Howwood, however it may result in population within Linwood and Elderslie being in a higher dB contour than today. Some areas of Linwood, and Foxbar, not currently within the  $L_{Aeq}$  contours may now fall into the lower dB contours.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

#### Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

#### Noise mitigations

The option offers noise relief for those communities currently located under immediate climb out and final approach, as the offset departures route aircraft away from the final approach track. It also aims to share the impacts of noise by splitting the NORBO departures (which make up 58% of Glasgow's overall movements). Unlike other options, it does not offer respite configurations that would be alternated and achieve predictable respite.

Air Quality Air Quality The provide the straight and the straight and departure route (known as 'offset departures') there may be

		slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option A will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider Society	Capacity / resilience	This option sees the SIDs splitting before 5nm, which will improve capacity compared to the baseline as aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. In addition to this, this option splits the NORBO departures across two routes which will enhance operational performance throughout the day and reduce ground delays and CO <sub>2</sub> contributions. In order to gain the full benefits of this, future investment may be required in additional taxiway infrastructure to enable aircraft to be 'lined up' in the correct order before take-off however this is not within scope of an Airspace Change project. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to decommissioned as part of a NERL UK wide programme under
		the Airspace Modernisation programme. There is currently no long term <sup>3</sup> resilience for Glasgow's SIDs when NERL

<sup>&</sup>lt;sup>3</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

Second 1         Table 13 theory data on the overlight of these areas, based on the NIK vectoring baseline and if aircrift violations of the overlight of D2A count         D2A count <thd2a count<="" th=""> <thd2a count<="" th=""> <th< th=""><th></th><th></th><th>decommissions the NERL's VOR withdra</th><th></th><th></th><th>SIDs is at</th><th>osolutely es</th><th>ssential fo</th><th>or the Gla</th><th>asgow op</th><th>eration</th><th>following</th></th<></thd2a></thd2a>			decommissions the NERL's VOR withdra			SIDs is at	osolutely es	ssential fo	or the Gla	asgow op	eration	following
System         NRA real NRA count         Design and count         Desi and count <thdesign and="" count<="" th=""></thdesign>			Table 18 shows data	a on the overflig	ht of these ar	eas, base	ed on the N	ITK vector	ring base	line and i	f aircraft	were to
General Action         Post Build Partice count Partice partice partice Partice partice partice Partice partice partice Partice partice partice Partice partice partice partice Partice partice partice partice Partice partice partice partice partice partice partice partice partice Partice partice partinterpart partice Partice partice partine partice parting partit			Table 18 RWY 23 Westerly Departures Option A – Tranquillity overflown									
Section         Image: Control in the section the section the section in the section the section in the secti			System	NSA are	ea NSA co					count	DQA ar	ea
General Aviation         New Yara Distinct Controlling Option along to controlling to DOA 0         O <td></td> <td>Tranquillity</td> <td></td> <td>0.02</td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>0</td> <td>0</td> <td></td>		Tranquillity		0.02	1					0	0	
Rev 23 Option A         0         0         0         0         0         0           The data shows that there is no change in eventight of DCA's and there is a reduction is an public shows the origination alongade the baseline control, with trancal along and A chances as map-which shows the origination alongade the baseline control and the TR Networks and origination of the option alongade the baseline control and the TR Networks and origination the overflight of DCA's and there is a reduction the NTN hearing and I arter to losine disagow's easing SID certifications. We provide the the NTN hearing and I arter to losine disagow's easing SID certifications.           Table 19 along and the control of the option alongade the baseline control of the NTN hearing and I arter to losine disagow's easing SID certifications.         SSB         SPA         SPA         National Network Control of Networks.           Table 19 along and the control of the option alongade the baseline control of the NTN hearing and I arter.         SSB         SPA         SPA         National Networks.         National Networks.           Table 19 Along and the top the option of theooption optin option of the option of theooptin option of theoopti		Tranquinty	RWY23 Baseline (Centreli	<b>ne –</b> 0	0		0	0		0	0	
Asianal parks compared to the vectoring baseline. Technical appends. A containe and yield we baseline centre contrary of this object anologidal the baseline centre contrary. With tanget and and the table in centre centre contrary of the stand shows. It is a contrary of this object anologidal the baseline centre contrary. With tanget and the table is centre centre contrary of the stand shows. Table 19 Runnay 23 Departure. Option A – Biodiversal/v – areas overflow between 0-7000th table of the VERS and the centre centre intervent in the centre intervent inter					0		0	0		0	0	
Securities       Table 19 Rumary 23 Departure Option A – Biodiversity – areas overflown between 0-7000t         We will be used to be addressed of the second se			National parks comp contour of this option Table 19 shows data	ared to the vector alongside the b on the overflight	oring baseline aseline centre t of biodiverse	. Technica line conto	al appendix our, with tra	A contain inquil sites	is a map v s also sho	which sho wn.	ows the c	overflight
General Aviation         Access         System         SSAC area count         SSAC stage         SSAC area count         Stage         Teal area count         Peak area count         park count			, , , , , , , , , , , , , , , , , , ,	0		ersity – are	eas overflo	wn betwee	ən 0-7000	oft		
General Aviation         Access         Event mark (W 23) (Centreline - votating (N)X 2)         Incl 3 (Centreline - votatin (Centreline - votating (N)X 2)         Incl 3				SAC	1222	1222	SPA	SPA			NSA	NSA
General Access         Access         Economic impact increased option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained existing CAS whiles difficulty of actraft will cliently obtained with the baseline on optimal impacts. We exist the scene to reduct the total volume of CAS.         Is a single volume of CAS.         Is a single volume of CAS.           General Aviation         Access         Economic impact from increased of for the same larger down of the vector motion. All arm with the very minimal.           General Aviation         Access         Economic impact from increased         We evel the increased affective capacity dotalide in the same larger with we baseline do nothing westerly departure box on the same larger down of the vector motion of the vector motion of the same larger down of the vector motion of the vector motion of the same larger down of the same larger down of the vector motion and Larger from increased and "larger down of the same larger down of the same larger down of the vector motion of the vector motion and Larger from increased affective capacity down of the total volume of the VINEPNO.           Fuel burn </td <td></td> <td></td> <td></td> <td>SALA</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td>area</td>				SALA						-		area
Baseline Optioneering to in the Potion A         0         0         3         23.69         1         21.89         0         0         0           Biodiversity         RWY 23 Dep Optioneering to interests         0         0         26         34.66         13         33.33         0         0         0         0           Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the base Caselis Sample and Bart Locking SSB would be avoided.         Nover slower aircraft, dimbing at beliew a 6% dimb gradient and lying the NOBDO SDL moverflight of SDI and the vast majority of aircraft will climb above 2000ft before overflight end worth will be vary overfly White Bareflicto. Dam and Chichodric Store SSIS below 2000ft. Sice NOBDO SDL moverflight of aircraft will climb above 2000ft before overflight and area is to interest.           We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full C Appriate al Stage 3.         Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option cashing CAS whilst offering opportunity to reduce the total volume of CAS.           We existed an "liketry to contribute to a reduction in bottlenecks outside CAS because this option cashing CAS in the same larged area is a colomin smaller. We have also used this volume division and if there is scope to reduce the total volume of CAS.         No existe CAS while the increased effective capacity detailed in the section above will result in a positive area or all a			– Vectoring (NTK data)	3 1.42	32	65.82	12	58.95	1	1.68	1.00	0.02
General Aviation Commercial Arises of Economic Impact Aviation Commercial aritimes       Access       Rev 23 Dep (Dep and Bar Lock SSIS would be avoided.       13       33.33       0       0       0         General Aviation Commercial aritimes       Access       Rever alicraft, climbing at below a 6% climb gradient and flying the SRBBO SID, may overfly Whinn Barmufflock Dam and Chlochodrick Store SSIS below 2000ft. Given the low overfl% of aircraft expected to SID and the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected to a reduction in bottlenecks outside CAS because this option can be contained existing CAS whilst offening opportunity to reduce the total volume of CAS. The total volume of CAS. The total volume of the "alistrative alisting CAS in the same lateral area is c.100m <sup>2</sup> smaller. than currently exists. The Glasgov compared to existing CAS in the same lateral area is c.100m <sup>2</sup> smaller than currently exists. The Glasgov is compared at there is scoped with the baseline do nothing westerly departure baseline.         Ve estimate that Option A. when compared to baseline nominal contralines, will result in a positive economic import commercial air traffic compared with the baseline do nothing westerly departure baseline.         Ve a siturate that Option A. when compared to baseline do nothing vesterly departure baseline.       Seconomic impact the NORBO - LAKEY 134.0       Seconomic impact the NORBO - LAKEY 104.1         DEPS       TLA       54.70       0.41       24.70       91.3       34.4         NoRBO - SUBUK       93.40       0.2       247.71       91.3       24.71       74.7		Biodiversity	Baseline (Centreline – Optioneering	0 0	3	23.69	1	21.89	0	0	0	0
General Aviation       Arcess and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the base Castle Semple and Barn Lochs SSI would be avoided.       Compared to the base and the vast majority of aircraft will be avoid be avoided.         General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained existing CAS whils offering opportunity to reduce the total volume of CAS. The total volume of CAS required to contain ALL arriv departure options combined to help stakeholder engagement on potential impacts. We have also used this volu ourderstand if there is scope to reduce the total volume of CAS. The total volume of CAS. The total volume of CAS. The total volume of the Illustrative arrive and it there is scope to reduce the total volume of CAS. The total volume of the Illustrative compared to avisting CAS whiles offering opportunity to reduce the total volume of the Illustrative arrive and it there is scope to reduce the total volume of CAS. The total volume of the Illustrative compared to avisting CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow commercial at reflect compared with the baseline do nothing westerly departure baseline.         General Aviation arritimes       Ke expect the increased effective capacity detailed in the section above will result in a overall improve commercial at reflect compared with the baseline do nothing westerly departure baseline.       Memoresite the commercial in the IUSIV. TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operate reductions in the LUSIV. TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operate reductions in the USIV. TALLA, PERTH, Edges 123 & 55.854 & 60.2 & 74 FOVLE 33.00 & 0.82 & 27.06 & 26.3 & 27.4 FOVLE 33.00 & 0.82 & 27.06 &			RWY 23 Dep	0 0	26	34.66	13	33.33	0	0	0	0
General Aviation       Recess       Barmuttlock Dam and Chlochdarick Stone SSIs below 2000th. Given the low overall % of aircraft expected that any in will be very minimal.         General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained existing CAS whilst offering opportunity to reduce the total volume of CAS.         General Aviation       Access       We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arriv devisiting CAS whilst offering opportunity to reduce the total volume of CAS. The total volume of the "illustrative" airspace to compared to existing CAS in the same lateral area is c.100m <sup>3</sup> smaller than currently exists. The Glasgow for c.47m <sup>4</sup> smaller.         Keneral Aviation       Economic impact from increased effective capacity       We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improver track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There a track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are populations in the LUSIV. TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operated frequently than the NORBO.         Epsel       TRN       98.60       0.86       0.83.60       0.82.60       0.94.44         DEPS       TLA       54.70       0.41       22.427       47.9       94.3       24         DEPS       TLA       54.70       0.41       22.427       47.9       94.3 <th< td=""><td></td><td colspan="8">Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the baseline,</td></th<>			Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the baseline,									
General Aviation       Access       We created an "illustrative CAS volume" which was a single volume of CAS. The total volume of the ave also used this vol departure options combined to help stakeholder engagement on potential impacts. We have also used this vol understand if there is scope to reduce the total volume of the CAS. The total volume of the "illustrative" airspace v compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow i c.47nm <sup>4</sup> smaller.         Economic impact from increased effective capacity       We expect the increased effective capacity detailed in the section above will result in a positive economic impri- commercial air traffic compared with the baseline do nothing westerly departure baseline.       Me expect the increased effective capacity detailed in the section above will result in an overall improver track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There at reductions in the LUSIV, TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operate frequently than the NORBO.         Fuel burn       RWY 23       Imm       % Weighting       Score 100, 120, 120, 120, 120, 120, 120, 120,			Barmufflock Dam and Chlochodrick Stone SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SID and the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected that any impacts will be very minimal. We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full Options									
Aviation       PLOBES       departure options combined to help stakeholder engagement on potential impacts. We have also used this volu understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume call at traffic compared to the total volume of the "illustrative" airspace volume called at traffic compared with the baseline do nothing westeriy departure baseline.         General Aviation / Commercial is       We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improver track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There a reductions in the LUSIV, TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operate frequently than the NORBO.         General airlines       Fuel burn       RWY 23       TRN       38.50       3.69       142.065       39.4       14         DEPS       TRN       38.50       3.69       142.065       39.4       14         ORBO - LAKEY       39.4       14       NORBO - LAKEY       39.4       14									this optic	on can be	containe	ed within
General Aviation / Commercial air traffic compared with the baseline do nothing westerly departure baseline.         Me estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improvem track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are reductions in the LUSIV, TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operated frequently than the NORBO.           Fuel burn         RWY 23         Baseline (Centreline)         Amm           NORBO - SUBUK         93.40         26.2         2447.08         94.3         24           NORBO - SUBUK         93.40         26.2         2447.08         94.3         24           NORBO - LAKEY         93.40         26.2         2447.08         94.3         24           NORBO - LAKEY         93.40         32         2988.8         84.4         27           LUSIV-DCS         84.80         10.66         903.968         81.3         866           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           FoyLe         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37 <td></td> <td>Access</td> <td colspan="5">We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival departure options combined to help stakeholder engagement on potential impacts. We have also used this volun understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace vol compared to existing CAS in the same lateral area is c.100nm<sup>3</sup> smaller than currently exists. The Glasgow CT</td> <td>olume to e volume</td>		Access	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival departure options combined to help stakeholder engagement on potential impacts. We have also used this volun understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace vol compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CT					olume to e volume				
General Aviation / Commercial airlines       Fuel burn       Image: This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are operated frequently than the NORBO.       Image: This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are operated frequently than the NORBO.         Fuel burn       Image: This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are operated frequently than the NORBO.       Image: This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are reductions in the LUSIV, TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operated frequently than the NORBO.         Fuel burn       Image: This is mainly driven by the reduction in track mileage of the NORBO LAKEY route. There are reductions in the LUSIV, TALLA, PERTH, LOMON, CLYDE and ROBBO routes although these are operated frequently than the NORBO.         Fuel burn       Image: This is mainly driven by the reduction in track mileage and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would a improvement in fuel burn.		from increased								sitive eco	nomic im	pact on
General Aviation / Commercial airlines         Fuel burn         RWY 23         TRN         38.50         3.69         142.065         39.4         144           NORBO - SUBUK         93.40         26.2         2447.08         94.3         244           NORBO - LAKEY         93.40         32         2988.8         84.4         27           LUSIV-DCS         84.80         10.66         903.968         81.3         86           DEPS         TLA         54.70         0.41         22.427         47.9         19           PERTH         69.80         1.23         85.854         60.2         74           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           CLYDE         19.50         2.87         55.965         16.7         47           ROBBO         19.60         2.05         40.18         17.1         35           Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anti-ipated that this option would stimprovement in fuel burn.			track mileage. This is reductions in the LU	s mainly driven SIV, TALLA, PE	by the reducti	on in trac	k mileage	of the NO	RBO LAK	KEY route	e. There	are also
General Aviation / Commercial airlines         Fuel burn         Fuel burn         TRN         38.50         3.69         142.065         39.4         144           NORBO - SUBUK         93.40         26.2         2447.08         94.3         24           NORBO - LAKEY         93.40         32         2988.8         84.4         27           LUSIV-DCS         84.80         10.66         903.968         81.3         86           PERS         TLA         54.70         0.41         22.427         47.9         19           PERTH         69.80         1.23         85.854         60.2         74           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           CLYDE         19.50         2.87         55.965         16.7         47           ROBBO         19.60         2.05         40.18         17.1         35           Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would simprovement in fuel burn.			RWY 23			Baseline				Α		
General Aviation / Commercial airlines         NORBO - SUBUK         93.40         26.2         2447.08         94.3         24           NORBO - LAKEY         93.40         32         2988.8         84.4         27           LUSIV-DCS         84.80         10.66         903.968         81.3         86           PERTH         54.70         0.41         22.427         47.9         19           PERTH         69.80         1.23         85.854         60.2         74           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           CLYDE         19.50         2.87         55.965         16.7         47           Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would air improvement in fuel burn.         10.4         10.4         10.4			KWT 25	TDN								Score
Commercial airlines         Fuel burn         Fuel burn         NORBO - LAREY         93.40         32         2988.8         84.4         27           DEPS         LUSIV-DCS         84.80         10.66         903.968         81.3         86           PERTH         69.80         1.23         85.854         60.2         74           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           CLYDE         19.60         2.05         40.18         17.1         35           Order         Total         Total         6768.134         64           Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 700°th), it is anticpated that this option would st improvement in fuel burn.         6768.134         64												145.386 2470.66
Fuel burn         DEPS         TLA         54.70         0.41         22.427         47.9         19           PERTH         69.80         1.23         85.854         60.2         74           FOYLE         33.00         0.82         27.06         26.3         21           LOMON         26.70         2.05         54.735         18.1         37           CLYDE         19.50         2.87         55.965         16.7         47           ROBBO         19.60         2.05         40.18         17.1         35           Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would simprovement in fuel burn.         47.4	Commercial											2700.8
DEPS       PERTH       69.80       1.23       85.854       60.2       74         FOYLE       33.00       0.82       27.06       26.3       21         LOMON       26.70       2.05       54.735       18.1       37         CLYDE       19.50       2.87       55.965       16.7       47         ROBBO       19.60       2.05       40.18       17.1       35         Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 700ft), it is anticipated that this option would as improvement in fuel burn.		Fuel burn										866.658 19.639
LOMON       26.70       2.05       54.735       18.1       37         CLYDE       19.50       2.87       55.965       16.7       47         ROBBO       19.60       2.05       40.18       17.1       35         Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would simprovement in fuel burn.			DEPS									74.046
CLYDE       19.50       2.87       55.965       16.7       47         ROBBO       19.60       2.05       40.18       17.1       35         Total       6768.134       64         Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would simprovement in fuel burn.												21.566
ROBBO       19.60       2.05       40.18       17.1       35         Total       6768.134       64         Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would simprovement in fuel burn.												37.105 47.929
Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would s improvement in fuel burn.												35.055
(subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would s improvement in fuel burn.			Total					67	68.134		e	6418.844
			(subject to the NAT	S NERL ACP for								
<b>Commercial</b> <b>airlines</b> Training costs Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to ran additional training costs for airlines.		Training costs	their procedures acc	ordingly and unc	lertake trainin							

	Other costs	No other airline costs are foreseen.
Airport / Air navigation service	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L <sub>Aeq,16h</sub> contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L <sub>Aeq,16h</sub> contour area and residential properties within the 66dB L <sub>Aeq,16h</sub> contour area. The UK Government's current aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L <sub>Aeq,16h</sub> noise contour or above. Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will cover the varied property types situated within the 63dB contour area. The L <sub>Aeq</sub> modelling in Stage 3 will determine if there are any increases in households within the 63dB L <sub>Aeq,16h</sub> area as a result of this options as a result of the track adjustments on departure. If it does and track adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow, with regards funding their Noise Insultation Scheme.
provider	Operational costs	This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>4</sup> ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick Centre and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal, when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER.
		Other than the use of track adjustments on departure no safety issues are expected. The early right turn on ROBBO/FOYLE/LOMON/CLYDE/PERTH departures replicated what is tactically achieved today for most of those departures (excluding PERTH).
All	Interdependencies, conflicts, and trade- offs	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options on their proposed shortlist which would cater for a duel NORBO southbound track structure. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace.
		In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.
		CAP1711 describes the objective as:
AII	AMS	Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO2 reductions, provide relief from noise to those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure would mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a single NORBO SID structure). However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>4</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

## 4.3. Runway 23 Westerly Departure Option B

Runway 23 Westerly Departures – Option	on B
	Offset right departures with turns at c.2nm from the runway. Offset left departures with turns at c.1nm and c.5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until c.5nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group Impact	Qualitative Assessment
Communities Noise impact on health and quality of life	Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.

do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic, albeit at comparatively low percentages compared to other routes such as NORBO.

#### **Overflight data**

The Technical Appendix to this document includes images and data which illustrate the NTK vectoring baseline data, the baseline centreline overflight contour data and the option's centreline overflight contour data. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 20 gives an overview of the Option B overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is an increase in the area of the overflight contours and the number of population overflown.

#### Table 20 Westerly departures option B overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option B	225.76	37664
-		

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of care homes and places of worship overflown compared to the centreline baseline and an increase in the number of schools overflown. Number of hospitals remains the same. Compared to the vectoring data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis, should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

#### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB  $L_{Amax}$  contours which compare Option B against the baseline. 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 21 shows an increase in the population within the 60dB  $L_{Amax}$ contour and an increase in population within the 65dB  $L_{Amax}$  contour. This is due to the earlier divergence of SIDs compared to the baseline however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today. We'd expect to see a decrease in population compared to the 2019 vectored  $L_{Amax}$ contours.

#### Table 21 60dB and 65dB LAMax Data - Rwy23 Dep Option A

	60dE	3 L <sub>Amax</sub>	65dB L <sub>Amax</sub>		
System	Area (km²)	Population	Area (km²)	Population	
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704	
RWY 23 Dep Option B	433.35	121890	160.28	70853	

#### $L_{Aeq}$

The westerly departures make up a component of the overall L<sub>Aeq</sub> daytime and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall L<sub>Aeq</sub> contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. It is expected that this change will result in the L<sub>Aeq</sub> contours shortening compared to current day. The offset departure to the left, which would operate around 68% of departure movements, is expected to result in the L<sub>aeq</sub> contour extending further to the south-west to reflect the offset track. When reviewing population density, this suggests there may be some benefit to Howwood and Johnstone, however the lobe would now potentially extend over Foxbar and parts of Ferguslie. The equivalent ROBBO/CLYDE/LOMON/FOYLE/ PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L<sub>Aeq</sub> contours however the offset route may result in some areas of Linwood, which currently sit in the lower dB L<sub>Aeq</sub> contours, to move into a higher dB contour.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

#### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

#### **Noise Mitigation**

Air Quality

The option offers relief for those communities currently located under immediate climb out and final approach as the offset departures route aircraft away from the final approach track. Unlike other options, it does not offer respite configurations that would be alternated and achieve predictable respite. This option would not mitigate the effects for those newly overflown by a NORBO departure by splitting the NORBO departures across 2 tracks.

This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral

		tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option B will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider Society		This option sees the SIDs splitting before 5nm which will improve capacity compared to the baseline as aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.
	Capacity / resilience	This option does not split the NORBO departures across two routes, which would otherwise enhance operational performance and reduce ground delays and CO <sub>2</sub> contributions, particularly at peak periods.
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>5</sup> resilience for

<sup>&</sup>lt;sup>5</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

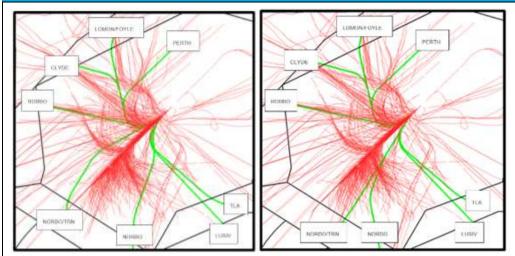
		Glasgow's SIDs when N Glasgow operation follow					PBN SIDS IS	s absolutely es	sential for the
		Table 22 shows data on the overflight of these areas, based on the NTK vectoring baseline and if aircraft were to follow Glasgow's existing SID centrelines.							
	Tranquillity	Table 22 RWY 23 Westerly Departures Option B – Tranquillity overflown							
		System	NSA a	rea NS	SA count	National Parks area Pa	National arks count	DQA area	DQA count
		RWY 23 Baseline – Vectoring (NTK data)	0.02	2	1	1.68	1	0	0
		RWY23 Baseline (Centreline - Optioneering tool)	- 0		0	0	0	0	0
		RWY 23 Option B	0		0	0	0	0	0
		The data shows that there is no change in overflight of DQA's and there is a reduction in overflight of NSAs and National parks compared to the vectoring baseline. Technical Appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.							
	Below 2000ft no overflight of Special Protection Areas, Special Areas of Cons           Scenic Areas, and Sites of Special Scientific Interests is expected for the vas           the baseline Castle Semple and Barr Lochs SSSI would be avoided.								
	Biodiversity	Lower slower aircraft, climbing at below a 6% climb gradient and flying the ROBBO SID, may overful and Barmufflock Dam SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected that any is very minimal.							SID, and the
		We will fully quantify the Appraisal at Stage 3.	overflight c	of biodiver	rse sites usin	g the full Glasg	jow fleet miz	x, as part of ou	r Full Options
		Option B is likely to cont within existing CAS while						his option can	be contained
General Aviation	Access	within existing CAS whilst offering opportunity to reduce the total volume of CAS. We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.							
	Economic impact from increased effective capacity	We expect the small in economic impact on cor however the continuatior	nmercial ai	r traffic co	ompared with	n the baseline	do nothing	westerly depai	rture baseline
		in track mileage. This is also small reductions in	mainly driv	en by the	reduction in	track mileage	of the NOR		ite. There are
		in track mileage. This is	mainly driv the TRN,	en by the NORBO	e reduction in SUBUK, LU Burn Option B	track mileage SIV, TALLA, F	of the NOR PERTH, LO	BO LAKEY rou	ite. There are
		in track mileage. This is also small reductions in routes.	mainly driv the TRN,	en by the NORBO	e reduction in SUBUK, LU Burn Option B ne (Centrelin	track mileage SIV, TALLA, F	of the NOR	BO LAKEY rou	ite. There are
		in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i>	mainly driv the TRN, <i>Calculations</i>	en by the NORBO s – <i>Fuel B</i> Baselin	e reduction in SUBUK, LU Burn Option B ne (Centrelin	track mileage SIV, TALLA, F e)	of the NOR PERTH, LO	BO LAKEY rou MON, CLYDE	ite. There are
		in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i>	mainly driv the TRN, Calculations TRN NORBO SUBUK	en by the NORBO <i>– Fuel B</i> Baselin nm	e reduction in SUBUK, LU <i>curn Option B</i> ne (Centrelin % Weight	track mileage SIV, TALLA, F e) ing <mark>Score</mark>	of the NOR PERTH, LO B nm	BO LAKEY rou MON, CLYDE Score	ite. There are
Aviation / Commercial		in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i>	mainly driv the TRN, Calculations TRN NORBO	en by the NORBO <i>E – Fuel B</i> Baselin nm 38.50	e reduction in SUBUK, LU Burn Option B ne (Centrelin % Weight 3.69	e) ing Score 142.065	of the NOR PERTH, LO B nm 37.5	BO LAKEY rou MON, CLYDE Score 138.375	ite. There are
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN NORBO SUBUK NORBO	en by the NORBO Baselin nm 38.50 - 93.40	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2	track mileage SIV, TALLA, F ing Score 142.065 2447.08	of the NOR PERTH, LO B nm 37.5 91.6	BO LAKEY rou MON, CLYDE 138.375 2399.92	ite. There are
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i>	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA	en by the NORBO <b>Baselin</b> nm 38.50 93.40 93.40 84.80 54.70	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427	of the NOR PERTH, LO 37.5 91.6 85.1 81.3 47.9	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH	en by the NORBO 5 - Fuel B Baselin nm 38.50 - 93.40 - 93.40 - 93.40 84.80 54.70 69.80	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854	of the NOR PERTH, LO 2011 2011 2011 2011 2011 2011 2011 201	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN Calculations TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE	en by the NORBO <b>Baselin</b> nm 38.50 93.40 93.40 84.80 54.70 69.80 33.00	e reduction in SUBUK, LU eurn Option B (Centrelin 3.69 26.2 32 10.66 0.41 1.23 0.82	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06	of the NOR PERTH, LO 37.5 91.6 85.1 81.3 47.9 60.2 26.3	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH	en by the NORBO 5 - Fuel B Baselin nm 38.50 - 93.40 - 93.40 - 93.40 84.80 54.70 69.80	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854	of the NOR PERTH, LO 2011 2011 2011 2011 2011 2011 2011 201	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON	en by the NORBO <b>Baselin</b> nm 38.50 93.40 93.40 44.80 54.70 69.80 33.00 26.70	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735	of the NOR PERTH, LO B 10 37.5 91.6 85.1 81.3 47.9 60.2 26.3 18.1	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b>	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE	en by the NORBO <b>Baselin</b> <b>nm</b> 38.50 93.40 93.40 93.40 69.80 33.00 26.70 19.50	e reduction in SUBUK, LU eurn Option B (Centrelin 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965	of the NOR PERTH, LO 2011 2011 2011 2011 2011 2011 2012 2013 18.1 10.7	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929	ite. There ar
Aviation / Commercial	Fuel burn	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b> DEPS	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE ROBBO	en by the NORBO 5 - Fuel B Baselin nm 38.50 - 93.40 - 93.40	e reduction in SUBUK, LU eurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965 40.18 6768.134	of the NOR PERTH, LO 261 37.5 91.6 85.1 81.3 47.9 60.2 26.3 18.1 16.7 17.1 t to climb co	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929 35.055 6363.493	and ROBBC
Aviation / Commercial airlines Commercial	Fuel burn Training costs	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b> DEPS Total Given the improvement is (subject to the NATS NE	TRN NORBO SUBUK NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE ROBBO	en by the NORBO 5 - Fuel B Baselin nm 38.50 93.40 93.40 93.40 44.80 54.70 69.80 33.00 26.70 19.50 19.50 19.60 26.70 19.50 troduced and under troduced and under	e reduction in SUBUK, LU eurn Option B e (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05 2.87 2.05 2.87 2.05	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965 40.18 6768.134 on for all aircraf 7000ft), it is an	of the NOR PERTH, LO 2011 2011 2011 2011 2012 2013 101 2013 2013	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929 35.055 6363.493 ontinuously to a nat this option of As part of this of	and ROBBC
Aviation / Commercial airlines Commercial		in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b> DEPS Total Given the improvement i (subject to the NATS NE improvement in fuel burr Flight procedures are up update their procedures	TRN NORBO SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE ROBBO	en by the NORBO 5 - Fuel B Baselin nm 38.50 93.40 93.40 93.40 44.80 54.70 69.80 33.00 26.70 19.50 19.50 19.60 26.70 19.50 troduced and under troduced and under	e reduction in SUBUK, LU eurn Option B e (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05 2.87 2.05 2.87 2.05	track mileage SIV, TALLA, F ing Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965 40.18 6768.134 on for all aircraf 7000ft), it is an	of the NOR PERTH, LO 2011 2011 2011 2011 2012 2013 101 2013 2013	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929 35.055 6363.493 ontinuously to a nat this option of As part of this of	and ROBBC
General Aviation / Commercial airlines Commercial airlines Airport / Air navigation service provider	Training costs	in track mileage. This is also small reductions in routes. <i>Table 23 Track Length C</i> <b>RWY 23</b> DEPS Total Given the improvement i (subject to the NATS NE improvement in fuel burn Flight procedures are up update their procedures to require any additional	mainly driv the TRN, Calculations Calculations Calculations Calculations Calculations SUBUK NORBO LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE ROBBO In track mile ROBBO In track mile RCBBO CLYDE ROBBO	en by the NORBO <i>Fuel B</i> <b>Baselin</b> nm 38.50 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50 19.60 26.70 19.60 eage, and or the airs troduced or the airs troduced or the airs financial contour co al propert financial contour co at financial contour co	e reduction in SUBUK, LU aurn Option B (Centrelin % Weight 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05 2.87 2.05 4 the aspiration space above worldwide as ertake trainin lines. elocation sch or sensitive but assistance to pover the varie f there are ar rack adjustmo	track mileage         SIV, TALLA, F         SIV, TALLA, F         ing       Score         142.065         2447.08         2988.8         903.968         22.427         85.854         27.06         54.735         55.965         40.18         6768.134         on for all aircraf         7000ft), it is and         s part of an AIF         g if required. The         terme for reside         aildings, such a         be offered to         or be offered to         or poperty type         by increases in least on departure	ential proper AC cycle. Anis westerly ential proper s schools an h contour a wards the n w Airport are s situated w households ure. If it doe	BO LAKEY rou MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929 35.055 6363.493 Ontinuously to a hat this option is n As part of this SID option is n rties within the nd hospitals, w rea. The UK ( oise insulation e currently deve within the 63dB within the 63dB s and track ad	and ROBBC and ROBBC and ROBBC at least 6000 would see at cycle, airline tot anticipate 69dB LAeq.16 ithin the 63dl Government of residentia eloping a new contour area B LAeq.16h area justments area

	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>6</sup> ;	
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick Centre and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.	
All	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER.	
		Other than the use of track adjustments on departure no safety issues are expected. The early right turn on ROBBO/FOYLE/LOMON/CLYDE/PERTH departures replicated what is tactically achieved today for most of those departures (excluding PERTH)	
		There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options ion their proposed shortlist which would cater for a duel NORBO southbound track structure, noting that the split of NORBO traffic takes place above 7000ft in this option.	
All	Interdependencies, conflicts, and trade- offs	As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace.	
		In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.	
		This option is dependent on changes to the network.	
		CAP1711 describes the objective as:	
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.	
All	AMS	This option would be expected to generate significant CO <sub>2</sub> reductions, provide relief from noise to those most frequently overflown by Glasgow arrivals and departures.	
		However, this option would not accommodate future demand in the most effective manner as a single initial NORBO departure would likely generate future ground delay. In addition, positioning all NORBO departures over the same newly overflown communities would not mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to sharing across a dual NORBO SID structure).	
		However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.	
		This option could be expected to result in reductions in the volume of Glasgow's CAS	

<sup>&</sup>lt;sup>6</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

### 4.4. Runway 23 Westerly Departure Option C

#### Runway 23 Westerly Departures – Option C

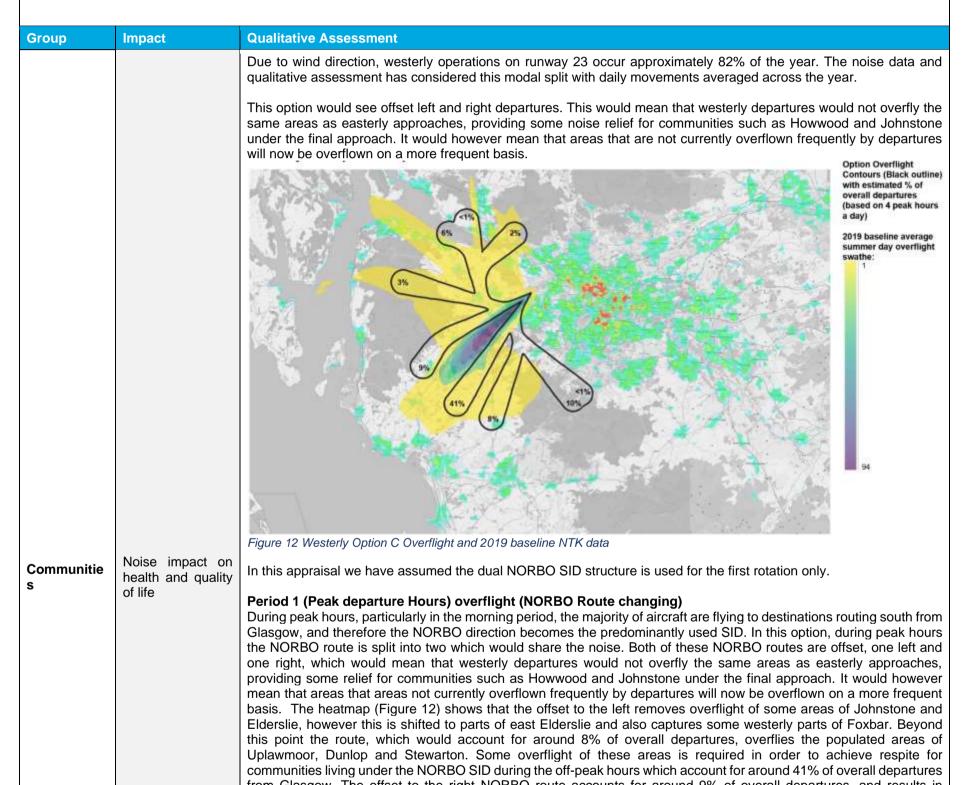


This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure periods. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different NORBO flight path which offsets to the left, with the rest of the routes remaining the same. The reason for this would be to mitigate the small increase in mileage of a NORBO route which offsets to the right, compared to the baseline SID.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Figure 11 Option C Peak Hours

Figure 10 Option C Rest of the day



overflight of Linwood and Kilbarchan at lower levels, and overflight of parts of Lochwinnoch and Kilbarchan at lower levels.

#### **Period 2 overflight**

During the off-peak periods the NORBO departure, which accounts for approximately 41% of overall traffic (assuming this route is used all day after the first rotation), offsets to the left but follows a different path than the peak hours offset-left SID. The initial section of the NORBO route follows the same path as the peak period configuration, and therefore there is very limited respite for communities living under the early parts of these routes who will experience around 49% of departures overall. From the heatmap, this level of overflight would be a significant change from current day, where those areas are typically experiencing somewhere between 1 - 10 flights per day on average. The route initially flies over Elderslie however then endeavours to avoid areas of dense population with the exception of Barrmill which is overflown at higher altitudes. The LUSIV and TALLA SIDs also offset left and route over Neilston; beyond this they largely avoid dense areas of population.

The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, it is not expected that the contours would increase in size to overfly any additional dense areas of population.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option C. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

#### **Overflight data**

Table 24 gives an overview of the Option C overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population and noise sensitive sites overflown; this is due to the nature of having multiple NORBO routes, an additional NORBO respite route and also avoiding the easterly final approach track whereby more people are overflown. However, the noise is shared and therefore it is overflight on a less frequent basis than for those who live under easterly final approach currently experience.

Table 24 Westerly departures option C overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option C	305.53	60931

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

#### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option C against the centreline baseline. These 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 25 shows an increase in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 25 60dB and 65dB LAMax Data – Rwy23 Dep Option C

	60dB L <sub>Amax</sub>		65dB	LAmax
System	Area (km²)	Population	Area (km²)	Population
RWY23 Baseline (Centreline - Optioneering tool)	285.37	99120	95.69	53704
RWY 23 Dep Option C	563.66	146232	206.59	80377

#### LAeq

The westerly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall  $L_{Aeq}$  contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. It is expected that this change will result in the L<sub>Aeq</sub> contours shortening compared to current day. The offset departure to the left, which would operate around 60% of departure movements, is expected to result in the L<sub>Aeq</sub> contour extending further to the south-west to reflect the offset track. When reviewing population density, this suggests there may be some benefit to Howwood and Johnstone, however the lobe would now potentially extend over Foxbar and parts of Ferguslie. The equivalent ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L<sub>Aeq</sub> contours however the offset route may result in some areas of Linwood, which currently sit in the lower dB L<sub>Aeq</sub> bands, to move into a higher dB contour.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

#### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

#### Noise Mitigation

The option offers relief for those communities currently located under immediate climb out and final approach as the offset departures route aircraft away from the final approach track. Having 2 NORBO SIDs also reduces the frequency of overflight for communities situated under just one NORBO SID, but only for the first rotation. It also offers an alternative respite configuration during peak departure periods for communities who live under the NORBO departure which accounts for the majority of departures from Glasgow airport however the benefits of this are minor as the respite configuration mainly benefits communities to the north-west (See overflight section above).

The introduction of alternative predictable respite arrangements also increases population overflown and the 60dB and 65dB L<sub>Amax</sub> outcomes compared to other options; the benefits and impacts of this will be further analysed as part of the Full Options Appraisal at Stage 3 when we have quantitative information about the frequency of overflight should this option progress.

	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be not emissions in their totality, there will be a change in the location of emissions below 1000ft which could a quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral track overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there r increases in the concentrations below these flightpaths. However, it should be noted that these changes be small compared to the contribution of road traffic (M8/A737) to local air quality.									
	Greenhouse gas impact	compared to the baseline	Our fuel burn assessment (see below) has anticipated that Option C will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity / resilience	This option sees the SIDs able to depart in intervals This is expected to reduce of this will be seen particul However, this option only gain the full benefits of this be 'lined up' in the correct availability of the dual NOI daily peaks in demand out The introduction of PBN S which provides resilience. the Airspace Modernisation decommissions the VORs. VOR withdrawal programm	1 minutes ap ground holdin larly in future s splits the NOF s, future inves corder before RBO structure side of these p SIDs also rem This equipme on programme Introduction c	art (subject to ng which in tur scenarios with RBO departure tment may be take-off howev during the exi peak times. oves Glasgow nt is due to be . There is cur	safety case ai n will reduce g increased traff es across two r required in ad- ver this is not sting peak dep r's dependency decommission rently no long	nd NERL abilit pround-based e ic levels. routes during p ditional taxiway within scope of parture hours o y on convention ned as part of a term <sup>7</sup> resilience	y to accept 1-r emissions and beak departure / infrastructure f an Airspace ( nly would not a nal ground-ba NERL UK wic e for Glasgow	minute separations delays. The benefit periods. In order t to enable aircraft t Change project. Th accommodate futur sed navigation aids de programme unde 's SIDs when NER			
Wider Society		Glasgow's existing SID ce	Table 26 shows data on the overflight of these areas, based on the NTK vectoring baseline and if aircraft were to follow         Glasgow's existing SID centrelines.         Table 26 RWY 23 Westerly Departures Option C – Tranquillity overflown								
·····,	Tranquillity	System	NSA area	NSA count	National Parks area	National Parks count	DQA area	DQA count			
		RWY 23 Baseline – Vectoring (NTK data)	0.02	1	1.68	1	0	0			
		RWY23 Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0			
		RWY 23 Option C	0	0	0	0	0	0			
		The data shows that there is no change in overflight of DQA's and there is a reduction in overflight of NSAs and National parks compared to the vectoring baseline. Technical Appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.									
	Biodiversity	Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the baseline Castle Semple and Barr Lochs SSSI would be avoided. Lower slower aircraft, climbing at below a 6% climb gradient and flying the ROBBO SID, may overfly Whinnerston and Barmufflock Dam SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SID, and the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected that any impacts will be very minimal. We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full Options									
		Appraisal at Stage 3. Option C is likely to contri existing CAS whilst offerin					this option can	be contained withi			
General Aviation	Access	We created an "illustrative options combined to help s if there is scope to reduce existing CAS in the same la	CAS volume" stakeholder en the total volu	which was a sir ngagement on me of CAS. Th	ngle volume of potential impac le total volume	CAS required t cts. We have a of the "illustra	lso used this ve tive" airspace v	olume to understan volume compared t			
	Economic impact from increased effective capacity	We expect the increased e commercial air traffic com NORBO departures in a si	pared with the	e baseline do	nothing weste	rly departure t	baseline. Howe	ever, the merging o			
		We estimate that Option ( track mileage. This is main overall reductions in all roo	nly driven by t								
		Table 27 Track Length Calcu	lations – Fuel B	Burn Option C							
			Baseline	(Centreline)			С				

				Baselir	ne (Centrelin	e)		C			
General		RWY 23	RWY 23		% Weighting	Score	nm P1	nm P2	Average	Score	
Aviation	./		TRN	38.50	3.69	142.065	39.4	37.5	38.45	141.8805	
Commercia airlines	Fuel burn		NORBO - SUBUK			2447.08	94.3	91.6	92.95	2435.29	
		DEPS	NORBO - LAKEY	93.40	32	2988.8	84.4	85.1	84.75	2712	
			LUSIV- DCS	84.80	10.66	903.968	81.3	81.3	81.3	866.658	
			TLA	54.70	0.41	22.427	47.9	47.9	47.9	19.639	
			PERTH	69.80	1.23	85.854	60.2	60.2	60.2	74.046	
			FOYLE	33.00	0.82	27.06	26.3	26.3	26.3	21.566	
			LOMON	26.70	2.05	54.735	18.1	18.1	18.1	37.105	
			CLYDE	19.50	2.87	55.965	16.7	16.7	16.7	47.929	

<sup>7</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		ROBBC	19.60	2.05	40.18	17.1	17.1	17.1	35.055			
		Total	_	_	6768.134				6391.169			
		Given the improvement in tra to the NATS NERL ACP for fuel burn. In the Full Options	the airsp	ace above	7000ft), it is ant	icipated	that this c	ption would	d see an improvement			
Commercial airlines	Training costs	Flight procedures are updat their procedures accordingl any additional training costs	ed or intro y and unc	oduced wor lertake trair	dwide as part o	f an AIR	AC cycle.	As part of	this cycle, airlines upda			
	Other costs	No other airline costs are fo	reseen.									
Airport / Air navigation service	Infrastructure costs	Glasgow currently operates area and noise insulation s contour area and residentia policy now requires financia L <sub>Aeq,16h</sub> noise contour or abo 2022, which will cover the v will determine if there are ar of the track adjustments on there will be an increased co	schemes f I propertion I assistant ove. There aried prop y increase departure ost for Gla	for sensitive es within th ce to be off efore, Glasg berty types es in house e. If it does asgow with	e buildings, suc e 66dB L <sub>Aeq,16h</sub> ered towards th ow Airport are situated within holds within the and track adjust regards funding	ch as so contour e noise currently the 63dl 63dB L stments their No	chools and area. The insulation / developin 3 contour acontour are propo bise Insulta	I hospitals O UK Gove of resident ng a new N area. The as a result sed in Gla ation Scher	, within the 63dB $L_{Aeq.}$ rnment's current aviation ial properties in the 63d loise Insulation Policy f $L_{Aeq}$ modelling in Stage of this options as a resised sgow's ACP submission me.			
provider	Operational costs	This airspace change propo PBN SIDs removes Glasg	The initial deployment phase of the ACP may require some ATC system engineering amendments. This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>8</sup> ;									
Deployment costs This option is expected to require air traffic controller training for the controllers Prestwick and Glasgow Airport. The scale and nature of this training requires further Full Options Appraisal when we are appraising our shortlist of options and once furth network above 7000ft and interdependencies with Edinburgh. Owing to the respite training required for this option, compared to other options that form part of this IOA.						er explorat rther inforn e configura	and assistants located at NATS r exploration as part of the Stage 3 ther information is known about the configuration, there may be more					
AII	Safety	This option requires a Track CAA IFP department wanted the aircraft doesn't turn before required during IFP ground DER. A SID structure from the sate expected that perhaps a mutual an option where a SID utilist after departure introduces introducing other issues*. So wrong SIDs and the wrong to *As an example, mitigations with completely different nations going to the same places in SID names to match the SID	d a 'not be ore the er validation ume runwa ich more s ation wou hazards to uch haza ime of da identified mes. How the netwo	elow 500ft <sup>2</sup> f ad of the ru to ensure th subtle chan ild change s o the opera rds are not y but also H l for SIDs s ever, flight ork are req	yover WP posit hway. PANS Of he WP is accept anges during the ge to a SID stru- significantly fror ation which at t just associated luman Factor (H witching to fund planning and AT	ioned at PS does able, es he day i cture ca n a left his stag with air IF) issue amental M issue	the Decla sn't require pecially fo s uncharte n be safel curn to a ri e cannot craft inadv es associa different c es previous	red End of e this. Add llowing and ered territo y accommon ght turn (o considered vertently fly ted with A directions a sly identifie	Runway (DER) to ensu- itional assurances will I other turn shortly after the odated, ATC advised the r vice-versa) immediated to be mitigated without ring (or being issued) the rC confusion.			
AII	Interdependencies , conflicts, and trade-offs	There are few interdepende NORBO departures are sep In NERL's ScTMA ACP, the track structure, noting these As highlighted in Glasgow F cognisant of their airspace. In addition, the cumulative the ScTMA need to be co-o This option is dependent on	arated from y have opt SIDs work Prestwick / effect on of rdinated a	m Prestwich tions ion the uld then me Airport's fee other airspa and conside	r's airspace and ir proposed sho rge into one init odback in Stage nce users as a r red.	does no ortlist wh ial track 2A, the	ot conflict v ich would for the res final prope	vith Edinbu cater for a st of the da osed CAS	irgh's traffic below 7000 dual NORBO southbour y arrangements need to l			
		CAP1711 describes the obj Deliver quicker, quieter, and UK airspace. This option would be expect most frequently overflown b	t cleaner j	nerate sign	ficant CO <sub>2</sub> redu	uctions,	provide re	lief and re				
All	AMS	However, this option would departure track for the majo NORBO departure over the	not accor rity of the	nmodate fu day would	ture demand in ikely generate f	the mo uture gr	st effective ound dela	e manner a y. In additi	on, positioning that sing			

	NORBO departure over the same newly overflown communities for the rest of the day would not mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a dual NORBO SID structure).
	However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise. This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>8</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.5. Runway 23 Westerly Departure Option D

Runway 23 Wes	sterly Departures – Opt	ion D	
		This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different NORBO flight path which follows a straight line from the runway until splitting at 5nm, with the rest of the routes remaining the same. The reason for this would be to mitigate the small increase in mileage of a NORBO route which offsets to the right, compared to the baseline SID as well as mitigating the effects for those newly overflown by the peak NORBO SIDs. This option is similar to Option C except that the daytime (non-peak)	HISTH I
$\langle \ \rangle$	WORKS LURIV	NORBO route is different.	
<b>O</b> 1000	lunneet	For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	
Group	Impact	Qualitative Assessment	
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The no qualitative assessment has considered this modal split with daily movements averaged across the year.	
		This option would see offset left and right departures. This would mean that westerly departures wou the same areas as easterly approaches, providing some relief for communities such as Howwood ar under the final approach. It would however mean that areas that are not currently overflown f departures will now be overflown on a more frequent basis.	nd Johnstone
		In this appraisal we have assumed the dual NORBO SID structure is used for the first rotation only.	
		<b>Period 1 (Peak departure Hours) overflight (NORBO Route changing)</b> During peak hours, particularly in the morning period, the majority of aircraft are flying to destinations from Glasgow, and therefore the NORBO direction becomes the predominantly used SID. In this of peak hours the NORBO route is split into two, which would share the noise. Both of these NORBO offset, one left and one right, which would mean that westerly departures would not overfly the sa easterly approaches, providing some relief for communities such as Howwood and Johnstone un approach. It would however mean that areas that are not currently overflown frequently by departure overflown on a more frequent basis. The heatmap Figure 13 shows that the offset to the left removes some areas of Johnstone and Elderslie, however this is shifted to parts of east Elderslie and also car westerly parts of Foxbar. Beyond this point the route, which would account for around 8% of overall flig the populated areas of Uplawmoor, Dunlop and Stewarton. Some overflight of these areas is require achieve respite for communities living under the NORBO SID during the off-peak hours which accound 42% of overall departures from Glasgow. The offset to the right route accounts for around 9% of overal and results in overflight of Linwood and Kilbarchan at lower levels, and overflight of parts of Loch Kilbirine at higher levels.	ption, during O routes are me areas as oder the final s will now be s overflight of aptures some thts, overflies ed in order to nt for around II departures,
			Contours (Black ou with estimated % o overall departures (based on 4 peak h
		5% 2% 3%	a day) 2019 baseline aver summer day overfit swathe: 1
Communities	Noise impact on health and quality of life		54

Figure 13 Westerly Option D Overflight and 2019 baseline NTK data

### Period 2 overflight

During the off-peak periods the NORBO departure, which accounts for approximately 42% of overall traffic (assuming this route is used all day after the first rotation) would fly straight ahead, similar to how aircraft fly the NORBO route today. At 5nm the route would then split into two, with 21% of departures continuing straight ahead and 21% turning south. The initial straight-ahead section between the runway and 5nm overflies Johnstone, Elderslie and Howwood as the majority of departures do today. The straight-ahead section beyond 5nm overflies Beith and parts of Kilbirnie however this will be different to current day owing to the concentration of traffic along the PBN routes. From the NTK data we can see that the route to the south route would increase the frequency of overflight compared to today however this route largely avoids areas of dense population with the exception of parts of Dunlop at around 7000ft.

In both periods, the ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option D. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

### Overflight data

Table 28 gives an overview of the Option D overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population overflown; this is partially due to the nature of the respite routes whereby more people are overflown, however the noise is shared and therefore it is overflight on a less frequent basis.

Table 28 Westerly departures option D overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option D	332.84	82804

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring data, there is a decrease in potentially noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option D against the baseline. 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 29 shows a significant increase in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

### Table 29 60dB and 65dB LAMax Data - Rwy23 Dep Option D

	60dE	3 L <sub>Amax</sub>	65dB	LAmax
System	Area (km²)	Population	Area (km²)	Population
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704
RWY 23 Dep Option D	583.18	153095	214.24	84120

### $L_{Aeq}$

The westerly departures make up a component of the overall  $L_{Aeq}$  day time and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall  $L_{Aeq}$  contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. Unlike some other options, the NORBO offset routes are only used for a small part of the day, with the majority of the NORBO departures continuing to fly straight ahead to 5nm as they do today. The introduction of the offset routes overall may result in a small change in the L<sub>Aeq</sub> contours shortening compared to current day. The offset departures to the left, which would operate around 19% of departure movements, is expected to result in the L<sub>Aeq</sub> contour extending slightly further to the south-west to reflect the offset track, this change is likely to occur over an area with low population however it would require further quantitative investigation at Stage 3 should this option progress. The offset departures to right, which would operate around 21% of departure movements, is expected to result in the L<sub>Aeq</sub> contour extending slightly further to the north-east to reflect the offset track, this change is likely to occur over Linwood however it would require further quantitative investigation at Stage 3 should this option progress.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

	Noise Abatement Procedures A change to the existing NAPs would be required to accommodate the offset departures and turns.
	<b>Noise Mitigations</b> The option offers an alternative respite configuration during peak departure periods for communities who live under the NORBO departure which accounts for the majority of departures from Glasgow airport. This means that overall, the NORBO noise is shared across three different routes although the straight-ahead off-peak route, which is similar to current day, sees the majority of the traffic.
	The other routes remain the same during peak and off-peak periods however they have comparatively lower percentages of overall flights operating.
	The introduction of alternative predictable respite arrangements (for those communities newly overflown by the peak NORBO) increases population overflown and the 60dB and 65dB L <sub>Amax</sub> outcomes compared to other options; the benefits and impacts of this will be further analysed as part of the Full Options Appraisal at Stage 3 when we have quantitative information about the frequency of overflight (should this option progress).
Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral

		tracks are newly o there may be sligh changes are likely	t increases	in the cor	ncentrations b	elow these flig	ghtpath	ns. Howeve	r, it should	be noted that the
	Greenhouse gas impact	Our fuel burn asse compared to the b This will be explor	essment (se aseline. We	ee below) therefore	has anticipate expect to see	ed that Option	D will ding im	have an ov	erall impro	ovement in fuel b buse gas emissio
		This option sees the beable to depart separations). This delays. The benef	t in interva is expecte	uls 1 minu ed to redu	ites apart (su ce ground ho	bject to safe	ety cas n turn	se and NEF will reduce	RL ability ground-ba	to accept 1-min ased emissions a
	Capacity / resilience	However, this opti to gain the full be aircraft to be 'linec project. The availa accommodate futu	nefits of th I up' in the ability of th	is, future i correct ore le dual NC	investment m der before tak DRBO structu	ay be require e-off howeve re during the	ed in a r this is e existi	dditional ta s not within ng peak de	xiway infra	structure to ena In Airspace Char
		The introduction of which provides re- under the Airspace NERL decommiss following NERL's	silience. The Modernisa sions the V	nis equipm ation progr ORs. Intro	ent is due to ramme. There oduction of P	be decommis is currently n	sionec lo long	d as part of term <sup>9</sup> resilie	a NERL L ence for G	IK wide program asgow's SIDs wi
		Table 30 shows d follow Glasgow's e				s, based on th	ne NTK	Cvectoring b	baseline a	nd if aircraft were
Wider Society		Table 30 RWY 23 W	/esterly Dep	artures Opt	tion D – Tranqı	iillity overflown				
		System		NSA area	NSA cou	nt Nationa Parks ar		National arks count	DQA ar	ea DQA coun
	Tranquillity	RWY 23 Base Vectoring (NTK		0.02	1	1.68		1	0	0
	Tanquinty	RWY23 Baseline (Centr	eline –	0	0	0		0	0	0
		Optioneering RWY 23 Option		0	0	0		0	0	0
		The data shows that there is no change in overflight of DQA's and there is a reduction in overflight of NSAs and National parks compared to the vectoring baseline. Technical Appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.								
	Biodiversity	<ul> <li>Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Compared to the baseline Castle Semple and Barr Lochs SSSI would be avoided.</li> <li>Lower slower aircraft, climbing at below a 6% climb gradient and flying the ROBBO SID, may overfly Whinnerston and Barmufflock Dam SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SID, and the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected that any impacts will be very minimal.</li> <li>We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full Options Appraisal at Stage 3.</li> </ul>								
		Option D is likely within existing CA							this optio	n can be contair
General Aviation	Access	We created an "ill departure options to understand if th volume compared CTR was c.47nm <sup>3</sup>	ustrative C combined t here is scop to existing	AS volum to help state	e" which was keholder enga ice the total v	a single volu agement on p olume of CAS	ime of otentia S. The	CAS requir Il impacts. V total volum	Ve have al le of the "i	so used this volu Ilustrative" airspa
	Economic impact from increased effective capacity	We expect the inc on commercial air of NORBO depart	traffic comp	bared with	the baseline	do nothing we	sterly o	departure ba	aseline. Ho	owever, the merg
		We estimate that in track mileage. T are also some sm	his is main	ly driven b	y the reduction	n in track mile	eage of	f the NORB	O LAKEY	route however th
		Table 31 Track Leng	gth Calculati	ons – Fuel	Burn Option D					
					e (Centreline	)			D	
General		RWY 23		nm	weighting	Score		1 nm P2		e Score
Aviation / Commercial			TRN NORBO -			142.065 2447.08	39.4 94.3	37.8 92.5	38.6 93.4	142.434 2447.08
airlines	Fuel burn		SUBUK NORBO LAKEY			2988.8	94.3 84.4	92.5 85.6	93.4 85	2720
			LUSIV-			903.968	81.3	81.3	81.3	866.658
		DEPS	DCS TLA			903.968 22.427	61.3 47.9	47.9	47.9	19.639
			PERTH			85.854	60.2	60.2	47.3 60.2	74.046
			FOYLE			27.06	26.3	26.3	26.3	21.566
			LOMON	26.70	2.05	54.735	18.1	18.1	18.1	37.105
				10 50	2.07		107	10.7	407	47.000
			CLYDE ROBBO			55.965 40.18	16.7 17.1	16.7 17.1	16.7 17.1	47.929 35.055

<sup>&</sup>lt;sup>9</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Total 6768.134 6411.512					
		Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least 6000f (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would see an improvement in fuel burn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail					
Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airline update their procedures accordingly and undertake training if required. This westerly SID option is not anticipate to require any additional training costs for airlines.					
	No other airline costs are foreseen.						
Airport / Air navigation	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L <sub>Aeq,10</sub> contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63d L <sub>Aeq,16h</sub> contour area and residential properties within the 66dB L <sub>Aeq,16h</sub> contour area. The UK Government's current aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L <sub>Aeq,16h</sub> noise contour or above. Therefore, Glasgow Airport are currently developing a new Nois Insulation Policy for 2022, which will cover the varied property types situated within the 63dB contour area. The L <sub>Aeq</sub> modelling in Stage 3 will determine if there are any increases in households within the 63dB L <sub>Aeq,16h</sub> area as result of this options as a result of the track adjustments on departure. If it does and track adjustments are propose in Glasgow's ACP submission, there will be an increased cost for Glasgow with regards funding their Nois Insulation Scheme.					
service		The initial deployment phase of the ACP may require some ATC system engineering amendments.					
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>10</sup> .					
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh. Owing to the respite configuration there may be more training required for this option compared to other options that form part of this IOA.					
AII	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACI the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DEF to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Addition assurances will be required during IFP ground validation to ensure the WP is acceptable, especially followir another turn shortly after the DER. A SID structure from the same runway which changes during the day is unchartered territory for the UK. Whilst is expected that perhaps a much more subtle change to a SID structure can be safely accommodated, ATC advise that an option where a SID utilisation would change significantly from a left turn to a straight ahead (or vice-versa immediately after departure introduces hazards to the operation which at this stage cannot considered to b mitigated without introducing other issues*. Such hazards are not just associated with aircraft inadvertently flyir (or being issued) the wrong SIDs and the wrong time of day but also HF issues associated with ATC confusion. *As an example, mitigations identified for SIDs switching to fundamental different directions after departure were SIDs with completely different names. However, flight planning and ATM issues previously identified by NERL requires SIDs going to the same places in the network are required to terminate at the same point which in turn would mean similar SID names to match the SID termination point.					
AII	Interdependencies, conflicts, and trade- offs	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The lead hand NORBO departures are separated from Prestwick's airspace and does not conflict with Edinburgh's traff below 7000ft. In NERL's ScTMA ACP, they have options on their proposed shortlist which would cater for a dua NORBO southbound track structure, noting these SIDs would then merge into one initial track for the rest of the day. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace. In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburg and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.					
		<ul> <li>CAP1711 describes the objective as:</li> <li>Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.</li> <li>This option would be expected to generate significant CO<sub>2</sub> reductions and provide relief and respite from noise those communities that would be newly overflown by the peak NORBO Routes. However, that would come at the expense of then overflying the communities most frequently overflown by Glasgow arrivals and departures livir under final approach the rest of the day.</li> </ul>					
All	AMS	This antion would not accommodate future domand in the most effective menner as a single initial NORE					

			under final approach the rest of the day.				
All	AMS	This option would not accommodate future demand in the most effective manner as a single initial NORBO departure track for the majority of the day would likely generate future ground delay.					
			However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.				
			This option could be expected to result in reductions in the volume of Glasgow's CAS				

<sup>&</sup>lt;sup>10</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.6. Runway 23 Westerly Departure Option E

Runway 23 Wes	terly Departures – Optic	on E
		Straight ahead departures only (no offsets) with turns at c.1nm and c.9nm from the runway NORBO is traffic is shared between a route that turns left at c.1nm and one that doesn't turn until c.9nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
Communities	Noise impact on health and quality of life	Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see all departures going straight ahead, however compared to today, some departures would turn at c.1nm, c.2nm and c.9nm rather than all turning at 5nm. The order of the year of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see all departures going straight ahead, however compared to today, some departures would turn at c.1nm, c.2nm and c.9nm rather than all turning at 5nm. The largest percentage of aircraft departing from Glasgow currently utilise the NORBO SID which routes to the south. In this option, the NORBO traffic is permanently split between two routes; one that routes straight ahead and then turns at c.2nm. Unlike other options, these routes are not offset and so the straight-ahead sections overfly similar areas to today such as Johnstone and Elderslie, which are the same populations as under final approach.
		this largely follows the areas where departures fly today. This includes overflight of Johnstone, Elderslie and Howwood, and at higher altitudes, Beith and the south of Kilbirnie. The other 26% of NORBO departures will fly the route that turns at c.2nm. Beyond the 2nm, the turn to the south introduces overflight over some new areas although figure 14 shows these are not densely populated. Aircraft would then route over areas that are currently overflown today including the populated areas of Lugton, Dunlop, western parts of Uplawmoor, and the northwestern parts of Stewarton at 7000ft. From the heatmap, this level of overflight would be a change from current day, where those areas are typically experiencing somewhere between around 1–10 flights per day, on average.

The LUSIV and TALLA SIDs, which account for 10% and <1% of traffic respectively, also turn earlier today

resulting in some new areas of overflight. Figure 14 shows that this largely avoids dense areas of population with the exception of western Neilston which will mainly be overflown by the TALLA departures.

The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs fly straight ahead before turning right. This initial part of the right turn routes over parts of Johnston and Kilbarchan. Beyond this point, the ROBBO SID which is estimated to be operated by 3% of overall Glasgow departures, routes over areas overflown today, and avoids dense areas of populations. The CLYDE, LOMON and PERTH SIDS turn north and overfly parts of the Bridge of Weir and Quarriers village – these areas will see the cumulative impact of all three SIDs. Beyond this point, the CLYDE SID, which accounts for around 6% of overall Glasgow departures, routes over Kilmacolm before reaching the eastern parts of Port Glasgow. The LOMON SID overflies eastern areas of Kilmacolm, before reaching Langbank and the western parts of Dumbarton at higher altitudes. Finally, the PERTH SID largely avoids areas of dense population with the exception of the easter parts of Dumbarton which are overflown around 7000ft. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LOMON and PERTH SIDs may increase in size and overfly additional parts of Dumbarton and

### may extend as far as Alexandria.

#### Overflight data

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option E. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

As shown in Table 32, against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population overflow; this is due to the routes turning earlier than they do today alongside splitting the NORBO route into two. This does however mean that the noise from the busiest departure route is shared.

Table 32 Westerly departures option E overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option E	248.01	69308

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

### 60dB and 65dB L<sub>Amax</sub>

Technical Appendix A includes 60dB and 65dB  $L_{Amax}$  contours which compare Option E against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 33 shows an increase in the population within the 60dB  $L_{Amax}$  contour and an increase in population within the 65dB  $L_{Amax}$  contour however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

#### Table 33 60dB and 65dB LAMax Data – Rwy23 Dep Option E

	60dE	3 L <sub>Amax</sub>	65dB L <sub>Amax</sub>		
System	Area (km²)	Population	Area (km²)	Population	
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704	
RWY 23 Dep Option E	458.27	139426	161.26	64472	

### LAeq

The westerly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall  $L_{Aeq}$  contours.

Most aircraft today fly straight ahead for 5nm before turning and the departures which turn before 5nm will influence the shape of the L<sub>Aeq</sub> contour. It is expected that this change will result in the L<sub>Aeq</sub> contours shortening compared to current day although 32% of NORBO traffic will continue straight ahead and so this reduction is expected to be less than some other options. This may benefit some parts of Howwodd. The NORBO, LUSIV and TALLA turns to the left, which overall account for around 37% of Glasgow departures are expected to result in the L<sub>Aeq</sub> contour extending further to the south; the heatmap data suggests that this will occur over areas where there are not high levels of population density. The equivalent ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L<sub>Aeq</sub> contours however the turns may result in some areas of Johnstone, which currently sit in the lower dB L<sub>Aeq</sub> bands, to move into a higher dB contour.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

# **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

		<b>Noise Mitigation</b> The option shares the noise from the existing most heavily used NORBO route into two routes. This offers some noise relief for those communities currently located under immediate climb out and final approach however this would not be predictable respite; having 2 NORBO SIDs reduces the frequency of overflight for communities situated under just one NORBO SID. This option helps to reduce the numbers of newly overflown by having approximately half of the NORBO departures flying straight ahead, as today.
	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft; the majority of departures will climb above 1000ft whilst flying straight ahead as today. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option E will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity / resilience	This option sees the SIDs splitting before 5nm which will improve capacity compared to the baseline as aircraft

		will be able to dep separations). This delays. The benef relies on achieving In addition to this, performance throu of this, future invest	is expecte its of this w at least a this option ghout the d	ed to redu vill be see 45° split l n splits th day and re	ce ground he en particularly between the ne NORBO de educe ground	olding which y in future so two NORBO epartures ad delays and 0	in turn cenarios SIDs. cross tw CO2 con	will reduce g with increas o routes whi tributions. In	round-based of ed traffic leve ch will enhand order to gain t	emissions and ls. This option ce operational he full benefits
		The introduction of aids, which provid programme under Glasgow's SIDs w Glasgow operation	oefore take- of PBN SID des resilien the Airsp hen NERL	off howe also re ace. This ace Mod decomm	ver this is not moves Glaso equipment i ernisation pr issions the V	t within scop gow's depen s due to be rogramme. T ORs. Introdu	e of an <i>i</i> dency o decom There is uction of	Airspace Cha n convention missioned as currently no	ange project. nal ground-bas s part of a N o long term <sup>11</sup>	ed navigation ERL UK wide resilience for
		Table 34 shows d to follow Glasgow'				as, based o	n the NT	TK vectoring	baseline and i	f aircraft were
		Table 34 RWY 23 W	esterly Dep	artures Op	otion E – Tranc	quillity overflow	wn			
		System		NSA area	a NSA cou	unt Parks		National Parks count	DQA area	DQA count
		RWY 23 Basel Vectoring (NTK		0.02	1	1.6		1	0	0
	Tranquillity	RWY23 Baseline (Centr Optioneering	eline –	0	0	0		0	0	0
		RWY 23 Optio		0	0	0		0	0	0
		The data shows th National parks co overflight contour	mpared to	the vect	oring baselin	e. Technica	I Appen	dix A contai	ns a map whi	ch shows the
		Below 2000ft no o Scenic Areas, and the baseline Castl	Sites of S	pecial Sc	ientific Intere	ests is expec	ted for t			
	Biodiversity	Lower slower aircr and Barmufflock I vast majority of air very minimal.	Dam SSSIs	below 20	000ft. Given	the low over	all % of	aircraft expe	ected to fly the	SID, and the
		We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full Options Appraisal at Stage 3.								
		Option E is likely t within existing CA							his option car	be contained
General Aviation	Access	We created an "ille departure options volume to underst airspace volume o The Glasgow CTR	combined and if there compared to	to help e is scope o existing	stakeholder e to reduce t g CAS in the	engagement he total volu	t on pot me of C	ential impact AS. The tota	ts. We have a al volume of th	also used this ne "illustrative"
	Economic impact from increased effective capacity	We expect the inc on commercial air								onomic impact
		We estimate that 0 in track mileage. there are also som	This is mair	nly driver	by the redu	ction in trac				
		in track mileage.	This is main the reduction	nly driver ns all othe	h by the redu er departure	ction in tracl routes.				
		in track mileage. <sup>-</sup> there are also som	This is main the reduction	nly driver ns all othe ons – Fuel Baselin	by the redu er departure <i>Burn Option I</i> e (Centreline %	iction in tracl routes. ≘ e)	k mileaç	ge of the NO		
		in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i>	This is main ne reduction gth Calculation	nly driven ns all othe <i>cons – Fuel</i> Baselin nm	by the redu er departure <i>Burn Option I</i> e (Centreline % Weighting	ction in tract routes. ≘ e) Score	k mileaç nm P	ge of the NO		
General		in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i>	This is main ne reduction gth Calculation TRN NORBO – SUBUK	nly driver ns all othe ons – Fuel nm 38.50 93.40	by the redu er departure <i>Burn Option I</i> e (Centreline <mark>% Weighting</mark> 3.69 26.2	ction in track routes. e) Score 142.065 2447.08	nm P 37.8 92.5	ye of the NOI <b>Score</b> 139.482 2423.5		
Aviation / Commercial		in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i>	This is main ne reduction gth Calculation TRN NORBO – SUBUK NORBO – LAKEY	nly driver ns all othe ons – Fuel <mark>Baselin</mark> nm 38.50 93.40	a by the redu er departure <i>Burn Option I</i> e (Centreline % Weighting 3.69	ction in tract routes. ≘ e) Score 142.065	k mileag nm P 37.8	ye of the NO <b>Score</b> 139.482		
Aviation /	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i>	This is main ne reduction gth Calculation TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS	nly driver ns all othe ons – Fuel nm 38.50 93.40 93.40 84.80	by the redu er departure <i>Burn Option I</i> <b>e (Centreline</b> <b>Weighting</b> 3.69 26.2 32 10.66	ction in track routes. ■ Score 142.065 2447.08 2988.8 903.968	k mileag nm P 37.8 92.5 83 81.7	<ul> <li>Score</li> <li>139.482</li> <li>2423.5</li> <li>2656</li> <li>870.922</li> </ul>		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> RWY 23	This is main ne reduction gth Calculation NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA	nly driver ns all othe ons – Fuel nm 38.50 93.40 93.40 84.80 54.70	by the redu er departure <i>Burn Option I</i> <b>e (Centreline</b> <b>%</b> <b>Weighting</b> 3.69 26.2 32 10.66 0.41	ction in track routes. Score 142.065 2447.08 2988.8 903.968 22.427	k mileag nm P 37.8 92.5 83 81.7 49	<ul> <li>Score</li> <li>139.482</li> <li>2423.5</li> <li>2656</li> <li>870.922</li> <li>20.09</li> </ul>		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> RWY 23	This is main ne reduction gth Calculation TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS	nly driver ns all othe ons – Fuel nm 38.50 93.40 93.40 93.40 84.80 54.70 69.80	by the redu er departure <i>Burn Option I</i> <b>e (Centreline</b> <b>Weighting</b> 3.69 26.2 32 10.66	ction in track routes. ■ Score 142.065 2447.08 2988.8 903.968	k mileag nm P 37.8 92.5 83 81.7	<ul> <li>Score</li> <li>139.482</li> <li>2423.5</li> <li>2656</li> <li>870.922</li> </ul>		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> RWY 23	TRN TRN Calculation TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON	nly driver ns all othe ons – Fuel <mark>Baselin nm</mark> 38.50 93.40 93.40 84.80 54.70 69.80 33.00 26.70	by the redu er departure <i>Burn Option I</i> (Centreling (Weighting 3.69 26.2 32 10.66 0.41 1.23	ction in track routes. Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735	k mileag nm P 37.8 92.5 83 81.7 49 62.6	<ul> <li>Score</li> <li>139.482</li> <li>2423.5</li> <li>2656</li> <li>870.922</li> <li>20.09</li> <li>76.998</li> <li>22.714</li> <li>39.975</li> </ul>		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> RWY 23	This is main reduction of <i>Calculatio</i> TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE	nly driver ns all othe ons – Fuen <b>Baselin</b> nm 38.50 93.40 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50	by the redu er departure <i>Burn Option I</i> (Centreline (Weighting 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87	Cition in track         Score         142.065         2447.08         2988.8         903.968         22.427         85.854         27.06         54.735         55.965	k mileag nm P 37.8 92.5 83 81.7 49 62.6 27.7 19.5 17.6	Pi       Score         139.482       2423.5         2656       870.922         20.09       76.998         22.714       39.975         50.512       50.512		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> <b>RWY 23</b> DEPS	TRN TRN Calculation TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON	nly driver ns all othe ons – Fuen <b>Baselin</b> nm 38.50 93.40 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50	by the redu er departure <i>Burn Option I</i> <b>e (Centreline</b> <b>%</b> <b>Weighting</b> 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05	ction in track routes. Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965 40.18	k mileag nm P 37.8 92.5 83 81.7 49 62.6 27.7 19.5	<ul> <li>Score</li> <li>139.482</li> <li>2423.5</li> <li>2656</li> <li>870.922</li> <li>20.09</li> <li>76.998</li> <li>22.714</li> <li>39.975</li> <li>50.512</li> <li>35.67</li> </ul>		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> RWY 23	This is main reduction of <i>Calculatio</i> TRN NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE	nly driver ns all othe ons – Fuen <b>Baselin</b> nm 38.50 93.40 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50	by the redu er departure <i>Burn Option I</i> (Centreline (Weighting 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87	Cition in track         Score         142.065         2447.08         2988.8         903.968         22.427         85.854         27.06         54.735         55.965	k mileag nm P 37.8 92.5 83 81.7 49 62.6 27.7 19.5 17.6	Pi       Score         139.482       2423.5         2656       870.922         20.09       76.998         22.714       39.975         50.512       50.512		
Aviation / Commercial	Fuel burn	in track mileage. <sup>-</sup> there are also som <i>Table 35 Track Leng</i> <b>RWY 23</b> DEPS	TRN TRN NORBO – SUBUK NORBO – SUBUK NORBO – LAKEY LUSIV- DCS TLA PERTH FOYLE LOMON CLYDE ROBBO	nly driver ns all othe ons – Fuen nm 38.50 93.40 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50 19.60	by the redu er departure <i>Burn Option I</i> (Centreline Weighting 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05 2.87 2.05	ction in track         routes.         Score         142.065         2447.08         2988.8         903.968         22.427         85.854         27.06         54.735         55.965         40.18         6768.134	k mileag nm P 37.8 92.5 83 81.7 49 62.6 27.7 19.5 17.6 17.4 all aircra ft), it is a	Pice         of the NOI           139.482         139.482           2423.5         2656           870.922         20.09           76.998         22.714           39.975         50.512           35.67         6335.863           aft to climb construction         construction	RBO LAKEY	at least 6000ft would see an

<sup>&</sup>lt;sup>11</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

airlines		update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.						
	Other costs	No other airline costs are foreseen.						
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP. Unlike options that propose track adjustments on departure, this option is unlikely to change the populations						
Airport / Air		within the 63dB L <sub>Aeq,16h</sub> noise contour and therefore not affect Glasgow's noise insultation scheme costs.						
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>12</sup> ;						
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.						
All	Safety	No safety issues have been identified.						
		There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options ion their proposed shortlist which would cater for a duel NORBO southbound track structure.						
All	Interdependencies, conflicts, and trade- offs	As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace.						
		In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.						
		This option is dependent on changes to the network.						
		CAP1711 describes the objective as:						
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.						
All	AMS	This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some relief from nois those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure we mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under single NORBO SID structure).						
		This option could be expected to result in reductions in the volume of Glasgow's CAS						

<sup>&</sup>lt;sup>12</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.7. Runway 05 Easterly Departures Baseline

Runway 05 Easte	erly Departures Basel	ine		
		This option represents the do-nothing sca Easterly SIDs. Today, all Glasgow SIDs clin 5nm before turning. This means that the interval between successive departing aircraft The result is that during peak departure times the runway and at the runway holding points, emissions and delay. Beyond 5nm, aircraft a off the SID centrelines by ATC, resulting in br Some aircraft less than 5700kg MTWA do no the SIDs. These are usually non-jet aircraft a than jet aircraft. These aircraft are vectored them turn towards their destination early, redu- reduces departure delays. Glasgow Airport's current SIDs are depend ground-based navigation equipment (VORs) undergoing a rationalisation programme by N mitigate VOR rationalisation however this is an of FASI implementation. The AMS mandates meet that national requirement.	nb straight ahead to minimum departure is at least 2 minutes. a, aircraft are held on leading to increased re typically vectored oad swathes. At have to depart via and therefore slower by ATC which helps uces track miles and ent on conventional which are currently ATS NERL. Glasgow is currently interim measure that only can or	ly be used to bridge the gap ahead
		For more information on our do-nothing sce	nario, please see our Stage 2A	document on the CAA's Airspace
		Change Portal.	· · · · ·	·
Group	Impact	Qualitative Assessment		
	Noise impact on	Due to wind direction, easterly operations on a qualitative assessment has considered this management and the subscription of	odal split with daily movements as w climb straight ahead to 5nm be by ATC resulting in dispersion. The enerated using NTK data:	veraged across the year. ofore turning. Beyond 5nm, aircraft
Communities	health and quality of life	Figure 15 Runway 05 Departure Vectoring Swathe The Technical Appendix to this document in important to note that this data is not modelled a preliminary means of comparison between includes data based on this NTK heat map ar the centreline of the current published SID: Table 36 Easterly departures baseline overflight data	cludes a larger version of this m I in the same way as the overflight In this baseline and the airspace	t contours, however it does provide change options. Table 36 below
		System	Area (km²)	Population

	System	Area (km²)	Population	Area (km²)	Population			
		60dB L <sub>Amax</sub> 65dB L <sub>Amax</sub>						
	<b>60dB and 65dB L</b> <sub>Amax</sub> Technical Appendix A includes the baseline and the options. 6 quantified at the Stage 3 Full C	OdB and 65dB L <sub>Amax</sub>						
	The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline. In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals, and places of worship; the full data around these is shown in technical appendix A, and as part of this IOA we will provide a qualitative statement around this data.							
	KWY US Baseline (Centreline – Op	buoneering tool)	180.52	1,	3213			
	RWY 05 Baseline (Centreline – Op	tioneering tool)	186.52	1-	73213			
	RWY 05 Baseline – Vectoring (NTI	K data)	246.99	36	54763			

		(Centreline	5 Baseline – Optioneering	356.82	382113	114	120793
		tool)	n these tables will be use	ed to compare the	e easterly departure on	tions against the 'do	nothing' baseling
		L <sub>Aeq</sub> The easterly	departures make up a c ontours from 2017, as a	omponent of the	overall LAeq daytime a	nd night time conto	urs. We have use
		Noise Abate	ment Procedures ine reflects current day,	there would be r	no changes to NAPs as	s a result of this opti	on.
		<b>Noise Mitig</b> a The existing		not offer any op	portunities for predicta	ble respite. Furtherr	nore, communitie
		Impacts to ai	r quality are considered f nificant impact on local g			n). Aircraft flying abo	ve this are unlike
	Air Quality	aircraft reach during this th	rting Glasgow have var 1000ft at different locati ey climb above 1000ft. O s which could occur belo	ons. Today, virtu Our IOA will there	ally all Glasgow depar	tures climb straight	ahead for 5nm an
		is linked to t	greenhouse gases arise rack length, we have in gas assessment is there	nitially looked at	the track length for the	he baseline westerl	y departures. Th
		Table 37 East	erly departure baseline – Ir				
		RWY 05		Baseline (Ce		<b>C</b>	
			TDN	nm	% Weighting	Scol	
			TRN NORBO – SUBUK	50.00 112.00	0.81	40.5 644.	
			NORBO – SOBOK		5.75	787.	
				112.00	7.03		
	Greenhouse gas		LUSIV-DCS	88.80	2.34	207.	
	impact	DEPS	TLA	49.20	0.09	4.43	
	impaor	0210	PERTH	50.30	0.27	13.5	
			FOYLE	19.10	0.18	3.44	
			LOMON	20.00	0.45	9.00	
			LOMON CLYDE		0.45 0.63	9.00 15.7	
				20.00			5
		Total We will estim	CLYDE	20.00 25.00 33.50	0.63 0.45	15.7 	5 8 ).92
		We will estim advantages/o shorter than us to qualitati in Technical	CLYDE ROBBO nate the differences betw disadvantages of the opt a typical flight today. As vely describe anticipated Appendix A.	20.00 25.00 33.50 ween this baselir tion. This estima CO <sub>2</sub> emissions a d greenhouse ga	0.63 0.45 ne and the option, to u tion will consider whet ire linked to the differer s impacts as a result of	15.7 15.0 1740 nderstand if there a her the aircraft trach nce in aviation fuel b f the option. Full dat	5 8 0.92 are any anticipate ks will be longer o purnt, this will allo a tables are show
Vider Society	Capacity / resilience	We will estim advantages/o shorter than a us to qualitati in Technical J Glasgow's cu results in a co This leads to movement no existing confi In future, incr disbenefits. A the additiona subsides, ho It is therefore delay at Glas	CLYDE ROBBO	20.00 25.00 33.50 ween this baselin tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as airo t which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulatio generate ground re traffic levels, f to this, no chang	0.63 0.45 ne and the option, to u tion will consider whet ire linked to the differer s impacts as a result of cy of departures flying craft are only able to d n increased emissions ies in ground holding a growth at the airport. cottish TMA are anticipa- ikely to be put in place ons stabilise the number delay for Glasgow.	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als	5 8 0.92 are any anticipate (s will be longer of burnt, this will allo a tables are show nm before turnin 2-minute interval uture increases ore the SIDs in the acity and resilience d pilots to manage il the peak in traffe
Wider Society	Capacity / resilience	We will estim advantages/c shorter than a us to qualitati in Technical J Glasgow's cu results in a c This leads to movement nu existing confi In future, incr disbenefits. A the additiona subsides, how It is therefore delay at Glass FASI program This baseline be decommis is currently n	CLYDE ROBBO	20.00 25.00 33.50 ween this baselir tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as airo d which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulation generate ground to this, no chang S benefits associ- entional ground-b RL UK wide program for Glasgow's SI	0.63 0.45 ne and the option, to u tion will consider whether is impacts as a result of craft are only able to d n increased emissions is in ground holding a growth at the airport. cottish TMA are anticipatively to be put in place ons stabilise the number delay for Glasgow. this baseline scenario le to the airspace arou ated with the program ased navigation aids of camme under the Airsp Ds when NERL decom	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least s and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als me. called VORs. This e pace Modernisation	5 8 0.92 are any anticipate (s will be longer of burnt, this will allo a tables are show nm before turnin 2-minute interval uture increases ore the SIDs in the acity and resilient d pilots to manager il the peak in traff eases in departur so inhibit the wide programme. The
Nider Society	Capacity / resilience	We will estim advantages/c shorter than a us to qualitati in Technical J Glasgow's cu results in a c This leads to movement nu existing confi In future, incr disbenefits. A the additiona subsides, how It is therefore delay at Glas FASI program This baseline be decommis is currently n critical opera CAP1616 out Areas of Out (NSA) and w (DQA) as pa	CLYDE ROBBO	20.00 25.00 33.50 ween this baselir tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as airo t which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulation generate ground to this, no chang S benefits associant to this, of rever of impacts upor y (AONB). In So I overflight data sessment. At this	0.63 0.45 De and the option, to u tion will consider whether the linked to the difference s impacts as a result of the departures flying craft are only able to do n increased emissions the sin ground holding a growth at the airport. Cottish TMA are anticipative tikely to be put in place ons stabilise the number delay for Glasgow. This baseline scenario the to the airspace around ated with the programmer ased navigation aids of the analysis with spec- cottand, the equivalent around these, Nationals to stage of the ACP we	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als me. called VORs. This e pace Modernisation imissions the VORs ecific reference to N c of AONB are National e will qualitatively a	5 8 0.92 are any anticipate (s will be longer of burnt, this will allo a tables are show m before turnin 2-minute interval uture increases ore the SIDs in the acity and resiliend d pilots to managorial if the peak in traff eases in departures in the peak in traff eases in departures in the wide programme. The which will result Jational Parks are proal Scenic Area proated quiet areas seess whether the
Wider Society	Capacity / resilience	We will estim advantages/o shorter than a us to qualitati in Technical J Glasgow's cu results in a co This leads to movement ne existing confi In future, incr disbenefits. A the additiona subsides, how It is therefore delay at Glass FASI program This baseline be decommis is currently n critical opera CAP1616 out Areas of Out (NSA) and w (DQA) as pa option differs AONB. Table 38 show	CLYDE ROBBO	20.00 25.00 33.50 ween this baselin tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as aird t which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulation generate ground re traffic levels, f to this, no chang S benefits associon to this, no chang S ben	0.63 0.45 De and the option, to u tion will consider whether the inked to the difference impacts as a result of the partures flying the process of the area to the the process of the area to the the program ased navigation aids of the potential to impact the po	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als me. called VORs. This e pace Modernisation imissions the VORs ecific reference to N c of AONB are National parks, and designed will qualitatively a t tranquillity with reg	5 8 0.92 are any anticipate (s will be longer burnt, this will allo a tables are show m before turnin 2-minute interval uture increases ore the SIDs in th acity and resiliend d pilots to manag il the peak in traff eases in departu so inhibit the wid quipment is due programme. The which will result Jational Parks are onal Scenic Area (nated quiet area seass whether the gards to noise area araft were to follo
Vider Society		We will estim advantages/o shorter than a us to qualitati in Technical . Glasgow's cu results in a c This leads to movement ne existing confi In future, incr disbenefits. A the additiona subsides, how It is therefore delay at Glas FASI program This baseline be decommis is currently n critical opera CAP1616 out Areas of Out (NSA) and w (DQA) as pa option differs AONB. Table 38 sho Glasgow's ex	CLYDE ROBBO	20.00 25.00 33.50 ween this baselir tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as airo d which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulation generate ground to this, no chang S benefits associantional ground-b RL UK wide progra for Glasgow's SI cant loss of rever of impacts upor y (AONB). In So l overflight data sessment. At this whether this has ht of these area The data from th	0.63 0.45 The and the option, to u tion will consider whether the linked to the difference impacts as a result of the option of the airport of the airport. The analysis of the airport of the airport of the airport. The analysis of the airport of the airp	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als me. called VORs. This e pace Modernisation imissions the VORs ecific reference to N c of AONB are Natival Parks, and desige will qualitatively a t tranquillity with reg heatmap and if airco compare options a	5 8 0.92 are any anticipate (s will be longer burnt, this will allo a tables are show m before turnin 2-minute interva uture increases ore the SIDs in the acity and resiliend d pilots to manage if the peak in traff eases in departur so inhibit the wid quipment is due programme. The which will result Jational Parks are conal Scenic Area protect area seass whether the gards to noise area araft were to follow
Vider Society		We will estim advantages/o shorter than a us to qualitati in Technical J Glasgow's cu results in a co This leads to movement ne existing confi In future, incr disbenefits. A the additiona subsides, how It is therefore delay at Glass FASI program This baseline be decommis is currently n critical opera CAP1616 ou Areas of Out (NSA) and w (DQA) as pa option differs AONB. Table 38 sho Glasgow's ex departure ba Table 38 Easter	CLYDE ROBBO	20.00 25.00 33.50 ween this baselin tion. This estima CO <sub>2</sub> emissions a d greenhouse ga , with the majorit e airport, as aird t which results in result in increas urpose for future nts across the So restrictions are I ad. Flow regulation generate ground re traffic levels, fi to this, no chang S benefits associant to this, no chang S benefits associant loss of rever of impacts upor y (AONB). In So I overflight data sessment. At this whether this has ht of these area The data from th	0.63 0.45 The and the option, to u tion will consider whether the and the option, to u tion will consider whether the linked to the difference simpacts as a result of the option of the aligner the optio	15.7 15.0 1740 nderstand if there a her the aircraft track nce in aviation fuel b f the option. Full dat straight ahead to 5 lepart with at least and delays. Any f nd delay and theref ated to result in capa in order for ATC an er of movements unt would result in incre nd Glasgow may als me. called VORs. This e pace Modernisation imissions the VORs ecific reference to N c of AONB are National parks, and designed will qualitatively a t tranquillity with reg	5 8 0.92 are any anticipate (s will be longer burnt, this will allo a tables are show m before turnin 2-minute interva uture increases ore the SIDs in the acity and resiliend d pilots to manage if the peak in traff eases in departur so inhibit the wid quipment is due programme. The which will result Jational Parks and parts and Scenic Area prated quiet area ssess whether the gards to noise and araft were to follog gainst the easter

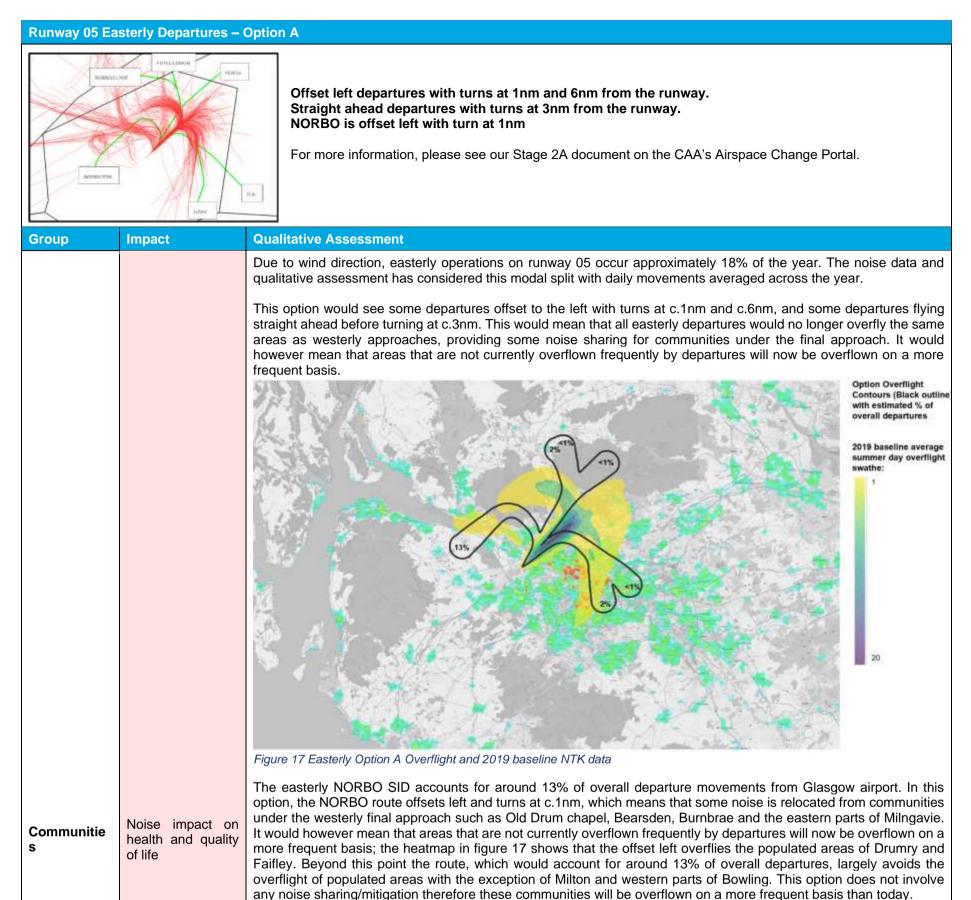
<sup>&</sup>lt;sup>13</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		RWY 05 Baseline (Centreli Optioneering to		0	0		0	0		2	0.38	
		The effects of airspa "In general, airspace ground-based infras Habitats legislation." some evidence that of are below around 50 where aircraft overfly Areas, and Sites of S Table 39 shows data Glasgow's existing S departure baseline.	change p tructure. Though disturband 0m (~1,6 y Special Special Sc a on the	oroposals a As such there is lim ce effects a 40ft). Cons Protection cientific Int	are unlikely hey are un nited resea associated sideration v n Areas, Sp terest, parti	to have an likely to h rch availa with aircra will therefo pecial Are cularly at reas, base	n impact up ave a dire ble on the aft can occu ore be given as of Cons altitudes be d on the N	on biodiv oct impact effects of ur during t n to the e servation, elow 2000	ersity beca t that woul aircraft no ake-off an ffects on e National Oft. map and if	use they d engag bise on w d landing cology a Parks, N	do not in e the Bir ildlife, th where a nd biodiv ational S were to t	nvolve rds or ere is ircraft versity Scenic follow
	Biodiversity	Table 39 Biodiversity –	SAC	SAC	SSSI	SSSI	SPA	SPA	National Park	Nationa park	NSA	NS
		RWY 05 Baseline – Vectoring (NTK	area 0	count 0	count 24	area 10.46	count	area 6.37	count 0	area 0	count 0	are: 0
		data) RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0
General Aviation	Access	National Scenic Area aircraft, climbing at b this is likely to be infi therefore be tactically This baseline scenar place today. The opt	pelow a 6 requently y turned I rio would ions will I	% climb g , as lower left before not offer a be qualitation <i>I Zone and C</i> rports are ddition to th shown in F	radient, ma and slower reaching the any change ively compa- tively compa	ay overfly of a ircraft where sites. The sites of from the ared again of the control of the cont	the Manse vill typically existing C ast this exist exist this exist exist this exist of the exist exist this exist this exist this exist exist this exist this exist this exist this exist this exist exist this exist this exist this exist this exist this exist this exist exist this exist this exist this exist this exist this exist this exist exist this exist this exist this exist this exist this exist exist this exist thi	Burn and not be re- controlled sting scent	Airspace of ario.	Wood S follow the (CAS) ar (CAS) ar th their c ad the air arying lo	SSIs hov NAP ar rangeme wn Cont oorts' airs wer and	rolled space upper

		Whilst the existing baseline scenario will not result in the requirement for more airspace, this option offers no opportunity to simplify the airspace boundaries or reduce the size of CAS which is something Glasgow has been specifically working with GA stakeholders to try to achieve.
	Economic impact from increased effective capacity	There will be no increase to capacity from today as a result of this option; later in this IOA we will qualitatively estimate the differences between this baseline and the airspace change options.
General Aviation / Commercial airlines	Fuel burn	As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline easterly departures. When departing from Glasgow, the majority of aircraft fly straight ahead until 5nm and then are vectored by air traffic control, this means that track length is varied from flight to flight. For the purposes of comparing our easterly SID options against the baseline scenario, we have taken the track length of the SID centerlines as an initial indication of 'do nothing' track length. We have then applied a weighting based on SID usage to provide an overall total track mileage for the system. At the Stage 3 Full Options Appraisal, track length and fuel burn will be modelled in further detail. <i>Table 40 Easterly SID Track Mileage</i> <b>RWY 05</b>

				nm	% Weighting	Score		
			TRN	50.00	0.81	40.50		
			NORBO – SUBUK	112.00	5.75	40.50 644.00		
			NORBO – LAKEY	112.00	7.03	787.36		
			LUSIV-DCS TLA	88.80 49.20	2.34	207.79		
		DEPS	PERTH	49.20 50.30	0.09 0.27	4.43		
			FOYLE	19.10		13.58 3.44		
			LOMON	20.00	0.18	9.00		
			CLYDE	25.00	0.45 0.63			
			ROBBO	33.50		15.75 15.08		
			RUBBU	33.50	0.45 Total 18%	1740.92		
Commercial airlines	Training costs Other costs	coordination w We will quality anticipated ac aircraft tracks climb. As this option IOA we will es As this option IOA we will es	with other traffic in the ai atively estimate the diffe dvantages/disadvantage will be longer or shorter is already in operation, stimate the difference be is already in operation, stimate the difference be	irspace. erences between t s of the option aga than a typical fligh there are no traini etween our options there are no othe etween our options	his baseline and the opt ainst current day. This es t today and will also cons ng costs anticipated as th s and this baseline. er costs anticipated as th s and this baseline.	usly climbing due to the tactical ion, to understand if there are any stimation will consider whether the sider the opportunity for continuous here will be no change; later in this here will be no change; later in this		
	Infrastructure costs	As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
Airport / Air navigation service provider	Operational costs	this IOA we w Glasgow Airp are currently substitution to the gap ahead	rill estimate the difference ort's current SIDs are de undergoing a rationalisa mitigate VOR rationalis d of FASI implementation	e between our op ependent on conve ation programme l sation however this on. Failure to mitig	tions and this baseline. entional ground-based na by NATS NERL. Glasgo s is an interim measure th ate the impacts of VOR	as there will be no change; later in avigation equipment (VORs) which ow is currently investigating RNAV hat only can only be used to bridge rationalisation in the long term will ot meeting the requirements of the		
	Deployment costs				loyment costs anticipate options and this baseline	d as there will be no change; later e.		
All	Safety	growth could	however result in increa levels within the Scottisl	sed complexity an	d workload for Air Traffic	ements at Glasgow. Future traffic c Controllers and pilots, which may t holding on the ground, in order to		
All	Interdependencies, conflicts, and trade- offs	however Eas departures. La	terly departures are saterally deconflicting the	ometimes require ese would be optin	d to be 'stepped up' nal.	er airports with Easterly departures underneath Edinburgh's GOSAM		
	0115		ScTMA route structure s less efficient profiles in			and Glasgow results in higher ATC		
All	AMS				e capacity for the benefit	of those who use and are affected		
		Doing nothing with Easterly departures will not align with the AMS. It will not enable any environmental benefits or maximise benefits from NERL's re-design of the ScTMA. No change and therefore no ACP submission will not enable any reduction in the volume of controlled airspace.						

# 4.8. Runway 05 Easterly Departure Option A



The ROBBO/CLYDE/LOMON/FOYLE/PERTH departures also offset to the left however these departures turn at c.6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The route initially flies over Dumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 7000ft. Figure 17 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for c.3nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning at c.3nm rather than 5nm. This results in overflight of some areas that are already overflown today however this would be at a higher frequency in future. Review of the population data shows that this route would overfly large areas of the city of Glasgow where there is a high density of population. Although this is not dissimilar to what happens today (the heatmap shows a large swathe across parts of the city), in future concentration of overflight would be expected to occur. The latter parts of the routes will overfly dense areas of population not typically overflown by easterly departures today.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE contour may also extend further over Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option A. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 41 gives an overview of the Option A overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing

SID centreline data, the area of the contours remains similar however there is a significant increase in the number of population and noise sensitive sites overflown which can be attributed to the offset routes, early turns than today, and the overflight of Glasgow city centre by the LUSIV/TALLA SID. At present, the baseline and option overflight contours do not take into account frequency of overflight which will be important when considering total population overflown; this will be further explored at Stage 3 should this option progress.

#### Table 41 Easterly departures option A overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option A	184.58	254041

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of hospitals, care homes and places of worship overflown compared to the centreline baseline. The number of schools overflown reduces. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

In our Stage 2A engagement, the Mains Estate Residents' Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward, we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB  $L_{Amax}$  contours which compare Option A against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 42 shows an increase in the population within the 60dB  $L_{Amax}$  contour and an increase in population within the 65dB  $L_{Amax}$  contour. This is due to the earlier divergence of SIDs compared to the baseline however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 42 60dB and 65dB L<sub>Amax</sub> Data – Rwy05 Dep Option A

	60dE	3 L <sub>Amax</sub>	65dB	L <sub>Amax</sub>
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option A	363.53	458336	129.97	179689

### $L_{Aeq}$

The easterly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{aeq}$  contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces offset departures and turns at 3nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal, if this option is taken forward.

#### Noise Abatement Procedures

			A change to the existing NAPs would be required to accommodate the offset departures and turns.
			<b>Noise Mitigation</b> The option does not offer an alternative, predictable respite configuration however it does aim to share the noise by relocating the majority of easterly departures to an offset track, rather than climbing straight ahead over the same areas as final approach, as they do today. This option would put all NORBO departures over newly overflown communities as well as the right turn LUSIV/TLA. The L <sub>Amax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality		This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse impact	gas	Our fuel burn assessment (see below) has anticipated that Option A will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.

Section         Observe the Result         Section of Result         Section of Result           Tranquility         Description of Result         To a function of Result         To a function of Result           Tranquility         Tranquility         To a function of Result         To a function of Result           Tranquility         Tranquility         To a function of Result         To a function of Result           Tranquility         Tranquility         To a function of Result         To a function of Result           Tranquility         Tranquility         To a function of Result         To a function of Result         To a function of Result           Tranquility         Tranquility         To a function of Result           Tranquility         Tranquility         To a function of Result           Tranquility         Tranquility         To a function of Result           Tranquility         Tranquility         To a function of Result         To a functio function of Result			some airc minute se	raft will be parations).	able to c This is e	depart in in expected to	tervals 1 m reduce gro	inutes a ound ho	marginally apart (subje Iding which e scenarios	ect to safety in turn will	/ case and reduce gr	d NERL a ound-bas	ability to a	accept 1-
Second			However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand.											
Factor Al Decision with the second			which prov the Airspa decommis	vides resilie ice Modern isions the V	ence. Thi hisation p /ORs. Int	s equipme programme	nt is due to . There is c	be deco currently	ommissione no long te	ed as part o rm <sup>14</sup> resilie	f a NERL	UK wide lasgow's	program SIDs who	ne under en NERL
System         NSA area         NSA area         NSA area         NSA count         National Parks area         DOA count         DOA count         DOA count         DOA count         PARKS area           RTW 05 Baseline (contraine - Optioneering tool)         0         0         0         0         0         2         0.38           Baseline (contraine - Optioneering tool)         0         0         0         0         0         3         0.94           The data shows that there is no change in National Scenic Areas and National Parks overflown. There is a docre that the nature in Onesco we will explore this further at State and this unit intermediate and this option progress. Tech Appendix A contains a map which shows the everflight contair of this option atogside the baseline centrelline cont with rangul 1864 and shows that there is no change in National State at State and State at State at State at St								anquilli	ty based or	the NTK v	ectoring b	aseline a	and if airc	raft were
Spacini       Park and Next and Nex			Table 43 E	asterly depa	arture – Tr	anquil areas	s overflown							
Biodiversity         SAC         SO         O <tho< th="">         O         O</tho<>				-		NSA area	NSA cou					count	DQA are	ea
Second Interview       Display and the second part of the second par			Vectori	ng (NTK d		0	0		0	0		4	0.66	
General Aviation         Access         System         Social Social Protection Network of the social of t		Tranquillity	Baseline	e (Centreli		0	0		0	0		2	0.38	
General Access         Access         Sister of DOAs overflow monopared to the vectoring baseline however there is an increase in the overall all At this stage, the frequency of overflow has not been articulated in the data and this will be important to understitute the frequency of overflow has not been articulated in the data and this will be important to understitute the approxement of this option, yee will explore this option progress. Technic Approxements and any will be able to extrain the coverall at a stage of the approxements. The able 44 biodiversity – areas overflow           Image: the approxement of the approx			Runwa	y 05 Optio	n A	0	0		0	0		3	0.94	
System       SAC       SAC       SAC       SSSI       SSSI       SPA       Indianal National Park       Ist.       Ist.         Biodiversity       Biodiversity       Biodiversity       0       0       24       10.46       11       6.37       0       0       0       0       0         Biodiversity       Biodiversity       Biodiversity       0       0       10       3.31       0 <td< th=""><th></th><th></th><th>At this sta the full ber Appendix with tranque Table 44 s</th><th>ge, the free nefits and i A contains uil sites als shows data</th><th>quency c mpacts c a map w so shown</th><th>of overflight of this optio hich shows</th><th>has not be n; we will e the overfli biodiverse</th><th>een artio xplore tl ght cont</th><th>culated in the further a tour of this of the further a tour of this of the function of the fun</th><th>ne data and It Stage 3 s option along</th><th>this will I hould this gside the t</th><th>be impor option p baseline</th><th>tant to un rogress. 7 centreline</th><th>derstand Fechnical contour,</th></td<>			At this sta the full ber Appendix with tranque Table 44 s	ge, the free nefits and i A contains uil sites als shows data	quency c mpacts c a map w so shown	of overflight of this optio hich shows	has not be n; we will e the overfli biodiverse	een artio xplore tl ght cont	culated in the further a tour of this of the further a tour of this of the function of the fun	ne data and It Stage 3 s option along	this will I hould this gside the t	be impor option p baseline	tant to un rogress. 7 centreline	derstand Fechnical contour,
System       SAC       SAC       SAC       SSB       SSB       SPAR       SPAR <t< th=""><th></th><th></th><th>Table 44 B</th><th>iodiversity –</th><th>areas ov</th><th>erflown</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>			Table 44 B	iodiversity –	areas ov	erflown								
General Aviation       RWY 05 Baseline data       0       0       24       10.46       11       6.37       0       0       0       0         Biodiversity       Biodiversity       Biodiversity       0       0       0       0       10       3.31       0			Sys	tem							Park	park	NSA	NSA area
Biodiversity       RWY 05 Baseline (Controlline - Dotioneering cool)       0       10       3.31       0       0       0       0       0       0         RWY 05 Option A       0       0       16       5.84       4       3.25       0			- Vectori	ing (NTK	0	0	24	10.46	5 11	6.37			0	0
General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained wile visiting CAS whilst offering opportunity to reduce the total volume of CAS.         General Aviation       Access       We created an "illustrative CAS volume" which was a single volume of CAS. We expect the increased effective capacity detailed in the section above will result in a positive economic impact to commercial airfalines.         General Aviation       Economic impact From increased effective capacity       We reated an "illustrative CAS volume" which was a single volume of CAS. We expect the increased effective capacity detailed in the section above will result in a positive economic impact commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a sin NORBO departure track would not deliver the biggest economic benefits.         General Aviation       Fuel burn       Fuel burn       Fuel burn       Fuel burn       Fuel burn       Fuel burn         General Aviation       Respect the sum and the parture options combined to help stakeholder engagement on potential impacts. We have also used this volum compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR to c.47mm <sup>3</sup> smaller.         General Aviation       Fuel burn		Biodiversity	RW Base (Centro Option	Y 05 eline eline – eering	0	0	10	3.31	0	0	0	0	0	0
General Aviation       Access       Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Lower slower aircraft, climbing at below a 6% climb gradient on the CLYDE/LOMON/FOYLE/PERTH SIDs, may over the Marise Burn and Mugdock Wood SSSIs below 2000ft. Given the low overall % of aircraft expected to fit the SI and the vast majority of aircraft will climb above 2000ft before overflying the sites, it is expected that any impacts be very minimal.         General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained wil existing CAS whilst offering opportunity to reduce the total volume of CAS.       Vecume of CAS         General Aviation       Economic impact from increased       We created an "illustrative CAS volume" which was a single volume of CAS. The total volume of the "illustrative" airspace volu compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR vi c.47nm <sup>3</sup> smaller.         General Aviation       We estimate that Option A, when compared to baseline nominal centrelines, will result in a positive economic impact of commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a sir NORBO departure track would not deliver the biggest economic benefits.         Fuel burn       We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improvement track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou however when considered against the overall % movements at GLA, any increase in track					0	0	16	5.84	4	3.25	0	0	0	0
General Aviation       Economic impact from increased effective capacity       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained wite existing CAS whilst offering opportunity to reduce the total volume of CAS. The total volume of CAS. The total volume of the "illustrative" airspace volu commercial air traffic compared effective capacity departure reduction in bottlenecks outside CAS because this option can be contained wite existing CAS whilst offering opportunity to reduce the total volume of CAS. The total volume of the "illustrative" airspace volu compared to existing CAS in the same lateral area is c. 100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR volume effective capacity         General Aviation       Economic impact from increased effective capacity       We estimate that Option A, when compared to baseline do nothing westerly departure baseline. However, having a sin NORBO departure reductions in the baseline do nothing westerly departure baseline. However, having a sin NORBO departure track would not deliver the biggest conomic benefits.         General Aviation Commercial airlines       We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improvement track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO DAK NORBO departure track would not deliver the biggest economic benefits.         Fuel burn       Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A up 50.00 0.81 40.50 49.20 39.85			Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft.											
General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained wite existing CAS whilst offering opportunity to reduce the total volume of CAS.         We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival a departure options combined to help stakeholder engagement on potential impacts. We have also used this volum understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volu compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR view c.47nm <sup>3</sup> smaller.         Kerneral Aviation       Kee expect the increased effective capacity detailed in the section above will result in a positive economic impact c.47nm <sup>3</sup> smaller.         We expect the increased effective capacity detailed in the section above will result in a noverall improvement increased effective capacity       We expect the total option A, when compared to baseline nominal centrelines, will result in an overall improvement track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou however when considered against the overall % movements at GLA, any increase in track miles is outweighed by decreases elsewhere.         Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A       Amm         RWY 05       Baseline (Centreline) nm       Amm         Me spinting       Score       Amm         TRN       50.00       0.81       40.50			Lower slower aircraft, climbing at below a 6% climb gradient on the CLYDE/LOMON/FOYLE/PERTH SIDs, may overfly the Marise Burn and Mugdock Wood SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SIDs and the vast majority of aircraft will climb above 2000ft before overflying the sites, it is expected that any impacts will be very minimal.										he SIDs,	
General Aviation       Access       Option A is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained wi existing CAS whilst offering opportunity to reduce the total volume of CAS.         We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival a departure options combined to help stakeholder engagement on potential impacts. We have also used this volume understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volu compared to existing CAS in the same lateral area is c.100m <sup>3</sup> smaller than currently exists. The Glasgow CTR v c.47nm <sup>3</sup> smaller.         Economic impact from increased effective capacity       We expect the increased effective capacity detailed in the section above will result in a positive economic impact or commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a sin NORBO departure track would not deliver the biggest economic benefits.         We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improvement track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou- however when considered against the overall % movements at GLA, any increase in track miles is outweighed by decreases elsewhere.         Fuel burn       Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A         RWY 05       Baseline (Centreline) Interventione TRN       Among % Weighting % Weighting						erflight of b	iodiverse s	sites usi	ing the full	Glasgow fl	eet mix, a	as part o	f our Full	Options
Aviation       Access       departure options combined to help stakeholder engagement on potential impacts. We have also used this volume understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volu compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR we c.47nm <sup>3</sup> smaller.         Keeneral Aviation       Keeneral Aviation       We estimate that Option A, when compared to baseline nominal centrelines, will result in a positive economic impact or commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a simple of the track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou however when considered against the overall % movements at GLA, any increase in track miles is outweighed by decreases elsewhere.         Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A         RWY 05       Baseline (Centreline) / nm       A         nm       % Weighting       Score         TRN       50.00       0.81       40.50       49.20       39.85			Option A i	s likely to a	contribute						e this opti	on can b	e contain	ed within
General Aviation commercial air       We estimate that Option A, when compared to baseline nominal centrelines, will result in an overall improvement track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou however when considered against the overall % movements at GLA, any increase in track miles is outweighed by decreases elsewhere.         Fuel burn       Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A         RWY 05       Baseline (Centreline) / nm       A         nm       % Weighting       Score         TRN       50.00       0.81       40.50       49.20       39.85		Access	departure understan compared	options co d if there is to existing	mbined t s scope t	o help stak o reduce tl	eholder en ne total vol	gageme	ent on pote CAS. The t	ntial impact otal volume	ts. We have a of the "il	/e also u lustrative	sed this v airspac	olume to e volume
General Aviation / Commercial airlines       Fuel burn       track mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAK LUSIV, TLA and FOYLE routes. There are also small increases to the PERTH, LOMON, CLYDE and ROBBO rou however when considered against the overall % movements at GLA, any increase in track miles is outweighed by decreases elsewhere.         Fuel burn       Table 45 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option A         RWY 05       Baseline (Centreline)         nm       % Weighting         Score       nm         TRN       50.00       0.81         40.50       49.20       39.85		from increased	commercia	al air traffic	c compar	ed with the	e baseline o	do noth	ing westerly	y departure				
Baseline (Centreline)     A       nm     % Weighting     Score       TRN     50.00     0.81     40.50     49.20     39.85	Aviation /		track milea LUSIV, TL however v	age. This o A and FO	option sh YLE route dered ag	ows small es. There a	reductions are also sm	in track all incre	c mileage for eases to the	or the TRN e PERTH, L	, NORBO OMON, (	SUNUK CLYDE a	, NORBO	LAKEY, O routes
RWY 05         nm         % Weighting         Score         nm         Score           TRN         50.00         0.81         40.50         49.20         39.85		Fuel burn	Table 45 T	rack Length				5 Easterl	y Departure	Option A			_	
					nm	%	Weighting			nm				
DEPS NORBO - 112.00 5.75 644.00 103.60 595.70			DEPS	NORBO										

<sup>&</sup>lt;sup>14</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		NORBO	- 440.00	7.00	707.00	400.00	700.04					
		LAKEY	_112.00	7.03	787.36	103.60	728.31					
		LUSIV-DCS		2.34	207.79	87.25	204.17					
		TLA	49.20	0.09	4.43	47.25	4.25					
		PERTH	50.30	0.27	13.58	50.50	13.64					
		FOYLE	19.10	0.18	3.44	18.50	3.33					
		LOMON	20.00	0.45	9.00	20.30	9.14					
		CLYDE	25.00	0.63	15.75	28.80	18.14					
		ROBBO	33.50	0.45	15.08	34.60	15.57					
		Total		-	1740.92		1632.09					
		Given the improveme (subject to the NATS improvement in fuel b Flight procedures are	S NERL ACF urn. In the F	P for the airspa ull Options App	ace above 7000ft), raisal at Stage 3 we	it is anticipa will investiga	ted that this op te track mileage	tion would see a in further detail.				
Commercial airlines	Training costs	their procedures are any additional training	ordingly and u	undertake train								
	Other costs	No other airline costs	No other airline costs are foreseen.									
Airport / Air navigation service	Infrastructure costs	area and noise insula contour area and resi policy now requires fir L <sub>Aeq,16h</sub> noise contour 2022, which will cove will determine if there result of the track are submission, there will The initial deployment	dential proper nancial assist or above. The r the varied p are any inc djustments of be an increa	erties within the tance to be offe erefore, Glasge property types s reases in hous on departure. It ased cost for Gl	e 66dB L <sub>Aeq,16h</sub> contored towards the noi ow Airport are curre situated within the 6 eholds within the 6 f it does and track asgow with regards	our area. The se insulation of ntly developin 3dB contour a 3dB L <sub>Aeq,16h</sub> a adjustments funding their	UK Governmer of residential pro- og a new Noise I area. The LAeg m rea as a result of are proposed Noise Insultation	it's current aviation perties in the 63d nsulation Policy for odelling in Stage of this options as in Glasgow's ACI in Scheme.				
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>15</sup> ;										
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.										
		This option requires a CAA IFP department the aircraft doesn't tu required during IFP g the DER.	wanted a 'not rn before the round valida	t below 500ft <sup>2</sup> fly e end of the run tion to ensure t	vover WP positioned way. PANS OPS d he WP is acceptab	at the Declar oesn't require le, especially	ed End of Runw this. Additional following anothe	ay (DER) to ensure assurances will be er turn shortly afte				
All	Safety	More detailed IFP inv the early left turn dep perhaps of the Twin would not usually be	oartures which otter aircraft	ch is considere for which alter	d achievable for th native tactical arrar	e majority of	Glasgow traffic	with the exception				
		There is a lack of glob left turn NORBO agai between the interaction potentially more CAS	nst the later	turn ROBBO/C	LYDE departure. T	he illustration	s created so far	have at least 6nn				
		There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having an earlier turn to the West on NORBO departures reduces this interaction. Conversely the ROBBO/CLYDE traffic routing further to the East may increase this interaction, albeit above 7000ft.										
All	Interdependencies , conflicts, and trade-offs	This option is expecte ScTMA route design network. In their Stag option is progressed,	but would ne 2A feedbac	ot make the m ck NERL quest	ost of their propose oned the requireme	ed dual south ent for both a	bound track stru LUSIV/TLA SID	acture in the uppe				
		The cumulative effect need to be co-ordinat			a result to CAS din	nensions at G	lasgow, Edinbur	gh and the ScTM				
		CAP1711 describes t	ne objective	as:								
		Deliver quicker, quieto UK airspace.	er, and clean	er journeys and	d more capacity for	the benefit of	those who use a	and are affected b				

All	AMS	This option would support the modernisation of the airspace. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>15</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.9. Runway 05 Easterly Departure Option B

Runway 05 E	asterly Departures	es – Option B	
		Offset left departures with turns at 1nm and 6nm from the runway.         Straight ahead departures with turns at 4nm from the runway.         NORBO is offset left with turn at 1nm         For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	
Group	Impact	Qualitative Assessment	
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise qualitative assessment has considered this modal split with daily movements averaged across the year.	data and
		This option would see some departures offset to the left with turns at c.1nm and c.6nm, and some departures flyin ahead before turning at c.4nm. This would mean that easterly departures would not overfly the same areas as approaches, providing some noise sharing for communities under the final approach. It would however mean t that are not currently overflown frequently by departures will now be overflown on a more frequent basis. Option Overflow (Contours (Blaw with estimated overall departure)	s westerly that areas light tek outline) d % of
		25 TN 2019 baseline summer day o swathe:	
		Figure 18 Easterly Option B Overflight and 2019 baseline NTK data	
Communiti es	Noise impact on health and quality of life	The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In the the NORBO route offsets left and turns at c.1nm, which means that some noise is relocated from communities westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie, however mean that areas that are not currently overflown frequently by departures will now be overflown or frequent basis; the heatmap in Figure 18 shows that the offset left overflies the populated areas of Drumry and	under the . It would on a more nd Faifley. verflight of
		The ROBBO/CLYDE/LOMON/FOYLE/PERTH departures also offset to the left however these departures turn. This again shares noise from communities under the westerly final approach such as Old Drum chapel, E Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated an route initially flies over Drumry and the western parts of Drumchapel before also routing over the western parts of and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The e CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 7000ft. Figure 18 shows that parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population. Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight a	Bearsden, ireas. The Baljaffray equivalent the latter opulation.
		c.4nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before c.4nm rather than 5nm. When reviewed against the heatmap shown in Figure 16, compared to Option A, this ro	

c.4nm rather than 5nm. When reviewed against the heatmap shown in Figure 16, compared to Option A, this route more closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at c.4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route would overfly areas of the city of Glasgow however by turning at 4nm there is more opportunity to avoid the most dense areas of population as aircraft are slightly further north. The route also heads towards the south-east rather than turning south as it does today; this too helps to avoid some of the most dense areas of population however it should be noted that the LUSIV route will overfly the Dennistoun and Craigend areas more frequently than today.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE contour may also extend further over Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option B. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 46 gives an overview of Option B overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline

data, the area of the contours reduces and there is also a decrease in the number of population overflown compared to the centreline data. This can be attributed to the LUSIV/TALLA SID turning at 4nm and aiming to avoid areas of dense population.

Table 46 Easterly departures option B overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option B	174.94	169398

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools overflown compared to the centreline baseline. The number of hospitals remains the same and the cares homes and places of worship reduces. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

In our Stage 2A engagement, the Mains Estate Residents' Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are any adverse effects as a result of aircraft overflight.

### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option B against the centreline baseline. These 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 47 shows an decrease in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

### Table 47 60dB and 65dB L<sub>Amax</sub> Data – Rwy05 Dep Option B

	60dE	3 L <sub>Amax</sub>	65dB L <sub>Amax</sub>			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option B	349.85	369502	125.22	141512		

### 

The easterly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces offset departures and turns at 4nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

## Noise Mitigation

The option does not offer an alternative, predictable respite configuration however it does aim to share the noise by

		relocating the majority of easterly departures to an offset track, rather than climbing straight ahead over the same areas as final approach as they do today. This option would put all NORBO departures over newly overflown communities. The L <sub>Amax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option B will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider Society	Capacity / resilience	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.

			r, like today, the demand.	nis option ha	as all NOR	BO depart	ures on one	e initial route	which we	ould not	cater for	<sup>r</sup> future	pea
		The intro provides Airspace decomm	oduction of PBN resilience. Th Modernisatio hissions the VC hdrawal progra	nis equipmer n programm NRs. Introduc	nt is due to ne. There	be decon is currently	nmissioned y no long	as part of a term <sup>16</sup> resilie	NERL UI ence for (	K wide p Glasgow'	orogramn 's SIDs	ne unde when N	er th
			3 shows data o lasgow's existii			s of tranqu	illity based o	on the NTK v	vectoring b	baseline	and if air	craft we	ere
		Table 48	Easterly departu	ıre – Tranquil	areas overfl	own							
			System	NSA a	irea NSA	A count	National Parks count	National Parks area		count	DQA ar	ea	
			<sup>7</sup> 05 Baseline – ring (NTK data			0	0	0	2	4	0.66		
	Tranquillity		RWY 05 ne (Centreline oneering tool)			0	0	0		2	0.38		
		Runw	ay 05 Option	<b>B</b> 0		0	0	0	3	3	1.01		
		the num this stag benefits A contain sites also	a shows that th ber of DQAs o le, the frequence and impacts of ns a map which o shown.	verflown cor cy of overflig f this option; h shows the	mpared to t ht has not l we will exp overflight c	he vectorir been articu lore this fu ontour of th	ng baseline Ilated in the rther at Stag nis option al	however the data and this ge 3 should th ongside the b	re is an ir s will be ir his option baseline c	ncrease i mportant progress entreline	in the over to under s. Techni e contour,	erall are stand th cal Appe with tra	ea. ne f enc anq
			) shows data o lasgow's existii			verse areas	s up to 7000	Oft based on t	the NTK h	ieatmap	and if air	craft we	≱re
		Table 49	Biodiversity – ar	reas overflowr	1								
			/stem a	SAC SA area cou					National Park count	National park area	NSA count	NSA area	
	Biodiversity	– Vecto d	5 Baseline oring (NTK lata)	0 0	) 24	4 10.4	46 11	6.37	0	0	0	0	
		Ba: (Cent Optic	VY 05 seline treline – oneering	0 0	) 1(	) 3.3	1 0	0	0	0	0	0	
			ool) 5 Option B	0 0	) 16	5 5.9	3 4	3.25	0	0	0	0	
			000ft no overfl nd Sites of Spe							ational Pa	arks, Na	tional So	cer
		the Maris	lower aircraft, o se Burn and M majority of airc	ugdock Woo	d SSSIs be	low 2000ft	. Given the	low overall %	of aircraf	ft expecte	ed to fly t	he SIDs	s, a
		at Stage		_			-	-	-				
			B is likely to co CAS whilst offe						use this o	ption car	n be con	tained v	vith
General Aviation	Access	options of there is s	ted an "illustrat combined to he scope to reduce he same latera	elp stakehold the total vol	ler engagei lume of CAS	ment on po S. The total	otential impa l volume of t	acts. We have he "illustrative	e also use e" airspac	ed this vo e volume	olume to u	understa ed to exi	anc
	Economic impact from increased effective capacity	commer	ect the increase cial air traffic o departure trac	compared w	ith the bas	eline do n	othing wes	terly departu					
General		mileage. FOYLE r	nate that Optio This option sh routes. There a red against the re.	nows small r ire also smal	eductions i l increases	n track mil to the LUS	eage for the IV, PERTH,	∋ TRN, NORI LOMON, CL	BO SUNL YDE and	JK, NOR ROBBO	BO LAK	EY, TLA owever \	A a wh
Aviation / Commercia		Table 50	Track Length Ca	alculations – F	Fuel Burn RV	VY 05 Easte	erly Departure						
airlines	Fuel burn	RWY 05	;	Baseline ( nm	(Centreline % Weig		Score	B nm	Scor	'e			
			TRN	50.00	0.81		40.50	49.20	39.85				
		DEPS	NORBO SUBUK NORBO	<sup>-</sup> 112.00	5.75		644.00	103.60	595.7				
			LAKEY LUSIV-DCS	112.00 88.80	7.03 2.34		787.36 207.79	103.60 89.10	728.3 208.4				
			TLA	49.20	0.09		4.43	48.20	4.34				_

<sup>&</sup>lt;sup>16</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		PERTH	50.30	0.27	13.58	50.50	13.64				
		FOYLE	19.10	0.27	3.44	18.50	3.33				
		LOMON	20.00	0.45	9.00	20.30	9.14				
		CLYDE	25.00	0.63	15.75	28.80	18.14				
		ROBBO	33.50	0.45	15.08	34.60	15.57	-			
		Total			1740.92		<mark>1636.51</mark>				
		Given the improveme to the NATS NERL A burn. In the Full Optio	CP for the ai	rspace above 7 I at Stage 3 we	000ft), it is anticipat will investigate trac	ed that this op k mileage in fi	otion would see a urther detail.	n improvement in			
Commercia airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.									
	Other costs	No other airline costs are foreseen.									
Airport / Air navigation	Infrastructure costs	Glasgow currently ope and noise insulation s and residential proper financial assistance to or above. Therefore, C varied property types increases in househo departure. If it does an Glasgow with regards	chemes for s ties within th b be offered Glasgow Airp situated with lds within th nd track adju	sensitive buildin the 66dB LAeq,16h towards the noi port are currently hin the 63dB col e 63dB LAeq,16h stments are pro	gs, such as schools contour area. The U se insulation of res / developing a new ntour area. The LAec area as a result of posed in Glasgow's	s and hospital K Governmer idential prope Noise Insulati modelling in this options a	s, within the 63dB off s current aviation off s current aviation off s current aviation off s current aviation of s current aviation of the s current aviation of the s current aviation of the s current aviation of the s current aviation of the s current aviation of the s current aviation of the s curren	B $L_{Aeq,16h}$ contour a on policy now requ $L_{Aeq,16h}$ noise con 2, which will cover rmine if there are track adjustments			
ervice provider		The initial deployment	t phase of th	e ACP may req	uire some ATC syst	tem engineeri	ng amendments.				
	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>17</sup> .									
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.									
A II	Safety	This option requires a IFP department want aircraft doesn't turn be during IFP ground val More detailed IFP inve early left turn departu the Twin Otter aircraft be expected to operat There is a lack of glob turn NORBO against the interactions but if to CAS.	ed a 'not be efore the end idation to en estigation su res which is for which al te on the NO bal/UK PBN F the later turn this is deeme	low 500ft; flyove d of the runway. sure the WP is oggests a minim considered ach ternative tactica RBO SIDs. Route Spacing C ROBBO/CLYD ed not sufficient,	er WP positioned a PANS OPS doesn acceptable, especia um climb gradient of evable for the majo I arrangements ma Guidance for some of E departure. The ill a wider turn would	t the Declared 't require this. ally following a of 5.7% climb ority of Glasgo y be required of the interactions cre be required in	d End of Runway Additional assura another turn short gradient is require ow traffic with the however that airc tons in this option ated so far have ncurring more CO	<ul> <li>(DER) to ensure ances will be required up to 1400ft on exception perhaperaft would not usuing the early at least 6nm betwing and potentially metal contract of the early and potential co</li></ul>			
AII	Interdependenci es, conflicts, and trade-offs	There are no interdep 7000ft however East departures. Having a ROBBO/CLYDE traffie This option is expecte ScTMA route design, In their Stage 2A fee progressed, we will ex The cumulative effect to be co-ordinated and	terly departu an earlier tu c routing furt ed to be pos but would no dback NERL kplore the ab on other airs d considered	ures are some urn to the We her to the East ssible within the tot make the mos questioned the bility to remove of space users as a d.	imes required to st on NORBO de may increase this in existing network b t of their proposed o e requirement for b one of these SIDs in	be 'stepped partures redu nteraction, alb but can also b dual southbou ooth a LUSIV/ n Stage 3.	up' underneath uces this interac eit above 7000ft. e accommodated nd track structure TLA SID in the f	Edinburgh's GOS tion. Conversely d within NERL's F in the upper netw uture. If this optio			
		CAP1711 describes the Deliver quicker, quiete airspace.	-		more capacity for	the benefit of	those who use a	nd are affected by			
AII	AMS	This option would sup reductions, provide so single NORBO depar concentrate noise from	ome relief fro ture route d	om noise to thos oes not meet fi	se most frequently uture demand and	overflown by therefore offe	Glasgow arrivals or the most econo	and departures b			

	This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>17</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.10. Runway 05 Easterly Departure Option C

Runway 05 I	Easterly Departure	es – Option C
		Offset left departures with turns at 1nm and 6nm from the runway.         Straight ahead departures with turns at 4nm from the runway.         For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitati assessment has considered this modal split with daily movements averaged across the year. This option would see all departures initially fly straight ahead before turns at 1nm, 3nm and 6nm from the runway. Toda the majority of departures fly straight ahead until at least 5nm before turning and therefore turns at 1nm and 3nm are change from current day. As aircraft will fly straight ahead, communities living under the final approach will be overflown both arrivals and departures.
Communiti es	Noise impact on health and quality of life	<ul> <li>Figure 19 Easterly Option C Overflight and 2019 baseline NTK data</li> <li>The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option the NORBO route turns at 1nm, which means that some noise is relocated from communities under the westerly fir approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatm data (Figure 19) suggests that a left turn at 1nm would overfly the populated areas of Drumry and Faifley. Beyond this pot the route, which would account for around 13% of overall departures, largely avoids the overflight of populated areas w the exception of Milton and western parts of Bowling.</li> <li>The ROBBO/CLYDE/LOMON/FOYLE departures fly straight ahead before turning left at 6nm. This means that they over the same areas as the final approach track before turning and up to around 5nm, this reflects what happens today. Figure 19 shows today's vectoring swathe turning at around 5nm and therefore a turn at 6nm will result in some areas not current overflown being overflown in future however the population data suggests that these areas have very low population lever The PERTH, which accounts for less than 1% of Glasgow's overall departures, flies straight ahead overflying the same area sparsely populated.</li> <li>Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 3r before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning at 3r rather than 5nm. This results in overflight of some areas that are already overflow needs the would be at a high frequency in future. Beview of the population shat are already overflow the some track as today before turning at an portil would overfly the some areas that are already overflow today however this would be a</li></ul>

where there is a high density of population. Although this is not dissimilar to what happens today (the heatmap shows a large swathe across parts of the city), in future concentration of overflight would occur. The latter parts of the routes will overfly dense areas of population not typically overflown by easterly departures today.

frequency in future. Review of the population data shows that this route would overfly large areas of the city of Glasgow

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option C. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 10 Westerly departures baseline overflight data 51 gives an overview of the Option C overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contours reduces however there is an increase in the number of population overflown compared to the centreline data. This can be attributed to the earlier turns than today and the LUSIV/TALLA SID turning at 3nm and routing over the centre of Glasgow.

Table 51 Easterly departures option C overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option C	172.34	251000

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of schools overflown compared to the centreline data. The number of hospitals, care homes and places of worship increases. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

### 60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option C against the centreline baseline. These 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 52 shows an increase in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 52 60dB and 65dB L<sub>Amax</sub> Data – Rwy05 Dep Option C

	60dE	B L <sub>Amax</sub>	65dB	LAmax
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option C	339.28	453932	121.06	175911

### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces turns at 1nm, 3nm and 6nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, due to the turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the left may result in the component part of the contour extending further to the northwest to reflect the earlier turn; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the turns at 1nm, 3nm.

### **Noise Mitigation**

Air Quality

The option does not offer an alternative, predictable respite configuration and would continue to see all departures (except NORBO) to climb straight ahead as today. The early left turn on NORBO departures would reduce the volume of traffic that climbs straight ahead however it would be positioned over newly overflown communities as well as the right turn LUSIV/TLA. The L<sub>Amax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.

This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.

	compared to the contribution of road traffic to local air quality.					
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option C will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.				
/ider ociety	Capacity / resilience	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace				
		Modernisation programme. There is currently no long term <sup>18</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NERL's VOR withdrawal programme.				

<sup>&</sup>lt;sup>18</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Table 53 Easterly departure – Tranquil areas overflown										
		System		NSA area	NSA cou		tional s count	National Parks area	DQA	count	DQA ar	ea
		RWY 05 Base Vectoring (NT	( data)	0	0		0	0		4	0.66	
	Tranquillity	RWY 05 Baseline (Centr Optioneering	reline –	0	0		0	0		2	0.38	
		Runway 05 Op	tion C	0	0		0	0		3	0.94	
		The data shows the number of DQAs stage, the frequer and impacts of thi a map which show shown.	overflown icy of over s option; w	n compared t flight has no ve will explor	to the vector t been articul e this further	ing base ated in th at Stage	line howe le data ar 3 should	ever there is nd this will be this option p	an incre importa progress	ease in t ant to und . Technic	he overa lerstand t cal Apper	ll area. he full be idix A co
		Table 54 shows of follow Glasgow's	existing S	ID centreline		areas up	o to 7000	ft based on	the NTK	heatma	p and if a	ircraft w
		Table 54 Biodiversi	ty – areas o	overflown								
		System	SAC area		SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area
	Biodiversity	RWY 05 Baselin – Vectoring (NT data)		0	24	10.46	11	6.37	0	0	0	0
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0
		<b>RWY 05 Option</b>	<b>C</b> 0	0	14	5.57	4	3.32	0	0	0	0
		Below 2000ft no Areas and Sites o										
		Option C is likely t CAS whilst offerin						because th	is option	can be c	ontained	within e
General Aviation	Access	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand it there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.										
	Economic impact from increased effective capacity	We expect the inc commercial air tra departure track w	ffic compa	ared with the	baseline do i	nothing w	esterly d					
		We estimate that mileage. This opt TLA routes. There same. When con decreases elsewh	on shows are also sidered a	small reduc	tions in track ses to the F0	c mileage DYLE, LO	e for the T DMON, C	RN, NORB	O SUNU ROBBO I	JK, NORI routes. T	BO LAKE he PERT	Y, LUS H remai
		Table 55 Track Len	gth Calcula	ations – Fuel E	Burn RWY 05	Easterly D	)eparture (	Option C				
		RWY 05	Ba	iseline (Cen	treline)				С			
			nn 50		Weighting	Sco		nm	Scor			
eneral		TRN	50	.00 0.	81	40.5	0	49.40	40.0	1		
viation / commerci		NORBC SUBUK	) – 11	2.00 5.	75	644.	00	103.90	597.4	43		
viation / commerci	Fuel burn		) <sup>–</sup> 11		75 03	644. 787.		103.90 103.90	597.4 730.4			
General Aviation / Commerci al airlines	Fuel burn	SUBUK NORBO	) <sup>-</sup> 11 ) <sup>-</sup> 11 DCS 88	2.00 7. .80 2.			36 79			42 17		

		DEPS	TLA	49.20	0.09	4.43	47.25	4.25	
			PERTH	50.30	0.27	13.58	50.30	13.58	
			FOYLE	19.10	0.18	3.44	20.40	3.67	
			LOMON	20.00	0.45	9.00	24.10	10.85	
			CLYDE	25.00	0.63	15.75	33.10	20.85	
			ROBBO	33.50	0.45	15.08	39.00	17.55	
		Total				1740.92		1642.77	
		Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least 6000ft (subject the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would see an improvement in further burn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.							
Commerci al airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.							
ai airimes	Other costs	No other airline costs are foreseen.							
Airport /	Infrastructure	The initia	l deployment	phase of the	ACP may require	some ATC syst	em engineerii	ng amendments	however beyond this

Air	opoto	there are not expected to be any changes to infractructure for the cirpert or the ANCD
Air navigation service provider	costs	there are not expected to be any changes to infrastructure for the airport or the ANSP. Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the 63dB LAeq, 16h noise contour and therefore not affect Glasgow's noise insultation scheme costs.
	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>19</sup> ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required however that aircraft would not usually be expected to operate on the NORBO SIDs.
All	Salety	There is a lack of global/UK PBN Route Spacing Guidance for some of the interactions in this option. Namely the early left turn NORBO against the later turn ROBBO/CLYDE departure. The illustrations created so far have at least 6nm between the interactions but if this is deemed not sufficient, a wider turn would be required incurring more CO <sub>2</sub> and potentially more CAS.
		There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having an earlier turn to the West on NORBO departures reduces this interaction. Conversely the ROBBO/CLYDE traffic routing further to the East may increase this interaction, albeit above 7000ft.
All	Interdependenci es, conflicts, and trade-offs	This option is expected to be possible within the existing network and can also be accommodated within NERL's FASI ScTMA route design but would not make the most of their proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3.
		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities. This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>19</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.11. Runway 05 Easterly Departure Option D

Runway 05 E	Easterly Departure	es – Option D
		Straight ahead departures only (no offsets) with turns at 1nm, 4nm and 6nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see all departures initially fly straight ahead before turns at 1nm, 4nm and 6nm from the runway. Today, the majority of departures fly straight ahead until at least 5nm before turning and therefore turns at 1nm and 4nm are a change from current day. As aircraft will fly straight ahead, communities living under the final approach will be overflown by both arrivals and departures.
		Option Overflight Contours (Black outline) with estimated % of overall departures
		The second
Communiti es	Noise impact on health and quality of life	Figure 20 Easterly Option D Overflight and 2019 baseline NTK data The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route turns at 1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap data (Figure 20) suggests that a left turn at 1nm would overfly the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 13% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling. This option does not involve any noise sharing/mitigation; therefore these communities will be overflown on a more frequent basis than today.
		The ROBBO/CLYDE/LOMON/FOYLE departures fly straight ahead before turning left at 6nm. This means that they overfly the same areas as the final approach track before turning and up to around 5nm, this reflects what happens today. Figure 20 shows today's vectoring swathe turning at around 5nm and therefore a turn at 6nm will result in some areas not currently overflown being overflown in future, however the population data suggests that these areas have very low population levels. The PERTH, which accounts for less than 1% of Glasgow's overall departures, flies straight ahead overflying the same area as final approach and today's departures. The contour suggests that at 6000-7000ft it may overfly new areas however these are sparsely populated.

Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 5nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning. When reviewed against the heatmap shown in figure 20, compared to Option C, this route more closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 5nm occurring over an area with lower population density as aircraft do today. Beyond the turn, aircraft would fly towards the south-east, rather than turning towards the south/south-west as they do today. This results in avoidance of some of the most densely populated parts of Glasgow city centre although it results in overflight of Bishopbriggs and other densely populated areas of north-east of Glasgow city centre. The NTK heatmaps show that overflight already occurs in these areas today. The latter parts of the LUSIV/TALLA routes at higher altitudes overfly areas not currently overflown by Glasgow departures such as Dennistoun and Craigend.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option D. The vectoring data is not modelled in the same way as the overflight contours; however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 56 gives an overview of the Option D overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contours reduces and there is a decrease in the number of population overflown compared to the

### centreline data.

Table 56 Easterly departures option D overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option D	158.16	158513

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of hospitals, care homes and places of worship being overflown and schools remaining the same for centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

### 60dB and 65dB L<sub>Amax</sub>

Technical Appendix A includes 60dB and 65dB L<sub>Amax</sub> contours which compare Option D against the centreline baseline. These 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 57 shows a decrease in the population within the 60dB L<sub>Amax</sub> contour and an increase in population within the 65dB L<sub>Amax</sub> contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

	60dE	3 L <sub>Amax</sub>	65dB L <sub>Amax</sub>			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option D	320.66	364573	111.91	133584		

#### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  day ime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces turns at 1nm, 3nm and 6nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, due to the turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the left may result in the component part of the contour extending further to the northwest to reflect the earlier turn; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

## **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the turns at 1nm and 3nm.

		<b>Noise Mitigation</b> The option does not offer an alternative, predictable respite configuration and would continue to see all departures (except NORBO) to climb straight ahead as today. The early left turn on NORBO departures would reduce the volume of traffic that climbs straight ahead, however it would be positioned over newly overflown communities. The L <sub>Amax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths are likely to be small compared to the contribution of road traffic to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option D will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider Society	Capacity / resilience	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>20</sup> resilience for Glasgow's SIDs when NERL decommissions the
		VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NERL's VOR withdrawal programme.

<sup>&</sup>lt;sup>20</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Table 58 Easterly departure – Tranquil areas overflown											
		System		NSA area	NSA cou		tional s count	National Parks area	DQA	count	DQA ar	ea	
		RWY 05 Baselin Vectoring (NTK o		0	0		0	0		4	0.66		
	Tranquillity	RWY 05 Baseline (Centrel Optioneering to		0	0		0	0		2	0.38		
		Runway 05 Optio		0	0		0	0		3	1.01		
		The data shows that there is no change in National Scenic Areas and National Parks overflown. There is a decrease in the number of DQAs overflown compared to the vectoring baseline however there is an increase in the overall area. At the stage, the frequency of overflight has not been articulated in the data and this will be important to understand the full benefic and impacts of this option; we will explore this further at Stage 3 should this option progress. Technical appendix A contain a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.											
		Table 59 shows dat follow Glasgow's ex				areas up	p to 7000	ft based on	the NTK	heatma	p and if a	uircraft w	
		Table 59 Biodiversity -	- areas ov	rerflown									
		System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area	
	Biodiversity	RWY 05 Baseline – Vectoring (NTK data)	0	0	24	10.46	11	6.37	0	0	0	0	
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0	
		<b>RWY 05 Option D</b>	0	0	14	5.66	4	3.32	0	0	0	0	
		Below 2000ft no ov Areas, and Sites of S											
Conorol		Option D is likely to o CAS whilst offering						because th	is option	can be c	ontained	within e	
General Aviation	Access	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departur options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existin CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.											
	Economic impact from increased effective capacity	We expect the increased effective capacity detailed in the section above will result in a positive economic impact on commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a single NORBC departure track would not deliver the biggest economic benefits.											
		We estimate that O mileage. This option routes. There are al the same. When co decreases elsewher	n shows so small nsidered	small reduction	ctions in trac o the LUSIV	ck milea , FOYLE	ge for the E, LOMON	TRN, NOR , CLYDE a	RBO SUN	NUK, NC 30 route:	RBÓ LA s. The PE	KEY an ERTH re	
		Table 60 Track Length	n Calculati	ons – Fuel B	urn RWY 05	Easterly [	Departure (	Option D					
		RWY 05		eline (Cent					D				
General		TRN	nm 50.0		Weighting	Sco 40.5		nm 49.40	Scor 40.0 <sup>°</sup>				
viation /		NORBO SUBUK	<sup>-</sup> 112.			644		103.90	40.0 597.4				
ai airiines													
al airlines	Fuel burn	NORBO LAKEY	<sup>-</sup> 112.	.00 7.0	03	787	.36	103.90	730.4	42			
al airlines	Fuel burn	NORBO		30 2.3	34	787 207 4.43	.79	103.90 89.10 48.20	730.4 208.4 4.34				

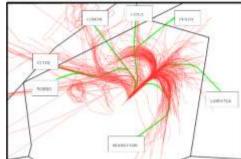
		DEPS	TLA	49.20	0.09	4.43	48.20	4.34			
			PERTH	50.30	0.27	13.58	50.30	13.58			
			FOYLE	19.10	0.18	3.44	20.40	3.67			
			LOMON	20.00	0.45	9.00	24.10	10.85			
			CLYDE	25.00	0.63	15.75	33.10	20.85			
			ROBBO	33.50	0.45	15.08	39.00	17.55			
		Total				1740.92		1647.19			
		Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least 6000ft (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would see an improvement in fuel burn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.									
Commerci al airlines	Training costs	procedur	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.								
	Other costs	No other airline costs are foreseen.									
Airport / Air	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.									

	Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the $63dB$ $L_{Aeq,16h}$ noise contour and therefore not affect Glasgow's noise insultation scheme costs.
Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>21</sup> .
Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
Sefety	More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required however that aircraft would not usually be expected to operate on the NORBO SIDs.
Salety	There is a lack of global/UK PBN Route Spacing Guidance for some of the interactions in this option. Namely the early left turn NORBO against the later turn ROBBO/CLYDE departure. The illustrations created so far have at least 6nm between the interactions but if this is deemed not sufficient, a wider turn would be required incurring more CO <sub>2</sub> and potentially more CAS.
	There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having an earlier turn to the West on NORBO departures reduces this interaction. Conversely the ROBBO/CLYDE traffic routing further to the East may increase this interaction, albeit above 7000ft.
Interdependenci es, conflicts, and trade-offs	This option is expected to be possible within the existing network but can also be accommodated within NERL's FASI ScTMA route design but would not make the most of their proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3.
	The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
	CAP1711 describes the objective as:
	Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
AMS	This option would support the modernisation of the airspace. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
	This option could be expected to result in reductions in the volume of Glasgow's CAS.
	costs Deployment costs Safety Interdependenci es, conflicts, and trade-offs

<sup>&</sup>lt;sup>21</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.12. Runway 05 Easterly Departure Option E

Runway 05 Easterl	y Departures – O	ption E
-------------------	------------------	---------



Offset left departures with turns at 1nm from the runway. Straight ahead departures with turns at 2nm and 6.5nm from the runway. NORBO is straight ahead to 2nm with a right turn. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

4	7/11	
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see some departures offset to the left with turns at 1nm, and some departures flying straight ahead before turning at 2nm and 6.5nm. Today, the majority of departures fly straight ahead until at least 5nm before turning and therefore the offset departures and turns at 2nm are a change from current day. As around 15% if aircraft will fly straight ahead, communities living under the final approach will be overflown by both arrivals and departures.
		20
		Figure 21 Easterly Option E Overflight and 2019 baseline NTK data
Communiti es	Noise impact on health and quality of life	The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route turns right at 2nm which is a change from the left turn today at 5nm today. This means that some noise is relocated from communities under the westerly final approach such as the northern parts of Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas of high population that are not currently overflown frequently by departures will now be overflown on a more frequent basis by 13% of overall traffic. The heatmap data (figure 21) shows that this overflight would occur over large parts of the city of Glasgow.
		The LUSIV route, which accounts for around 2% of Glasgow's overall departures, flies straight ahead overflying the same area as final approach and today's departures before turning at 6.5nm to head east. The contour suggests that it will route over areas already overflown today and will overfly the densely populated areas of Lennoxtown and Milton of Campsie.
		The ROBBO/CLYDE/LOMON/FOYLE departures all offset left before turning at 1nm. This means that around 4-5% of departures will no longer fly along the final approach resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in figure 21 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently frequently overflown below 7000ft.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the NORBO contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option E. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 61 gives an overview of the Option E overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour increases as does the number of population overflown compared to the centreline data. This can be attributed to the overall increase in contour area and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 61 Easterly departures option E overflight data								
System	Area (km²)	Population						
RWY 05 Baseline Vectoring (NTK data)	246.99	364763						
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213						
RWY 05 Option E	232.04	249498						

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

## 60dB and 65dB L<sub>aMax</sub>

Technical Appendix A includes 60dB and 65dB  $L_{aMax}$  contours which compare Option E against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 62 shows an increase in the population within the 60dB  $L_{aMax}$  contour and 65dB  $L_{aMax}$  contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 62 60dB and 65dB LaMax Data – Rwy05 Dep Option E

	60dE	3 L <sub>aMax</sub>	65dB	LaMax
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option E	427.82	468436	162.05	195679

# LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  daytime and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm and straight-ahead departures with turns at 2nm and 6.5nm and therefore the option deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, due to the offset and turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the right may result in the component part of the contour extending further to the southeast to reflect the earlier turn; this may result in northern parts of Westerton moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

### **Noise Mitigation**

Air Quality

The option does not offer an alternative, predictable respite configuration. The majority of the SIDs in this option overfly new communities with the right turn, single NORBO SID potentially having the biggest effect in terms of increasing the numbers of people overflown with a relatively high frequency.

This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below that these changes are likely to be small to be small to be another the straight and the straight to be small to be a change it to be another the straight to be small to be another the straight and the straight to be small to be another the straight to be another the straight to be another the straight to be small to be another to be straight to be small to be another to be straight to be small to be another to be straight to be straight to be small to be another to be straight to be

		compared to the contribution of road traffic to local air quality.
Wider <b>Society</b>	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option E will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity / resilience	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand.
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>22</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NER's VOR withdrawal programme.

<sup>&</sup>lt;sup>22</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Table 63 shows dat				tranquillit	y based o	n the NTK	vectoring	g baseline	and if a	ircraft we	
		follow Glasgow's existing SID centrelines: Table 63 Easterly departure – Tranquil areas overflown Option E											
			arture – 1	·		Na	ational	Nationa					
		System RWY 05 Baselin		NSA area	NSA co		s count	Parks are		count	DQA ar	ea	
	Tranquillity	Vectoring (NTK d RWY 05		0	0		0	0		4	0.66		
		Baseline (Centrel Optioneering to		0	0		0	0		2	0.38		
		Runway 05 Optic		2.91	1		1	14.3		2	1.27		
		The data shows that compared to the vec Appendix A contains tranquil sites also sh	toring da a map v	ata however	this data c	loes not ta	ake into ac	count frequ	uency of c	overflight a	at this sta	age. Tecl	
		Table 64 shows data follow Glasgow's exi				e areas u	p to 7000	ft based or	the NTK	(heatmap	and if a	ircraft we	
		Table 64 Biodiversity -	areas ou	/erflown Optic	on E								
		System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area	
	Biodiversity	RWY 05 Baseline Vectoring (NTK data)	0	0	24	10.46	11	6.37	0	0	0	0	
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0	
		RWY 05 Option E	1	0.46	22	12.6	9	7.73	1	14.3	1	2.91	
		Below 2000ft no over Areas, and Sites of S											
General Aviation	Access	of CAS. The Northbo ScTMA 7 in accorda "illustrative CAS volu is unlikely to happer anyway, therefore of We created an "illus options combined to there is scope to red CAS in the same late	Areas, and Sites of Special Scientific Interests is expected which would offer some small benefits compared to the baseline. The design option may require changes to the existing CAS boundaries but still offers potential to reduce the total volum of CAS. The Northbound SIDs on this option with the 7% climb gradient as illustrated would not quite be contained withi ScTMA 7 in accordance with the CAA CAS containment policy. However, this assessment (together with creation of the "illustrative CAS volume") assumed the northbound SIDs terminate at 7000ft and are all wholly contained within CAS whic is unlikely to happen in reality because 7000ft does not exist in Airspace Design terms and these routes are leaving CAS anyway, therefore offering more protection than today is potentially not proportionate. We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand there is scope to reduce the total volume of CAS. The total volume of the "illustrative CAS volume" compared to exist CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.										
	Economic impact from increased effective capacity	commercial air traffic	We expect the increased effective capacity detailed in the section above will result in a positive economic impact or commercial air traffic compared with the baseline do nothing westerly departure baseline. However, having a single NORBC departure track would not deliver the biggest economic benefits.										
		We estimate that Op mileage. This option and ROBBO routes. against the overall %	h shows There a	small reduc	tions in tra creases to	ick mileag the TRN,	e for the I LUSIV, T	NORBO SI LA, PERTI	JNUK, N H, and LC	ORBO LA DMON rou	KEÝ, FO utes. Wh	OYLE, Cl en consi	
		Table 65 Track Length	n Calculat	tions - Fuel B	urn RWY 05	5 Easterly L	Departure C	Option E					
		RWY 05		seline (Cen					E				
			nm		Weighting	-		nm	Scol				
General Aviation /		TRN NORBO SUBUK		00 0.8 2.00 5.7		40.5 644		50.70 104.20	41.0 599.				
Commerci al airlines		NORBO LAKEY	112	2.00 7.0	03	787	.36	104.20	732.	53			
	Fuel burn	LAKEY											

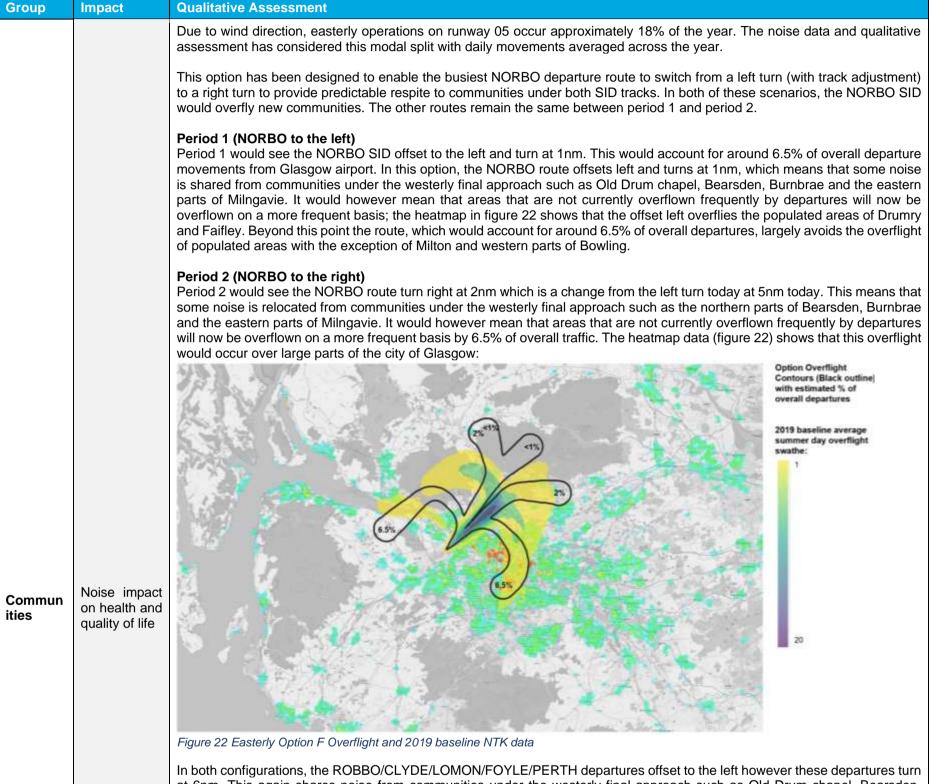
al airlines	Fuelburg		NORBO LAKEY	112.00	7.03	787.36	104.20	732.53			
	Fuel burn		LUSIV-DCS	88.80	2.34	207.79	104.20	243.83			
		DEPS	TLA	49.20	0.09	4.43	51.10	4.60			
			PERTH	50.30	0.27	13.58	52.20	14.09			
			FOYLE	19.10	0.18	3.44	17.60	3.17			
			LOMON	20.00	0.45	9.00	20.30	9.14			
			CLYDE	25.00	0.63	15.75	19.10	12.03			
			ROBBO	33.50	0.45	15.08	23.30	10.49			
		Total				1740.92		1670.09			
	Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least 60 the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would see an improburn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.										
Commerci al airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.									
	Other costs	No other airline costs are foreseen.									

Airport / Air navigation service	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L <sub>Aeq,16h</sub> contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L <sub>Aeq,16h</sub> contour area and residential properties within the 66dB L <sub>Aeq,16h</sub> contour area. The UK Government's current aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L <sub>Aeq,16h</sub> noise contour or above. Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will cover the varied property types situated within the 63dB contour area. The L <sub>Aeq</sub> modelling in Stage 3 will determine if there are any increases in households within the 63dB L <sub>Aeq,16h</sub> area as a result of this options as a result of the track adjustments on departure. If it does and track adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow with regards funding their Noise Insultation Scheme. The initial deployment phase of the ACP may require some ATC system engineering amendments.					
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>23</sup> ;					
	Deployment costsThis option is expected to require air traffic controller training for the controllers and assistants located a and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Sta Appraisal when we are appraising our shortlist of options and once further information is known about to 7000ft and interdependencies with Edinburgh.						
AII	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER. More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required.					
AII	Interdependenci es, conflicts, and trade-offs	There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having a slightly earlier turn to the West on NORBO departures reduces this interaction. Conversely the LUSIV/TLA traffic routing further to the East may increase this interaction, albeit above 7000ft. This option is not expected to be possible within the existing network as it could require a move of the LANAK hold. It would not make the most of NERL's proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3. The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.					
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate CO <sub>2</sub> reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities. This option could be expected to result in reductions in the volume of Glasgow's CAS.					

<sup>&</sup>lt;sup>23</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.13. Runway 05 Easterly Departure Option F

Runway 05 Easterly Departures – Optic		
	<ul> <li>This option shares NORBO traffic between a left and right turn with only one of those routes in use at a time. The rest of the routes remain in the same configuration.</li> <li>When turning left, the NORBO would offset left then turn further left at 1nm</li> <li>When turning right, the NORBO would go straight ahead to 2nm then a right turn.</li> <li>For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.</li> <li>Period 1 (Left), Period 2 (Right)</li> </ul>	
One liter the		



at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The routes initially overfly Drumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 6000-7000ft. Figure 22 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

The LUSIV route, which accounts for around 2% of Glasgow's overall departures, flies straight ahead overflying the same area as final approach and today's departures before turning at 6.5nm to head east. The contour suggests that it will route over areas already overflown today and will overfly the densely populated areas of Lennoxtown and Milton of Campsie.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the right turn NORBO contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend over further parts of Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option F. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 66 gives an overview of the Option F overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created

by having alternative respite configurations and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 66 Easterly departures option F overflight data

System	Area (km²)	Population	
RWY 05 Baseline— Vectoring (NTK data)	246.99	364763	
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213	
RWY 05 Option F	203.99	246626	

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

In our Stage 2A engagement, the Mains Estate Resident Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

### 60dB and 65dB LaMax

Technical Appendix A includes 60dB and 65dB  $L_{aMax}$  contours which compare Option F against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 67 shows an increase in the population within the 60dB  $L_{aMax}$  contour and 65dB  $L_{aMax}$  contour. This can be partially attributed to introducing an alternative respite route and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight.

Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

### Table 67 60dB and 65dB L<sub>aMax</sub> Data – Rwy05 Dep Option F

	60dI	B L <sub>aMax</sub>	65dB L <sub>aMax</sub>	
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option F	386.14	453065	147.12	200769

### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  day time and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm and straight ahead departures with turns at 2nm and 6.5nm and therefore the option deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

### Noise Mitigations

The option offers an alternative respite configuration via two NORBO SIDs which could be alternated. For the purposes of this

		IOA we have assumed that this is split 50/50 between the two SIDs on a daily basis however this can be explored in further detail with stakeholders as part of the Stage 3 consultation if this option progresses. Our overflight and $L_{aMax}$ data has shown an increase in the overall population and noise sensitive sites overflown however the impacts of noise are now shared and so there are decreases in the frequency of overflight where the frequency of overflight is currently high. This is something that was requested by stakeholders and formed part of the design principles. The benefits and impacts of this would require further quantitative analysis as part of the Stage 3 Full Options Appraisal should this option progress.
	Air Quality	This option has a change to how some aircraft will fly laterally below 1,000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1,000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1,000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option F will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity / resilience	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1 minute separations). This is expected to reduce ground holding which in turn will reduce ground based emissions and delays. The benefits of this will be

		seen particularly in future scenarios with increased traffic levels. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>24</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NER's VOR withdrawal programme										
		Table 68 shows data on Glasgow's existing SID o		of areas of t	ranquillity	based on	the NTK ve	ectoring b	baseline	and if aire	craft wer	e to f
		Table 68 Easterly departure – Tranquil areas overflown Option F										
		System	NSA area	a NSA co		ational ks count	National Parks are	a DQA	count	DQA ar	ea	
		RWY 05 Baseline Vectoring (NTK data)	0	0		0	0		4	0.66		
	Tranquillity	RWY 05 Baseline (Centreline - Optioneering tool)	- 0	0		0	0		2	0.38		
		Runway 05 Option F	0	0		0	0		2	1.27		
		The data shows that the number of DQAs overflor the frequency of overflig impacts of this option; we which shows the overflig	wn compared ht has not be e will explore ht contour of	to the vecto een articulate this further a this option al	ring base ed in the o it Stage 3 ongside tl	line howev data and th should this ne baseline	er there is his will be is s option pro e centreline	an increa mportant ogress. To contour,	ase in the to unde echnical with trai	e overall a erstand th appendix nquil sites	area. At le full be A conta s also sh	this stenefits ains a own.
		Table 69 shows data on Glasgow's existing SID o		of biodiverse	e areas up	) to 7000ft	based on t	he NTK h	ieatmap	and if air	craft wer	e to fe
		Table 69 Biodiversity - area	s overflown Op	otion F								
		System ar	AC SAC ea count	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area	
		RWY 05 Baseline Vectoring (NTK data)	0 0	24	10.46	11	6.37	0	0	0	0	
	Biodiversity	Optioneering tool)	) 0	10	3.31	0	0	0	0	0	0	
		RWY 05 Option F	0 0	17	6.16	4	3.25	0	0	0	0	
		Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Area and Sites of Special Scientific Interests is expected for the vast majority of aircraft.										
		Lower slower aircraft, cl Marise Burn and Mugdoo majority of aircraft will cli	ck Wood SSS	Is below 200	0ft. Giver	the low o	verall % of	aircraft e	xpected	to fly the	SIDs, ar	nd the
		We will fully quantify the Stage 3.	overflight of	biodiverse si	tes using	the full Gla	asgow fleet	mix, as	part of o	ur Full O	ptions A	pprais
		Option is likely to contribute whilst offering opportunit					ecause this	s option c	an be co	ontained v	vithin ex	isting
General Aviation	Access	Whist one mig opportunity to reduce the total volume of CAS. We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival options combined to help stakeholder engagement on potential impacts. We have also used this volume to und is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.							understa	nd if t		
	Economic impact from increased effective capacity	We expect the increased air traffic compared with would not deliver the big	effective cap the baseline o	acity detailed	d in the se	ction abov	e will result	in a posi	tive ecor	nomic imp		
		We estimate that Option mileage. This option sho There are also small incr SIDs means that when c the decreases elsewhere	ows reduction eases to the l onsidered ag	s in track m _USIV, TLA,	ileage for PERTH, l	the TRN, OMON, C	NORBO S	UNUK, N ROBBO	IORBO I routes. T	LAKEY a he reduc	nd FOY tion in th	LE rou le NOI

	the decreases elsewhere.											
General Aviation /		Table 70 Track Length Calculations Fuel Burn RWY 05 Easterly Departure Option F										
Commer				Baseline (Centreline)					F			
cial airlines		RWY 05	)	nm	% Weighting	Score	nm P1	nm P2	Average	Score		
	Fuel burn	DEPS	TRN	50.00	0.81	40.50	49.20	50.70	49.95	40.46		
			NORBO SUBUK	112.00	5.75	644.00	103.90	104.20	104.05	598.29		
			NORBO LAKEY	112.00	7.03	787.36	103.90	104.20	104.05	731.47		
			LUSIV-DCS	88.80	2.34	207.79	98.00	98.00	98.00	229.32		
			TLA	49.20	0.09	4.43	51.10	51.10	51.10	4.60		
			PERTH	50.30	0.27	13.58	50.50	50.50	50.50	13.64		
			FOYLE	19.10	0.18	3.44	17.60	17.60	17.60	3.17		
			LOMON	20.00	0.45	9.00	20.30	20.30	20.30	9.14		

<sup>&</sup>lt;sup>24</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

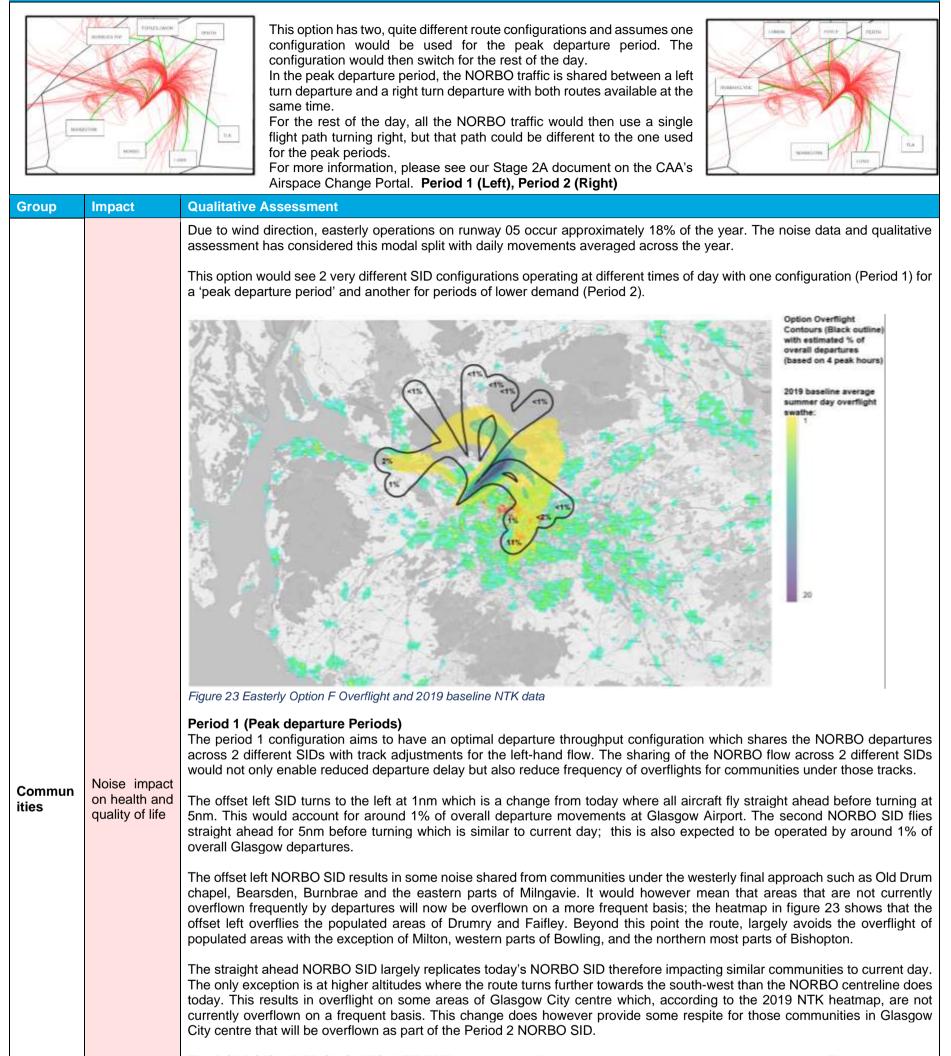
			CLYDE	25.00	0.63	15.75	28.80	28.80	28.80	18.14			
		Total	ROBBO	33.50	0.45	<u>15.08</u> 1740.92	34.60	34.60	34.60	<u>15.57</u> 1663.79			
		Given th	NERL ACP for	the airspace	e above 7000ft),	aspiration for all aird it is anticipated that ite track mileage in	t this option v	vould see an ir					
Commer cial	Training costs	Flight p	rocedures are	e updated or gly and unde	introduced worl	dwide as part of ar required. This west	n AIRAC cyc	le. As part of t					
airlines	Other costs	No othe	er airline costs	are foresee	n.								
Airport / Air navigatio	Infrastructure costs	noise ir resident assistar Therefo types si within th adjustm Noise Ir	nsulation sche tial properties nee to be offe ore, Glasgow A tuated within t he 63dB LAeq, nents are prop nsultation Sch	emes for ser within the 66 ered towards Airport are cu he 63dB con 16h area as a osed in Glas eme.	nsitive buildings, 6dB L <sub>Aeq,16h</sub> contr 5 the noise insu irrently developir tour area. The L 1 result of this op gow's ACP subr	on scheme for resid such as schools a our area. The UK G lation of residential ng a new Noise Insu Aeq modelling in Stag otions as a result o nission, there will be	and hospitals overnment's I properties i ulation Policy ge 3 will deter f the track ac e an increase	s, within the 6 current aviation n the 63dB L/ for 2022, which mine if there a djustments on ed cost for Glas	3dB L <sub>Aeq,16h</sub> co on policy now re Aeq,16h noise cor h will cover the re any increase departure. If it sgow with regar	ntour area and quires financial ntour or above. varied property s in households does and track			
n service provider	Operational costs	remove	The initial deployment phase of the ACP may require some ATC system engineering amendments. This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs emoves Glasgow's dependency on conventional ground based navigation equipment (VORs), which contributes to a reduction n NERL's operational costs as it enables VOR rationalisation <sup>25</sup> ;										
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh. Owing to the respite configuration, there may be more training required for this option compared to other options that form part of this IOA.											
AII	Safety	departm turn bef validation More de left turn Otter ain operate There is NORBC interaction A SID s that per a SID ur hazards are not issues a *As an complet same p the SID	nent wanted a fore the end o on to ensure the etailed IFP involution departures w rcraft for which a on the NORE is a lack of glob D against the ions but if this structure from thaps a much tilisation would is to the operat just associated associated witt example, miti- tely different in laces in the ne-	not below 50 f the runway ne WP is acc estigation su hich is cons n alternative 30 SIDs. bal/UK PBN later turn R is deemed r the same ru more subtle d change sig ion which at d with aircra h ATC confu gations iden ames. Howe etwork are re oint.	Doft flyover WP p 2. PANS OPS do 2. peptable, especial 2. iggests a minimu- idered achievable tactical arranger Route Spacing ( OBBO/CLYDE not sufficient, a v nway which change a change to a SII phificantly from a this stage canno ft inadvertently f rision. tified for SIDs se ever flight planni equired to termin	ture. These are pos positioned at the De- positioned at the um climb gradient of left for the majority of ments may be requi Guidance for some departure. The illus vider turn would be inges during the da D structure can be left turn to a right to to considered to be lying (or being issues mate at the same po- posfic with routes to	eclared End o Additional as er turn shortly of 5.7% climb of Glasgow the red however of the interact strations creat required incu- y is uncharted safely accomdurn (or vice-ver mitigated with ed) the wrong mental different previously ico int which in t	f Runway (DE surances will after the DEF gradient is rec raffic with the that aircraft we stions in this op ated so far ha urring more CC ered territory for modated, ATC rersa) immedia hout introducir g SIDs and the nt directions a dentified by NE urn would mea	R) to ensure the be required dur R. quired up to 140 exception perha- build not usually otion. Namely the twe at least 6m D <sub>2</sub> and potential or the UK. Whils C advised that a ately after depar- mg other issues* wrong time of co- fter departure of an similar SID m	e aircraft does"t ing IFP ground Oft on the early aps of the Twin be expected to the early left turn m between the ly more CAS. St it is expected in option where ture introduces C. Such hazards day but also HF were SIDs with Ds going to the hames to match			
All	Interdepende ncies, conflicts and tradeoffs	howeve a slightl traffic rc This opi structur NERL's requirer these S	er Easterly der ly earlier turn buting further t tion is not exp e which chan proposed du ment for both GDs in Stage 3	bartures are to the West to the East m bected to be ges would n al southbou a LUSIV/TL 3.	sometimes requies on NORBO dep nay increase this possible within t ot fit with the ex nd track structu A SID in the futo	e offs with routes to, ired to be 'stepped artures reduces this interaction, albeit a he existing network kisting operation. H re in the upper net ure. If this option is a result to CAS dir	up' underne s interaction. above 7000ft as it could r aving a singl twork. In the progressed,	ath Edinburgh Conversely th equire a move NORBO SII ir Stage 2A fe we will explo	s GÓSAM dep e CLYDE/ROB of the LANAK D would not ma edback NERL re the ability to	artures. Having BO/LUSIV/TLA hold and a SID ake the most of questioned the remove one of			

		CAP1711 describes the objective as:
		Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	This option would support the modernisation of the airspace. The option would be expected to generate CO <sub>2</sub> reductions, provide some relief and respite from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>25</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.14. Runway 05 Easterly Departure Option G

# Runway 05 Easterly Departures – Option G



The ROBBO/CLYDE/LOMON/FOYLE/PERTH departures offset to the left and these departures turn at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The routes initially overfly Drumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 6000-7000ft. Figure 23 shows that the latter parts of these routes fly over areas not currently overflown today however these parts largely avoid dense areas of population.

Finally the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 5nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning. When reviewed against the heatmap shown in figure 18 these routes more closely follow the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 5nm occurring over an area with lower population density as aircraft do today. Beyond the turn, aircraft would fly towards the south-east, rather than turning towards the south/south-west as they do today. This results in avoidance of some of the most densely populated parts of Glasgow city centre although it results in overflight already occurs in these areas today. The latter parts of the LUSIV/TALLA routes at higher altitudes overfly areas not currently overflown by Glasgow departures such as Dennistoun and Craigend.

Period 2	(Rest of the day)

Period 2 would see the NORBO route fly straight ahead before turning at 1.5nm. This means that some noise is relocated from communities under the westerly final approach such as the northern parts of Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas of high population density that are not currently overflown frequently by departures will now be overflown on a more frequent basis by around 11% of overall traffic. The heatmap data (figure 23) shows that this overflight would occur over large parts of the city of Glasgow.

The LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 4nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning at 4nm rather than 5nm. When reviewed against the heatmap shown in figure 23 this route more closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route would overfly areas of the city of Glasgow, including Bishopbriggs, however by turning at 4nm there is more opportunity to avoid the most dense areas of population as aircraft are slightly further north. The route also heads towards the south-east rather than turning south as it does today; this too helps to avoid some of the most dense areas of population however it should be noted that the LUSIV route will overfly the Dennistoun and Craigend areas more frequently than today.

The ROBBO/CLYDE/LOMON/FOYLE departures all offset left before turning at 1nm. This means that around 4-5% of departures will no longer fly along the final approach resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently overflown below 7000ft.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the right turn NORBO, LUSIV and TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The technical appendix to this document includes an image which compares the existing SID centrelines and option G. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data and the centreline data, there is an increase in the population overflown between 0-7000ft however it's important to note that this data does not account for the frequency of overflight. This option is aiming to share the noise and therefore the increase in population can be attributed to the overall increase in contour area created by having alternative respite configurations and the right NORBO turns over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

System	Area (km²)	Population
RWY 05 Baseline Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option G	318.06	398460

Table 71 Easterly departures option G overflight data

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there are also increases in noise sensitive buildings overflown. It's important to note that at this stage none of the data considers the frequency of overflight; although the data shows largely increases, the frequency of overflight has not been articulated. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

In our Stage 2A engagement, the Mains Estate Resident's Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

# 60dB and 65dB LaMax

Technical Appendix A includes 60dB and 65dB  $L_{aMax}$  contours which compare Option G against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 57 shows an increase in the population within the 60dB  $L_{aMax}$  contour and 65dB  $L_{aMax}$  contour. This can be attributed to introducing alternative respite routes and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

### Table 72 60dB and 65dB L<sub>aMax</sub> Data – Rwy05 Dep Option G

	60dE	3 L <sub>aMax</sub>	65dB LaMax			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option G	566.65	661368	194.89	229233		

### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  day time and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located north-east of the airport.

		Most aircraft today fly str departures with some tur a very similar route to too expected that this option	ns earlier than lay in the areas	today howev s within the ទ	er the lar scope of t	gest perce he L <sub>Aeq</sub> co	ntage of flig ntours. Wh	ghts (11% en we co	6 using th	e NORB	O right turn) fo	
		Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.										
		The full $L_{Aeq}$ contours will	be quantified	as part of ou	r Stage 3	Full Optic	ons Apprais	al if this o	option is	taken for	ward.	
		Noise Abatement Proce A change to the existing		e required to	accomm	odate the	offset depa	rtures ar	nd turns.			
		Noise Mitigation The option offers a respit there is further sharing of increase in the overall po are decreases in the fre requested by stakeholde quantitative analysis as p	f noise by splitt pulation and no quency of ove ers and formed	ing the NOR bise sensitive rflight where I part of the	BO depa e sites ov the freq design p	rtures into erflown ho uency of rinciples.	two routes wever the in overflight is	. Our ove mpacts o currentl	erflight ar of noise ai ly high. T	nd L <sub>aMax</sub> c re now sh This is so	lata has show nared and so t omething that	
	Air Quality	This option has a change to how some aircraft will fly laterally below 1,000ft. Whilst there are likely to be no increase in their totality, there will be a change in the location of emissions below 1,000ft which could affect local air quality. W tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1,000ft today there may								ality. Where la here may be s to the side of ations below th		
	Greenhouse gas impact	Our fuel burn assessmer the baseline. We therefo further detail in the Stage	re expect to se	e a correspo	onding im	provemen	t to greenh					
		This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1 minute separations). This is expected to reduce ground holding which in turn will reduce ground based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.										
	Capacity / resilience	The ability for 2 NORBO routes during the first rotation would further help to meet demand however if does not cater for simar demand during other period of the day.										
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term <sup>26</sup> resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NER''s VOR withdrawal programme.										
		Table 73 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and if aircraft were to follow Glasgow's existing SID centrelines:										
		Table 73 Easterly departure – Tranquil areas overflown Option G										
	Tranquillity	System	NSA area	NSA cou		tional s count	National Parks area	DQA	count	DQA are	ea	
		RWY 05 Baseline Vectoring (NTK data) RWY 05	0	0		0	0		4	0.66		
		Baseline (Centreline - Optioneering tool)	• 0	0		0	0	:	2	0.38		
Wider		Runway 05 Option G	2.91	1		1	14.3	ŧ	5	2.28		
Society		The data shows that the appendix A contains a n tranquil sites also shown	hap which show									
		Table 74 shows data on Glasgow's existing SID c		f biodiverse	areas up	to 7000ft I	based on th	e NTK h	eatmap a	and if airc	craft were to fo	
		Table 74 Biodiversity area	as overflown Opt	tion G								
		System SA ar		SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area	
		RWY 05 Baseline Vectoring (NTK data)	) 0	24	10.46	11	6.37	0	0	0	0	
	Biodiversity	RWY 05 Baseline (Centreline – 0 Optioneering tool)	) 0	10	3.31	0	0	0	0	0	0	
		<b>RWY 05 Option G</b> 0. Below 2000ft no overflight		28 rotection Are	15.22 as Spec	9 ial Areas (	8.14 of Conserva	1 ation Na	14.3 tional Pa	1 rke Noti	2.91 onal Scenic A	
		and Sites of Special Scie							aonal Pa	ins, indil	onal ocenic A	
		Lower slower aircraft, cli Marise Burn and Mugdoo majority of aircraft will cli We will fully quantify the	k Wood SSSIs mb above 2000	s below 2000 Oft before ove	)ft. Given erflying th	the low ov ne sites, it	verall % of a is expected	aircraft ex I that any	xpected to impacts	o fly the will be v	SIDs, and the ery minimal.	

<sup>&</sup>lt;sup>26</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

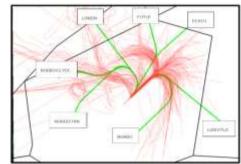
		Stage 3											
General Aviation	Access	offers po would no (togethe containe	otential to reduc ot quite be contain or with creation ed within CAS w	e the total v ained within of the "illus which is unli	anges to the existi volume of CAS. Th n ScTMA 7 in acco strative CAS volum kely to happen in r rerefore offering mo	e Northbound S rdance with the e") assumed th reality because	SIDs on this op CAA CAS co ne northbound 7000ft does r	otion with the 7 ontainment poli I SIDs termination not exist in Airs	% climb gradier cy. However, th te at 7000ft and pace Design te	nt as illustrated is assessment are all wholly			
		combine to reduc	ed to help stakel ce the total volur	holder enga me of CAS.	ume" which was a s agement on potenti The total volume c an currently exists.	al impacts. We of the "illustrativ	have also use e" airspace vo	ed this volume	to understand if	there is scope			
	Economic impact from increased effective capacity	air traffic	We expect the increased effective capacity detailed in the section above will result in a positive economic impact on commercial air traffic compared with the baseline do nothing westerly departure baseline. However the merging of NORBO departures in a single track for the majority of the day would not deliver the biggest economic benefits.										
		mileage CLYDE day. The in track	We estimate that Option G, when compared to baseline nominal centrelines, will result in an overa mileage. This option shows reductions in track mileage for the TRN, NORBO SUNUK, NORBO LA CLYDE routes. There are small increases to the PERTH and LOMON routes. The LUSIV remains aro day. The reduction in the NORBO SIDs means that when considered against the overall % movements a in track miles is outweighed by the decreases elsewhere.										
			<u>j</u>			, ,			0				
		RWY 05	5		(Centreline)	0		B0	G	0			
General				nm	% Weighting	Score	nm P1	nm P2	Average	Score			
Aviation / Commer			TRN NORBO	50.00	0.81	40.50	49.20	49.70	49.45	40.05			
cial			SUBUK	112.00	5.75	644.00	97.30	103.15	100.23	576.29			
airlines	Fuel burn		NORBO	112.00	7.03	787.36	96.50	96.00	96.25	676.64			
		DEPS	LUSIV-DCS TLA	88.80 49.20	2.34 0.09	207.79 4.43	88.80 48.20	88.80 48.20	88.80 48.20	207.79 4.34			
			PERTH	49.20 50.30	0.27	13.58	50.50	48.20 52.20	51.35	13.86			
			FOYLE	19.10	0.18	3.44	18.50	17.60	18.05	3.25			
				LOMON	20.00	0.45	9.00	20.30	20.30	20.30	9.14		
			CLYDE	25.00	0.63	15.75	28.80	19.10	23.95	15.09			
			ROBBO	33.50	0.45	15.08	34.60	23.30	28.95	13.03			
		Total				1740.92				1559.48			
Commer cial airlines	Training costs	Full Opt Flight pr procedu	tions Appraisal a rocedures are u	at Stage 3 v updated or i and under	above 7000ft), it is ve will investigate t introduced worldwi take training if requ	rack mileage in de as part of a	n further detail	le. As part of t	his cycle, airline	es update the			
unnics	Other costs	No othe	er airline costs ar	re foreseen									
Airport / Air navigatio n service	Infrastructure costs	<ul> <li>Glasgow currently operate a home owner relocation scheme for residential properties within the 69dB L<sub>Aeq</sub> noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L<sub>Aeq</sub> residential properties within the 66dB L<sub>Aeq,16h</sub> contour area. The UK Government's current aviation policy assistance to be offered towards the noise insulation of residential properties in the 63dB L<sub>Aeq,16h</sub> no Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will conture types situated within the 63dB contour area. The L<sub>Aeq</sub> modelling in Stage 3 will determine if there are any invition the 63dB L<sub>Aeq,16h</sub> area as a result of this options as a result of the track adjustments on departur adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow with Noise Insultation Scheme.</li> <li>The initial deployment phase of the ACP may require some ATC system engineering amendments.</li> </ul>								tour area and quires financia tour or above varied propert in household loes and trac			
provider	Operational costs	removes	s Glasgow's dep	Dendency o	ot anticipated to ch n conventional ground nables VOR ration	und based navi							
	Deployment costs	Glasgov when w interdep	w Airport. The so we are appraising pendencies with	cale and na g our short Edinburgh	air traffic controller iture of this training list of options and n. Owing to the rea n part of this IOA.	requires furthe once further ir	er exploration	as part of the \$ known about t	Stage 3 Full Opt he network abo	ions Appraisa ve 7000ft an			
		departm turn bef	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a not below 500ft flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER.										
AII	Safety	left turn	departures whi	ch is consi	ggests a minimum dered achievable f actical arrangemer	or the majority	of Glasgow tr						
		NORBO	) against the la	ter turn RC	Route Spacing Guid DBBO/CLYDE dep ot sufficient, a wide	arture. The illu	strations crea	ated so far ha	ve at least 6nn	n between th			
1													

<sup>&</sup>lt;sup>27</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		SID utilisation would change significantly from a left turn to a right turn (or vice-versa) immediately after departure introduces hazards to the operation which at this stage cannot considered to be mitigated without introducing other issues*. Such hazards are not just associated with aircraft inadvertently flying (or being issued) the wrong SIDs and the wrong time of day but also HF issues associated with ATC confusion. *As an example, mitigations identified for SIDs switching to fundamental different directions after departure were SIDs with completely different names. However flight planning and ATM issues previously identified by NERL requires SIDs going to the same places in the network are required to terminate at the same point which in turn would mean similar SID names to match the SID termination point.
AII	Interdepende ncies, conflicts and tradeoffs	There are no interdependencies, conflicts or trade offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having a slightly earlier turn to the West on NORBO departures reduces this interaction. Conversely the CLYDE/ROBBO traffic routing further to the East may increase this interaction, albeit above 7000ft. This option is not expected to be possible within the existing network as it could require a move of the LANAK hold and a SID structure which changes would not fit with the existing operation. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3. The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
AII	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some respite from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route for the majority of the day does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown and densely populated communities to the south of the airport for the majority of the day. This option could be expected to result in reductions in the volume of Glasgow's CAS.

# 4.15. Runway 05 Easterly Departure Option H

Runway 05 Easterly Departures – Option H



This option was generated as a result of Community and ATC feedback in our engagement. They proposed that ROBBO/CLYDE/LOMON SIDs could also turn left immediately, together with the left turn NORBO SID. Predictable respite is not a feature.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment								
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitat assessment has considered this modal split with daily movements averaged across the year.								
		This option would see the NORBO departures split between two routes. These would be operated throughout the day a therefore they would not be used in a respite configuration, however they would help to share the noise betwee communities. Unlike other options, the ROBBO/CLYDE/LOMON SIDS follow the same initial offset and turn as the left to NORBO route. There is a mixtures of offset departures and departures that fly straight ahead, therefore there is limited refore communities living under final approach however there are opportunities to share the noise.								
		The NORBO route accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NOR route is split into two. One NORBO SID offsets left and turns at 1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overfloon a more frequent basis; the heatmap in figure 24 shows that the offset left overflies the populated areas of Drumry as Faifley. Beyond this point the route, which would account for around 6.5% of overall departures, largely avoids the overflie of populated areas with the exception of Milton and western parts of Bowling. The other NORBO SID would fly straight and turn at 5nm. This would largely replicate today's NORBO departures and therefore impact similar communities to curre day. The only exception is at higher altitudes where the route turns further towards the south-west than the NORBO centrel does today. This results in overflight of some areas of Glasgow City centre which, according to the 2019 NTK heatmap, and currently overflown on a frequent basis by departures. The sharing of the route between the two SIDs means that frequency of overflight is reduced compared to some other options that use the same NORBO right turn route. Frequency overflight will be explored in further detail as part of Stage 3.								
		Option Overflight Contours (Black outline) with estimated % of overall departures (Based on 4hrs peak usage per day)								
ommuniti S	Noise impact on health and quality of life	A second seco								
		Figure 24 Easterly Option H Overflight and 2019 baseline NTK data								
		The LUSIV/TALLA equivalent SIDs have been combined into one route, which will account for under 3% of ove departures, fly straight ahead for 4nm before turning to the southwest. Whilst flying straight ahead, the route follows same track as today before turning at 4nm rather than 5nm. When reviewed against the heatmap shown in figure 24 t route more closely follows the most concentrated part of today's vectored swathe. The population data shows that whet we have a straight a straight and a shows that whet a straight a straight a straight and a straight a s								

would overfly areas of the city of Glasgow including Bishopbriggs and Craigend however by turning at 4nm there is more opportunity to avoid the most dense areas of population in the very centre of Glasgow as aircraft are slightly further north.

flying straight ahead, aircraft would overfly the same areas as today, with the turn at 4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route

The ROBBO/CLYDE/LOMON departures all offset left before turning at 1nm (The ROBBO/CLYDE has been combined into one route). This means that around 3% of these departures will no longer fly along the final approach resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently frequently overflown below 7000ft.

The FOYLE/PERTH departures also offset to the left however these departures turn at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight of other populated areas. The route initially flies over Dumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. Figure 24 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a

737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the NORBO right turn and LUSIV/TALLA contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The technical appendix to this document includes an image which compares the existing SID centrelines and option H. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 76 Easterly departures option H overflight data

System	Area (km²)	Population		
RWY 05 Baseline— Vectoring (NTK data)	246.99	364763		
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213		
RWY 05 Option H	234.43	248316		

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

In our Stage 2A engagement, the Mains Estate Resident" Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

### 60dB and 65dB L<sub>aMax</sub>

Technical Appendix A includes 60dB and 65dB L<sub>aMax</sub> contours which compare Option H against the centreline baseline. These 60dB and 65dB L<sub>Amax</sub> contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 77 shows an increase in the population within the 60dB L<sub>aMax</sub> contour and 65dB L<sub>aMax</sub> contour. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 77 60dB and 65dB L<sub>aMax</sub> Data – Rwy05 Dep Option H

	60dI	B L <sub>aMax</sub>	65dB L <sub>aMax</sub>			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option H	433.3	442907	147.96	158079		

### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  day time and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm as well as straight ahead departures. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall  $L_{Aeq}$  contours. When considering just the easterly departure component, the introduction of some traffic onto the offset departures may result in the contour shortening compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Drumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

# **Noise Mitigations**

The option does not offer an alternative respite configuration however it does aim to share the noise by relocating half of the NORBO departures and the ROBBO/CLYDE/LOMON/FOYLE/PERTH departures onto an offset track, rather than climbing straight ahead over the same areas as final approach as they do today. Splitting the NORBO departures into two on a permanent basis also shares the noise for those communities to the south of the centreline which will be overflown by the right turn NORBO route (although they are already overflown today). The L<sub>aMax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the baseline centreline data, and therefore further detailed

		data analysis which	conside	ers frequency	of overflia	ht. will be	required a	at Stage 3	if this opti	on proare	esses.			
	Air Quality	This option has a c emissions in their to Where lateral tracks there may be slight to the side of the concentrations belo the contribution of re	hange t tality, th s are mo decreas straight w these	o how some ere will be a c oving away fr es in the con ahead depa flightpaths. H	aircraft wil change in th om the sta centrations rture route However, it	II fly laten he locatio indard 'sti s below th e (known	ally below n of emiss raight ahea ese flightp as 'offset	1,000ft. V ions below ad' departe aths. Whe departure	Vhilst ther / 1,000ft v ure that a re lateral es') there	e are like which cou ircraft foll tracks are may be	ely to be ld affect low belov e newly c slight in	ocal air o w 1,000fl overflying creases	quality. t today g areas in the	
	Greenhouse gas impact	to the baseline. We	Our fuel burn assessment (see below) has anticipated that Option H will have an overall improvement in fuel burn compared o the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored n further detail in the Stage 3 Full Options Appraisal should this option progress.											
	Capacity / resilience	<ul> <li>This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to separations). This is expected to reduce ground holding which in turn will reduce ground based emissions benefits of this will be seen particularly in future scenarios with increased traffic levels.</li> <li>/ Having 2 NORBO routes for the whole day services future demand to the greatest extent.</li> <li>The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground based navig provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme u Modernisation programme. There is currently no long term<sup>28</sup> resilience for Glasgo''s SIDs when NERL de VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NER''s programme.</li> <li>Table 78 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and</li> </ul>										ion aids, er the Air	minute vs. The , which rspace ons the	
	Tranquillity	Table 78 shows dat follow Glasgow's ex <i>Table 78 Easterly dep</i> System	isting Sl earture –	ID centrelines	s between	0-7000ft: Option H	tional	n the NTK National Parks are	DOA	g baselin count	e and if a		<i>i</i> ere to	
		RWY 05 Baselir Vectoring (NTK o		0	0		0	0		4	0.66			
		RWY 05 Baseline (Centreline – Optioneering tool)		0	0		0	0		2	0.38			
		Runway 05 Optio		1	2.91		1	13.93		4	1.2			
Wider Society		The data shows that there is an increase in NSAs, National Parks, and DQAs compared to the vectoring and centreline data. Technical appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown. Table 79 shows data on the overflight of biodiverse areas up to 7000ft based on the NTK heatmap and if aircraft were to follow Glasgow's existing SID centrelines.												
		Table 79 Biodiversity-	Ū											
		System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area		
		RWY 05 Baseline Vectoring (NTK data)	0	0	24	10.46	11	6.37	0	0	0	0		
	Biodiversity	RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0		
		RWY 05 Option H	0	0	27	13.66	9	8.14	1	13.93	1	2.91		
		Below 2000ft no ove and Sites of Special Lower slower aircra Marise Burn and Mu vast majority of aircr	l Scienti ft, climb ugdock <sup>v</sup>	fic Interests is ing at below a Wood SSSIs	s expected a 6% climb below 200	for the va gradient 00ft. Giver	ast majority on the CL n the low o	y of aircraf YDE/LOM overall % c	t. ION/FOYI of aircraft	_E/PERT expected	H SIDs, i to fly the	may ove e SIDs, a	rfly the and the	
		We will fully quantify at Stage 3.	y the ov	erflight of bio	diverse site	es using t	he full Gla	sgow flee	t mix, as p	part of ou	r Full Op	tions Ap	praisal	

General Aviation	Access	The design option may require changes to the existing CAS boundaries to accommodate the LOMON SID but still offers potential to reduce the total volume of CAS. The Northbound SIDs on this option with the 7% climb gradient as illustrated would not quite be contained within ScTMA 7 in accordance with the CAA CAS containment policy. However, this assessment (together with creation of the "illustrative CAS volume") assumed the northbound SIDs terminate at 7000ft and are all wholly contained within CAS which is unlikely to happen in reality because 7000ft does not exist in Airspace Design terms and these routes are leaving CAS anyway, therefore offering more protection than today is potentially not proportionate. We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing CAS in the same lateral area is c.100nm <sup>3</sup> smaller than currently exists. The Glasgow CTR was c.47nm <sup>3</sup> smaller.
General Aviation / Commerc ial airlines	Economic impact from increased effective capacity	We expect the increased effective capacity detailed in the section above will result in the greatest positive economic impact on commercial air traffic compared with the baseline do nothing westerly departure baseline.
	Fuel burn	We estimate that Option H, when compared to baseline nominal centrelines, will result in an overall improvement in track

<sup>&</sup>lt;sup>28</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

mileage. This option shows reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAKEY, TLA, FOYLE, LOMON, CLYDE and ROBBO routes. There are increases to the LUSIV and PERTH routes. The reduction mainly in the NORBO SIDs but also in the other routes means that when considered against the overall % movements at Glasgow, any increase in track miles is outweighed by the decreases elsewhere.

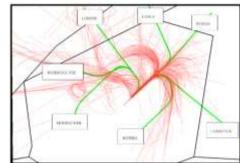
		Table 80	Track Length Ca	lculations	Fuel Burn RWY 05 E	asterly Departure	e Option H			
				Baseline	(Centreline)					
		RWY 05	5	nm	% Weighting	Score	nm	Score		
			TRN	50.00	0.81	40.50	49.20	39.85		
			NORBO SUBUK	112.00	5.75	644.00	103.60	595.70		
			NORBO LAKEY	112.00	7.03	787.36	96.50	678.40		
			LUSIV-DCS	88.80	2.34	207.79	96.50	225.81		
		DEPS	TLA	49.20	0.09	4.43	48.20	4.34		
			PERTH	50.30	0.27	13.58	50.50	13.64		
			FOYLE	19.10	0.18	3.44	18.50	3.33		
			LOMON	20.00	0.45	9.00	14.60	6.57		
			CLYDE ROBBO	25.00	0.63 0.45	15.75 15.08	18.40	11.59 10.26		
		Total	RUBBU	33.50	0.45	•	22.80			
		Total				1740.92		1589.48		
nmerc irlines	Training costs	In the Fu Flight procedu	ull Options Applored	raisal at Sta pdated or in and underta	ace above 7000ft), ige 3 we will invest ntroduced worldwic ake training if requi	igate track mile le as part of an	age in further AIRAC cycle.	detail. As part of this cy		
	Other costs	No other	r airline costs a	re foreseen.						
Nirport / Nir avigatio	Infrastructure costs	and resid financial above. T varied p increase departur Glasgow	dential properti assistance to l Therefore, Glas roperty types s in household re. If it does and with regards for	es within the be offered to gow Airpor ituated with Is within the d track adju unding their	sensitive buildings e 66dB L <sub>Aeq,16h</sub> cor owards the noise i t are currently dev in the 63dB conto e 63dB L <sub>Aeq,16h</sub> are stments are propo Noise Insultation	ntour area. The nsulation of res veloping a new ur area. The L <sub>A</sub> ea as a result o sed in Glasgow Scheme.	UK Governme idential prope Noise Insulat eq modelling i of this options 's ACP submi	ent's current avia rties in the 63dB ion Policy for 20 n Stage 3 will de as a result of th ssion, there will l		
service provider					ACP may require		-	-		
	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>29</sup> ;								
	Deployment costs	and Glas Appraisa	sgow Airport. T	he scale ar appraising	air traffic controller nd nature of this tr our shortlist of op Edinburgh.	aining requires	further explor	ation as part of t		
All	Safety	IFP depa doesn't t	artment wanted	a not below end of the ru	tment on departure v 500ft flyover WP unway. PANS OPS P is acceptable, es	positioned at the doesn't require	e Declared En this. Addition	d of Runway (DE al assurances wi		
		More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 140 early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception performing the transmission of transmission of the transmission of the transmission of transmission of transmission of transmission of transmission of the transmission of tra								
		7000ft he Having	owever Easterly a slightly ear	y departures rlier turn t	conflicts or trade o s are sometimes re o the West on more closely align	quired to be 'ste NORBO depa	epped up' und irtures reduce	erneath Edinburg es this interact		
All	Interdependenci es, conflicts and tradeoffs	having 2 feedbac	2 NORBO SIDs k NERL questi	maximises	possible within the the benefits from quirement for both f these SIDs in Sta	NERL's propos n a LUSIV/TLA	ed dual south	bound route stru		
		The ever	ulativo offect e	n other aire			nonciona at C	loogow Ediphur		

		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
AII	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO <sub>2</sub> reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure would mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a single NORBO SID structure). This option could be expected to result in reductions in the volume of Glasgow's CAS.

<sup>&</sup>lt;sup>29</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.16. Runway 05 Easterly Departure Option I

# Runway 05 Easterly Departures – Option I



This option is the same as Option H except that track adjustments do not feature. This is due to a concern that a track adjustment followed by an immediate left 180° turn for the NORBO/ROBBO/CLYDE/LOMON departure could be too technically challenging. This has a knock-on impact in that the PERTH/FOYLE would also not feature a track adjustment.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

iroup	Impact	Qualitative Assessment	
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and o assessment has considered this modal split with daily movements averaged across the year.	qualitativ
		This option would see the NORBO departures split between two routes. These would be operated throughout the therefore they would not be used in a respite configuration, however they would help to share the noise communities. Unlike other options, the ROBBO/CLYDE/LOMON SIDS follow the same initial turn as the left turn route. All departures fly straight ahead, therefore there is no relief for communities living under immediate final although the NORBO Left, ROBBO/CLYDE, LOMON and FOYLE do turn shortly after departure.	betwee
		The NORBO route accounts for around 13% of overall departure movements from Glasgow airport. In this or NORBO route is split into two. One NORBO SID turns at 1nm, which means that some noise is relocated from corrunder the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Mil would however mean that areas that are not currently overflown frequently by departures will now be overflown or frequent basis; the overflight contours and population data show that the left turn overflies the populated areas or and Faifley. Beyond this point the route, which would account for around 6.5% of overall departures, largely a overflight of populated areas with the exception of Milton and western parts of Bowling. The other NORBO SID straight ahead and turn at 5nm. This would largely replicate today's NORBO departures and therefore imparts or munities to current day. The only exception is at higher altitudes where the route turns further towards the set than the NORBO centreline does today. This results in overflight of some areas of Glasgow City centre which, and the 2019 NTK heatmap shown in Figure 22, are not currently overflown on a frequent basis by departures. The set the route between the two SIDs means that the frequency of overflight is reduced compared to some other option the same NORBO right turn route. Frequency of overflight will be explored in further detail as part of Stage 3.	mmunitie Ingavie. on a mor of Drumr avoids th would fl act simila outh-wes cording t sharing o
		Option Overfligh Contours (Black with estimated 5 overall departure	outline) % of
		The second secon	
ommunit	Noise impact on health and quality of life		

departures, fly straight ahead for 4nm before turning to the southwest. Whilst flying straight ahead, the route follows the same track as today before turning at 4nm rather than 5nm. When reviewed against the heatmap shown in figure 25 this route more closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route would overfly areas of the city of Glasgow including Bishopbriggs and Craigend however by turning at 4nm there is more opportunity to avoid the most dense areas of population in the very centre of Glasgow as aircraft are slightly further north.

The ROBBO/CLYDE/LOMON departures all turn at 1nm (The ROBBO/CLYDE has been combined into one route). This means that around 3% of these departures will no longer fly along the final approach up to 5nm resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap data shows that these departures turning left overfly the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently overflown below 7000ft.

The FOYLE/PERTH fly straight ahead and turn at 6nm. These routes therefore overfly the same areas as final approach and largely follow the same tracks as departures today, particularly from take off to 5nm. Beyond 6nm, at higher altitudes, the routes overfly Blanefield and Strathblane. Figure 25 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight

contours may extend further than what is shown in this IOA. In the case of this option, the NORBO right turn and LUSIV/TALLA contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The technical appendix to this document includes an image which compares the existing SID centrelines and option H. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 81 Easterly departures option I overflight data

System	Area (km²)	Population
RWY 05 Baseline Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option I	217.71	235019

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

### 60dB and 65dB LaMax

Technical Appendix A includes 60dB and 65dB  $L_{aMax}$  contours which compare Option I against the centreline baseline. These 60dB and 65dB  $L_{Amax}$  contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 82 shows an increase in the population within the 60dB  $L_{aMax}$  contour and 65dB  $L_{aMax}$ contour. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 82 60dB and 65dB LaMax Data – Rwy05 Dep Option I

	60dE	B L <sub>aMax</sub>	65dB L <sub>aMax</sub>			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option I	411.04	433493	132.97	147678		

### LAeq

The easterly departures make up a component of the overall  $L_{Aeq}$  day time and night time contours. We have used the overall  $L_{Aeq}$  contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the  $L_{Aeq}$  contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces straight ahead departures with some turns earlier than today however the largest percentage of flights follow a very similar route to today in the areas within the scope of the IAeq contours. When we consider this, and the modal split, it is expected that this option would have minimal impact on the shape and size of the overall L<sub>Aeq</sub> contours.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

### **Noise Abatement Procedures**

A change to the existing NAPs would be required to accommodate the offset departures and turns.

		<b>Noise Mitigation</b> The option does not offer an alternative respite configuration however it does aim to share the noise by splitting the NORBO departures into two on a permanent basis. This shares the noise for those communities to the south of the centreline which will be overflown by the right turn NORBO route (although they are already overflown today). The L <sub>aMax</sub> and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has the potential to change to how a small number of aircraft will fly laterally below 1,000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1,000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1,000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option I will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity /	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some

	resilience	separation	l be able to s). This is e this will be s	xpected	I to reduce	ground ho	lding whic	ch in turn w	ill reduce g	ground ba				
		The introdu provides re Modernisa	NORBO rout uction of PB esilience. Th tion progran roduction of e.	N SIDs is equip nme. Th	also remo ment is du nere is curr	ves Glasgo e to be dec ently no lor	ow's depe ommissio ng term <sup>30</sup>	endency or ned as par resilience	n conventio t of a NERL for Glasgov	nal grou - UK wide v's SIDs	e program when NE	nme unde RL deco	er the Air mmissio	rspac ons th
		follow Glas	shows data o sgow's existi	ing SID	centreline	S:		y based or	the NTK	vectoring	j baseline	e and if a	aircraft w	/ere
			System		SA count	NSA are	Na Na	ational	National	DQA	count	DQA ar	'ea	
	Tronguillity	RWY 0	5 Baseline- ng (NTK dat	-	0	0	Park	os count	Parks area 0	a –	4	0.66		
	Tranquillity	R Baseline	WY 05 (Centreline	e —	0	0		0	0		2	0.38		
		-	eering tool y 05 Option	-	1	1.62		1	12.7		4	1.19		
		data. Tech	shows that t nnical apper contour, with	ndix A	contains a	map whic								
		follow Glas	hows data o sgow's existi	ing SID	centreline	S.	e areas u	p to 7000f	t based on	the NTK	(heatmap	o and if a	aircraft w	/ere
		Table 84 Bi	iem I	SAC area	SAC count	on I SSSI count	SSSI area	SPA count	SPA area	Park	Nationa park	NSA count	NSA area	
	Biodiversity	RWY Baseli Vectorin dat	ine–- ig (NTK a)	0	0	24	10.46	11	6.37	0	area 0	0	0	
		RWY Base (Centre Optione too	eline eline – eering	0	0	10	3.31	0	0	0	0	0	0	
		RWY 05	Option I	0	0	25	12.99	9	7.86	1	12.7	1	1.62	
			00ft no overf Sites of Spe											
General Aviation	Access	potential to would not assessmen are all who	n option may o reduce the quite be c nt (together olly containe I these rout ate.	total ve ontaine with cre d within	olume of C d within S ation of the CAS whic	AS. The N CTMA 7 ir e "illustrativ h is unlikel	orthbound accorda e CAS vo y to happ	d SIDs on ance with olume") ass en in realit	this option the CAA ( sumed the y because	with the CAS cor northbou 7000ft de	7% climb ntainment ind SIDs f oes not e	o gradier policy. terminate xist in Ai	nt as illus Howeve e at 7000 rspace [	strate er, th Oft ar Desig
		options co there is sco	d an "illustra mbined to h ope to reduc same latera	elp stal e the to	keholder ei tal volume	ngagement of CAS. Th	on poter total vo	ntial impac	ts. We hav e ''illustrativ	e also us e'' airspa	sed this v ace volum	olume to ne compa	o unders ared to e	tand
	Economic impact from increased effective capacity	on	the increas			-				-	eatest po	ositive ec	onomic i	mpa
General		mileage. T LOMON, C NORBO S	te that Options This option s CLYDE and IDs but also track miles	shows r ROBBC in the o	eductions D routes. T other route	in track mi here are ir s means th	leage for acreases at when	the TRN, to the LUS considered	NORBO S SIV and FO	SUNUK, YLE rou	NORBO tes. The	LAKEY, reduction	TLA, Pl n mainly	ERT
Aviation / Commerci		Table 85 Tr	ack Length C				5 Easterly	Departure C	Option I					
al airlines	Fuel burn	RWY 05		nm		Weighting			nm	Scol				
		1	TRN NORBO SUBUK	50.00 112.0			40.9 644		49.10 103.90	39.7 597				
			NORBO _AKEY	112.0			787		96.50	678.				
			LUSIV-DCS	88.80 49.20	0.0	09	207 4.43	3	96.50 48.20	225. 4.34				
		F	PERTH	50.30	0.2	27	13.5	58	50.20	13.5	5			

<sup>&</sup>lt;sup>30</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

			FOYLE	19.10	0.18	3.44	20.30	3.65				
			LOMON	20.00	0.45	9.00	14.80	6.66				
			CLYDE	25.00	0.63	15.75	19.00	11.97				
			ROBBO	33.50	0.45	15.08	23.00	10.35				
		Total				1740.92		1591.93	_			
		the NAT burn. In	S NERL ACF	o for the airs ns Appraisal	pace above 70 at Stage 3 we	000ft), it is anticipate will investigate track	d that this o mileage in f	ption would see an urther detail.	east 6000ft (subject to n improvement in fuel			
Commerci al airlines	Training costs	procedu		ly and unde	ertake training				e, airlines update their ipated to require any			
	Other costs	No other	r airline costs	are foreseer	1.							
	Infrastructure costs	there are	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond the there are not expected to be any changes to infrastructure for the airport or the ANSP. Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the 63d									
Airport /		L <sub>Aeq,16h</sub> n	oise contour	and therefore	e not affect Gla	asgow's noise insulta	tion scheme	costs.				
Air navigation service provider	Operational costs	SIDs rer	noves Glasgo	w's depende	ency on conver		navigation e		nplementation of PBN which contributes to a			
providel	Deployment costs	and Glas Appraisa	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwi and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Optio Appraisal when we are appraising our shortlist of options and once further information is known about the network abo 7000ft and interdependencies with Edinburgh.									
All	Safety	early left the Twin	t turn departu Otter aircraft	res which is for which all	considered ac ternative tactic	hievable for the majoral arrangements may	ority of Glasg be required	yow traffic with the	ed up to 1400ft on the exception perhaps of			
						gether with a perman htforward to assure w			at do not wrap around			
	Interdependenci	There are no interdependencies, conflicts or trade offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAN departures. Having a slightly earlier turn to the West on NORBO departures reduces this interaction. Also keeping the CLYDE/ROBBO/LUSIV/TLA traffic more closely aligned to existing traffic patterns minimises this interaction. This option is not expected to be possible within the existing network as it could require a move of the LANAK hold and										
All	es, conflicts and tradeoffs	having 2 NORBO SIDs maximises the benefits from NERL's proposed dual southbound route structure. In their Stage feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we explore the ability to remove one of these SIDs in Stage 3.										
		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.										
		CAP171	1 describes tl	ne objective a	as:							
	AMS	Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are airspace.										
All		option w	ould be expe n by Glasgow	cted to gene arrivals and	rate significan departures an	t CO <sub>2</sub> reductions, pro	vide some re k structure w	elief from noise to ould mitigate the in	efficient manner. The those most frequently npacts on those newly re).			
		This opt	ion could be e	expected to re	esult in reducti	ons in the volume of	Glasgow's C	AS.				

<sup>&</sup>lt;sup>31</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.17. Runway 23 Westerly Arrivals Baseline

Runway 23 W	esterly Arrivals Bas	eline		
		The majority of aircraft are vectored to join fina however they are allowed to join final approach join final approach inside 6nm are likely performi For more information on our do nothing scenario Portal.	as close as 2000ft/6nm when u ing a visual approach.	using the ILS. The tracks shown which
Group	Impact	Qualitative Assessment		
Group	Impact	<ul> <li>Portal.</li> <li>Qualitative Assessment</li> <li>Due to wind direction, westerly operations on requalitative assessment has considered this mod</li> <li>Aircraft arriving at Glasgow are tactically control with the extended runway centreline. Aircraft talthough when undertaking an ILS approach approaches closer than 6nm.</li> <li>The NTK data shown in figure 26, demonstrates that there are wide areas that are overflown be Glasgow, Inverkip, Helensburgh, Cardross, Boy Cumbernauld, Kilsyth, Airdrie, Wishaw, Carluke eastern parts of the city centre of Glasgow. There before aircraft join the final approach which overfl Muirhead, eastern parts of Kirkintilloch, Milton of</li> <li>Figure 26 Runway 23 Departure Vectoring Swathe 20</li> <li>The technical appendix to this document include to note that this data is not modelled in the same means of comparison between this baseline and</li> <li>The technical appendix also includes a baseline not have any published PBN arrivals and theref NTK data for 2019 and analysing the arrivals centreline has then been processed through the Table 86 below includes data baseline overflight data 0-7</li> <li>System</li> <li>RWY 23 Arrivals Baseline (Centreline - optioneering tool)</li> <li>The data from these tables will be used to comp In addition to population overflown, we also have</li> </ul>	runway 23 occur approximately lal split with daily movements av olled (vectored) by ATC before j typically join final approach bet they can be as close as 6mm s the large swathe of overflight etween 1-10 times per day on a glestone, Birdgend, Greenock, e, Udston, Blantyre, East Kilbri re is some concentration which of lifes Larkhall, Motherwell, Belishi f Campsie, and Lennoxtown:	82% of the year. The noise data and eraged across the year. ioining final approach which is aligned tween 7nm and 13nm before landing h. Aircraft may also undertake visual created by today's vectoring. It shows average including Weymess Bay, Fort Dumbarton, Bonhill, Balloch, Balfron, ide, Newton Mearns, Clarkstone, and occurs from a south-easterly direction, ill, Coatbridge, Gartcosh, Moddlesburn,
		hospitals and places of worship; the full data aro will provide a qualitative statement around this d <b>60dB and 65dB L</b> AMax Technical Appendix A includes 60dB L <sub>AMax</sub> conto and the options. Although we have shown a 65 options as the scope of the contour is only on the N60/N65 metrics which will be quantified at the S	bund these is shown in technical data. Durs and data for the baseline, to 5dB L <sub>AMax</sub> contour in the append e final approach. 60dB and 65dB	appendix a, and as part of this IOA we b aid comparison between the baseline dix, this does not change between the

		Table 87 Westerly arrivals baseline	e L <sub>AMax</sub> data				
			60dE	B LAMax			
		System	Area (km²)	Population			
		RWY23 Arrivals Baseline (Centreline – optioneering tool)	57.86	68289			
		The data from these tables will	be used to compare t	the westerly arrivals	options again	ist the 'do n	othing' baseline.
		L <sub>Aeq</sub> Westerly arrivals make up a co contours from 2017, as an indic					
		Noise Abatement Procedures As this baseline reflects current		no changes to NAPs	s as a result c	of this option	٦.
		<b>Noise Mitigation</b> The option doesn't see the use The option doesn't contain med			er routine ve	ctoring doe	s disperse the tr
	Air Quelitu	Impacts to air quality are considered have a significant impact on loc		low around 1000ft (2	200m). Aircraf	t flying abo	ve this are unlike
	Air Quality	Aircraft arriving at Glasgow fly This is when they are very clos lateral changes below 1000ft he	se to landing. It's ther	efore highly unlikely	that any of o	ur arrival's	
		Emissions of greenhouse gase linked to track length, we have assessment is therefore linked	initially looked at the t	rack length for the ba	aseline weste	rly arrivals.	
	Greenhouse impact	We will estimate the difference advantages/disadvantages of the than a typical flight today. As qualitatively describe anticipate technical appendix a.	ne option. This estima CO <sub>2</sub> emissions are li	tion will consider whe inked to the differen	ether the aircr	aft tracks w n fuel burnt	ill be longer or sh , this will allow ເ
	Capacity	In future, increased forecast m disbenefits. Although vectoring to the vectoring practices may addition to this, no change to th AMS benefits associated with t	of arrivals is expecte be required to facilita ne airspace around G	ed to be able to meet ate the wider change	the forecast s to CAS, the	demand, w e network a	e anticipate chan nd the departure
	resilience	For some approaches, Glasgo which are currently undergoi decommissioned as part of a N approaches will remain available event on an ILS outage.	ing a rationalisation	programme by NA mme under the Airsp	ATS NERL.	This equip sation prog	oment is due to ramme. Although
		CAP1616 outlines the consider of Outstanding Natural Beauty we've therefore included overfli Tranquillity assessment. At this and whether this has the poten	(AONB). In Scotland ight data around these stage of the ACP we	d, the equivalent of a e, National Parks and will qualitatively asse	AONB are Na d designated ess whether th	ational Sce quiet areas he option di	nic Areas (NSA) (DQA) as part o
		Table 88 shows data on the ove The data from this table will be				eline and th	e centreline base
	Tranquillity	Table 88 Westerly arrival baseline	– Tranquillity overflown	0-7000ft			
Vider Society		System NS	A count NSA area		National [ arks area	DQA count	DQA area
		RWY 23 Arrival Baseline - Vectoring (NTK data)	1 17.51	5	79.21	8	2.29
		RWY23 Arrival Baseline (Centreline – optioneering tool)	1 23.63	1	34.52	0	0
	Biodiversity	The effects of airspace change general, airspace change prop ground-based infrastructure. As legislation." Though there is lim that disturbance effects associa 500m (~1,640ft). Consideration Special Protection Areas, Spec Scientific Interest, particularly a Aircraft arriving at Glasgow fly this typically occurs at around overflight of Mugdock Wood a centerline). It's highly unlikely t however we will compare this b	posals are unlikely to s such they are unlike ited research availabl ated with aircraft can n will therefore be give cial Areas of Conserv at altitudes below 2,00 a standard 3.0 degre 5nm (9-10km) from 1 nd Manse Burn SSS hat any of our arrival	b have an impact up ely to have a direct in e on the effects of air occur during take-off en to the effects on e ation, National Parks 00ft. ee approach and are landing. The NTK ve ils below 2000ft (Bo 's options will have a	oon biodiversi npact that wo rcraft noise or f and landing ecology and b s, National So aligned with ectoring base th are locate	ity because uld engage n wildlife, th where airco biodiversity cenic Areas the runway line shows d north of t	e they do not inv the Birds or Hab ere is some evid raft are below ard where aircraft ov and Sites of Sp r centreline at 16 some low frequ the extended rur

		This baseline scenario would not offer any change from the existing Controlled Airspace (CAS) arrangements in place today. The options will be qualitatively compared against this existing scenario.					
General Aviation	Access	Figure 27 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details)Within c.35nm of Glasgow airports are Edinburgh and Glasgow Prestwick Airport each with their own Controlled					
		Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports' airspace which generates the volumes shown in Figure 27. The controlled airspace at Glasgow has varying lower and upper limits with the volume closest to the airport going down to ground level. This is the Glasgow CTR shown in red outline. Also, in this figure can be seen Cumbernauld Airport approximately 15nm to the east of Glasgow airport which sits outside CAS where the base of the CTA is 3000ft. This is indicated with a yellow dot.					
		CAS structures to support Glasgow Airport's operation are out of date and the CTR itself can likely be reduced in size. Whilst the existing baseline scenario will not result in the requirement for more airspace, this option offers no opportunity to simplify the airspace boundaries or reduce the size of CAS which is something Glasgow has been specifically working with GA stakeholders to try to achieve. The most prominent feature of Westerly arrivals in relation to CAS is with regards to the Edinburgh-Glasgow Gap and the associated Gliding Corridor with a base of 3000ft. The ability to raise parts of CTA-1 would offer significant benefit to Cumbernauld and the gliding community.					
	Economic impact from increased effective capacity	There will be no increase to effective capacity by doing nothing with Westerly arrivals (in isolation to the rest of the system).					
General		As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline westerly arrivals. When arriving at Glasgow, aircraft are vectored by ATC before joining the final approach. This means that track length is varied from flight to flight. For the purposes of comparing our westerly arrival options against the baseline scenario, we have used the NTK vectoring baseline data and information from ATC to estimate an arrivals centreline; we have then used the track mileage from this centreline as an initial indication of 'do nothing' track length. We have then applied a weighting based on arrival direction to provide an overall total track mileage for the system. At the Stage 3 full options appraisal track length and fuel burn will be modelled in further detail.					
Aviation / Commercial		Table 89 Westerly Arrival Track Mileage					
airlines	Fuel burn	Track MileageOptionTrack miles (nm)Track miles (South), 13% (North) based on 2019 modal split)					
		Baseline (centreline)       58.2       2380.6         Aircraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the airspace.					
		We will qualitatively estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option against current day. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today and will also consider the opportunity for continuous descent from 7000ft.					
Commercial	Training costs	As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.					
airlines	Other costs	As this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.					
	Infrastructure costs	As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.					
Airport / Air	Operational costs	As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs)					
navigation service provider		For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is considered an interim measure and failure to implement a long term solution may result in additional operational costs.					
	Deployment costs	As this option is already in operation, there are no deployment costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.					
All	Safety	At current traffic levels, there are no safety concerns with the current arrangements at Glasgow. Future traffic growth could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic					

		levels within the Scottish TMA being capped, on increased aircraft holding in order to maintain safety.
All	Interdependencies , conflicts and tradeoffs	As detailed in our Stage 2A documentation on the CAA airspace change portal there are currently interdependencies between Westerly arrivals to Glasgow and Easterly arrivals to Edinburgh. Doing nothing will not reduce those dependencies however in all options, we expect some dependencies and airspace buffer arrangement will continue to be required based on the geography of the airports and runways.
		CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
AII	AMS	Whilst vectoring of arrivals is a perfectly reasonable options in a future operating environment, doing nothing with Westerly departures will not align with the AMS as it would constrain other options. Limiting our options to one which sees no change to vectoring practices could also reduce the ability to change CAS boundaries and improve CDA performance.

# 4.18. Runway 23 Arrival Option C

Runway 23 We	Runway 23 Westerly Arrivals Option C					
		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 8nm.				
	Ź	For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.				
Group	Impact	Qualitative Assessment				
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.				
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 8nm, and would be used by around 69% of overall arrivals.				
		Option Overflight Contours (Black outline) with estimated % of overall arrivals				
		2019 baseline average summer day overflight swathe:				
		20				
		Figure 28 Westerly Arrivals Option C Overflight and 2019 baseline NTK data				
Communitie s	Noise impact on health and quality of life	<b>Route from the North</b> This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 28 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could be more concentrated in future. Aircraft then join the final approach and overfly the same areas as they do today.				
		Route from the South The route from the south would see aircraft start a continuous descent at 7000ft from around the Larkhall area. When reviewed against the NTK data in figure 28, the route then tracks north-west following the same areas where there is concentration in arrivals today. This occurs over the populated areas of Motherwell, Bellshill, Cuparhead, Gartcosh, and East Kirkintillock amongst others. Aircraft then turn to join the final approach at 8nm from the threshold, over Milton on Campsie and Lennoxtown. Reviewed against the NTK data shown in figure 28, this is area where concentration of arrivals traffic is also seen today. Aircraft then join the final approach and overfly the same areas as they do today.				
		<b>Overflight Data</b> The technical appendix to this document includes a baseline image which shows a PBN centreline created using				

The technical appendix to this document includes a baseline image which shows a PBN centreline created using

concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is a small decrease in the area of the contours and the number of population and noise sensitive sites overflown.

Note that a Centreline for the baseline does not actually exist in reality, we created one based on the areas most frequently overflown by RWY 23 arrivals in today's airspace arrangement. Compared to the other options, Option C overflies the highest number of population compared between 0-4000ft and 0-7000ft. *Table 90 Westerly arrivals option C overflight data* 

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	1659.74	1250066
RWY23 Baseline (Centreline)	184.13	139113
RWY23 Option C	180.49	129769
Data on the number of noise sensitive buildir number of schools, care homes, and places of		

		remained the same. There note that at this stage nor will result in a reduction in than today. This is someth this option progress. The detailed in technical appen <b>60dB and 65dB L</b> AMax Technical Appendix A incl	ne of the data of number of bui ning that will be full data tables ndix A.	considers the f Idings overflor explored furt and counts o	frequency of ov wn, those that a her as part of th of noise sensitiv	rerflight; althou are overflown ne Stage 3 full ve buildings s	ugh concentrate will likely be at options apprai uch as hospita	ed PBN flight path a higher frequenc sal analysis shoul Is and schools, ar	
		are an indicator of the N60 in table 85 shows a decrea the same between the bas	) metrics which ase in the area a	will be quant and population	ified at the Stag	ge 3 Full Optic	ons Appraisal.	The data, as show	
		Table 91 60dB L <sub>AMax</sub> Data - F	Table 91 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option C						
				60dB L	-AMax				
		System	Area	(km²)	Population				
		RWY23 Baseline (Centreline Optioneering tool)	- 57	.86	68289				
		RWY 23 Dep Option C	55	.49	63544				
	Air Quality	the shape/size of the L <sub>Aeq</sub> that this may influence the with the contour shape ad This option has no change changes to local air quality	e shape of the o justing slightly e to how aircra	outer most 510 south-east to ft fly below 1,0	dB contour althe reflect the turn 000ft compared	ough we woul to join final ap to the baselir	d expect this to proach. he and so there	be relatively mine	
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option C will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.							
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.							
Wider		Table 92 shows data on the baseline. <i>Table 92 Westerly arrival opt</i>	0		n 0-7000ft		ctoring baseline	and the centrelir	
Society		System	NSA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
	Tranquillity	RWY 23 Baseline - Vectoring (NTK data)	1	17.51	5	79.21	8	2.29	
		RWY 23 Baseline (Centreline – Optioneering tool)	1	23.63	1	34.52	0	0	
		Runway 23 Option C	0	0	1	26.29	0	0	
		The data shows that there a map which shows the o also shown.							
	Biodiversity	The routes that form part of Arrival Option C join the final approach at 8nm and 12nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity.							
General Aviation	Access	Use of a pure PBN soluti expected to significantly re							
	Economic impact from increased effective capacity	Use of PBN transitions ald less accurate final approa							
		We estimate that Option 0 track mileage.	C, when compa	ared to baselin	ne nominal cen	trelines, will re	esult in a small	overall increase	

		track mileage.						
		Track Mileage						
		Option	Track miles (nm)	Track miles (Weighted 69% (South), 13% (North) based on 2019 modal split)				
General Aviation /		Baseline (centreline)	58.2	2380.6				
Commercial		С	62.8	2513.2				
airlines	Fuel burn	compared to today in order to avoid A. The southern route is almost id arrivals.	I noise sensitive sites. This can be s entical to the baseline centreline w	akes a less direct route to join final approach seen in the maps shown in technical appendix which will account for around 69% of westerly 2000ft (subject to the NATS NERL ACP for the				
		review whether we can balance noi	se and CO2 on the northern route.	this in further detail and as part of this we will We will also quantify fuel burn in further detail of continuous descent, in order to try to balance				

		CO <sub>2</sub> and noise.
Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>32</sup> .
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding. The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false GPWS
		alerts due to high ground under final approach/base-leg. This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.
All	Interdependencies , conflicts and tradeoffs	As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinbugh GOSAM departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below 7000ft. There would not be any dependencies with the network design with this option assuming LANAK stays where it is however that stack may require re-alignment to enable some RWY 05 departure options which could affect the upper portions of this PBN arrival option.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects of a pure PBN arrival solution at Glasgow include increased delay, reduced economic benefit, increased CO <sub>2</sub> emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

<sup>&</sup>lt;sup>32</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.19. Runway 23 Arrival Option D

Runway 23 We	esterly Arrivals Option	on D
		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 9nm. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 9nm, and would be used by 69% of overall arrivals.
		Contours (Black outline with estimated % of overall arrivals 2019 baseline average summer day overflight swathe:
Communitie s	Noise impact on health and quality of life	Figure 29 Westerly Arrivals Option D Overflight and 2019 baseline NTK data Figure 29 Westerly Arrivals Option D Overflight and 2019 baseline NTK data This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 29 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could
		<b>Route from the South</b> The route from the south would see aircraft start a continuous descent at 7000ft from around the northern part of the Larkhall area. When reviewed against the NTK data in figure 29, the route then tracks north/north-west tracking slightly north-east of where the heat map shows the main concentration occurring today. This part of the route flies over the populated areas of Motherwell, Bellshill, Cuparhead, Coatbridge, Croftfoot, and east of Moodiesburn. Aircraft then turn to join final approach at around 9nm from the threshold. The NTK data in figure 29 shows that this happens north-east of today's arrival concentration however this avoids the densely populated area of Kirkintilloch and Milton on Campsie and largely routes over areas with relatively low population density. Aircraft then join the final approach and overfly the same areas as they do today.

# **Overflight Data**

The technical appendix to this document includes a baseline image which shows a PBN centreline created using

concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 93 Westerly arrivals option D overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	1659.74	1250066
RWY23 Baseline (Centreline)	184.13	139113
RWY23 Option D	178.24	118103

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, and places of worship overflown compared to the centreline baseline data. There is an increase in hospitals. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths

		will result in a reduction in nur than today. This is something this option progress. The full detailed in technical appendix	that will be data tables	explored furth	ner as part of the	e Stage 3 full	options appra	sal analysis should
		<b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A include are an indicator of the N60 me in table 94 shows a decrease the same between the baselin	The data, as shown					
		Table 94 60dB L <sub>AMax</sub> Data - Rwy2	23 Arrival Opt	ion D				
				60dB L	AMax			
		System	Area (	(km²)	Population			
		RWY23 Baseline (Centreline - Optioneering tool)	57.8	86	68289			
		RWY 23 Dep Option D	54.	55	54040			
		L <sub>Aeq</sub> The north-east component of Option D sees a turn onto fin shape or size of the L <sub>Aeq</sub> conto	nal approach					
	Air Quality	This option has no change to changes to local air quality (p						e are no anticipated
	Greenhouse gas impact	Our fuel burn assessment (se to the baseline. We therefore explored in further detail in the	e expect to	see a corres	ponding increas	se to greenh	ouse gas emis	
	Capacity /	Use of PBN transitions alone less accurate final approach s					lding would inc	rease as a result of
	resilience	The introduction of PBN appropriate properties of a NERL UK wide propression approach and NDB	ogramme un	der the Airs	pace Modernisa	ation program		
		Table 95 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:						
	Tranquillity	Table 95 Westerly arrival Option D – Tranquil areas overflown 0-7000ft						
Wider Society		System N	SA count	NSA area	National Parks count	National Parks area	DQA count	DQA area
		RWY 23 Baseline - Vectoring (NTK data)	1	17.51	5	79.21	8	2.29
		RWY 23 Baseline (Centreline – Optioneering tool)	1	23.63	1	34.52	0	0
		Runway 23 Option D	0	0	0	0	0	0
		The data shows that there is a reduction in NSAs, National Parks and DQAs overflown; all are avoided. Technical appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.						
	Biodiversity	The routes that form part of A typically associated with chan before landing, this option is r	ges below 10	640ft, which v	when flying a sta	andard 3 degi	ree approach o	ccur at around 5nm
General Aviation	Access	Use of a pure PBN solution expected to significantly reduced to significant to significant significant to significant						
	Economic impact from increased effective capacity	Use of PBN transitions alone less accurate final approach s						
		We estimate that Option D, w track mileage.	/hen compar	red to baselin	ne nominal cent	relines, will re	esult in a small	overall increase in
		Track Mileage				Track m	iles (Weigh	ted 69%
		Option	Tracl	k miles (nm)			13% (North)	
General Aviation /		Baseline (centreline) D	58.2 <mark>63.9</mark>			2380.6 2589.1		
Commercial airlines	Fuel burn	This increase in driven large compared to today in order to A. The southern route also tak typically join today.	avoid noise	sensitive site	es. This can be	seen in the r	naps shown in	technical appendix
		All arrival options have been airspace above 7000ft).	designed to	continuously	descend from 7	7000ft (subje	ct to the NATS	NERL ACP for the
		As part of Stage 3, should this will review whether we can ba to understand the impacts of t CO <sub>2</sub> and noise.	lance noise a	and CO <sub>2</sub> on th	ne northern rout	e. We will als	o quantify fuel l	ourn in further detail
Commercial airlines	Training costs	Flight procedures are updated their procedures accordingly						

		any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>33</sup> ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding. The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false GPWS alerts due to high ground under final approach/base-leg.
		This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.
All	Interdependencies , conflicts and tradeoffs	As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinburgh GOSAM departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below 7000ft. There would not be any dependencies with the network design with this option assuming LANAK stays where it is however that stack may require re-alignment to enable some RWY 05 departure options which could affect the upper portions of this PBN arrival option.
All	AMS	<ul> <li>CAP1711 describes the objective as:</li> <li>Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.</li> <li>This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.</li> </ul>

<sup>&</sup>lt;sup>33</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.20. Runway 23 Arrival Option E

Runway 23 Wes	terly Arrivals Option E	
- Mar		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 10nm.
	À	For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 10nm, and would be used by 69% of overall arrivals.
		Option Overflig         Contours (Black         With estimated of verail arrivals         2019 baseline as         summer day or         swatte         0         Figure 30 Westerly Arrivals Option E Overflight and 2019 baseline NTK data
Communities	Noise impact on health and quality of life	<b>Route from the North</b> This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 30 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could be more concentrated in future. Aircraft then join the final approach and overfly the same areas as they do today.
		<b>Route from the South</b> The route from the south would see aircraft start a continuous descent from 7000ft, from around south of Motherwell. When reviewed against the NTK data in figure 30, the route then tracks north/north-west flying north- east of where the heat map shows the main concentration of arrivals occurring today. This part of the route flies over the populated areas of Motherwell, Bellshill, New Stevenson, Coatbridge, Glenboig, and Croftfoot. Aircraft then turn to join final approach at around 10nm from the threshold. The NTK data in figure 30 shows that this happens north-east of today's arrival concentration however this avoids the densely populated area of Kirkintilloch, Milton on Campsie and Moodiesburn nd largely routes over areas with relatively low population density with the exception of the small areas of Twechar and southern parts of Queenzieburn. Aircraft then join

the final approach and overfly the same areas as they do today.

# Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

### Table 96 Westerly arrivals option E overflight data

System	Area (km²)	Population		
RWY 23 Baseline (Vectoring)	1659.74	1250066		
RWY23 Baseline (Centreline)	184.13	139113		
RWY23 Option E	175.89	115858		
Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in				

		concentrated PBN flight path will likely be at a higher frequ 3 full options appraisal analy buildings such as hospitals a <b>60dB and 65dB L</b> амах Technical Appendix A inclu- contours are an indicator of data, as shown in table 97 sh	t's important to note that at this stage none of the data considers the frequency of overflight; althoug concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflow will likely be at a higher frequency than today. This is something that will be explored further as part of the Stag of full options appraisal analysis should this option progress. The full data tables and counts of noise sensiti buildings such as hospitals and schools, are detailed in technical appendix A. <b>60dB and 65dB LAMax</b> Technical Appendix A includes 60dB which compare Option E against the centreline baseline. These 60d contours are an indicator of the N60 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 97 shows a decrease in the area and population within the 60dB LAMax contour. The 65d AMax contours remain the same between the baseline and this option.							
		Table 97 60dB L <sub>AMax</sub> Data - Rwy23 Arrival Option E								
				60dB L	-AMax					
		System	Area (kn	1²)	Population					
		RWY23 Baseline (Centreline Optioneering tool)	- 57.86		68289					
		RWY 23 Dep Option E	53.19		53821					
		LAeq The north-east component of Arrival Option E sees a turn alter the shape or size of the	onto final appro							
	Air Quality	This option has no change anticipated changes to local								
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option E will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
		Table 98 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:         Table 98 Westerly arrival Option E – Tranquil areas overflown 0-7000ft								
		Table 98 Westerly arrival Option	n E – Tranquil are	as overflow						
Wider Society			NSA count N	SA area	National Parks count	National Parks area	DQA count	DQA area		
	Tranquillity	RWY 23 Baseline - Vectoring (NTK data) RWY 23	1	17.51	5	79.21	8	2.29		
		Baseline (Centreline – Optioneering tool)	1	23.63	1	34.52	0	0		
		Runway 23 Option E	0	0	1	26.29	0	0		
		The data shows that there is a reduction in the overflight of National Parks and there is also reduction in NSAs and DQAs which are now avoided.								
	Biodiversity	The routes that form part of Arrival Option E join the final approach at 9nm and 12nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.								
General Aviation	Access	Use of a pure PBN solution f expected to significantly redu								
	Economic impact from increased effective capacity	Use of PBN transitions alon result of less accurate final economic effect.								
		We estimate that Option E, water that the track mileage.	when compared	to baselir	e nominal cent	relines, will re	sult in an over	all increase in		
		Track Mileage								

		Track Mileage		
		Option	Track miles (nm)	Track miles (Weighted 69% (South), 13% (North) based on 2019 modal split)
General Aviation		Baseline (centreline)	58.2	2380.6
/ Commercial		E	72.8	3203.2
airlines	Fuel burn	compared to today in order to aver appendix A. The southern route al- most arrivals typically join today. All arrival options have been design the airspace above 7000ft). As part of Stage 3, should this optic we will review whether we can bala	bid noise sensitive sites. This can so takes a longer path as it joins fi ned to continuously descend from 7 on progress, we will look to refine this ance noise and CO <sub>2</sub> on the norther bacts of the increases in track leng	a less direct route to join final approach be seen in the maps shown in technical inal approach at 10nm which further than 000ft (subject to the NATS NERL ACP for s option in further detail and as part of this n route. We will also quantify fuel burn in th and benefits of continuous descent, in

Commercial	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.		
airlines	Other costs	No other airline costs are foreseen.		
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.		
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>34</sup> .		
<b>P</b>	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.		
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding. The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false		
		GPWS alerts due to high ground under final approach/base-leg. This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.		
All	Interdependencies, conflicts and tradeoffs As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinburgh of departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below. There would not be any dependencies with the network design with this option assuming LANAK stays is however that stack may require re-alignment to enable some RWY 05 departure options which could as upper portions of this PBN arrival option.			
All	AMS	<ul> <li>CAP1711 describes the objective as:</li> <li>Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.</li> <li>This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.</li> </ul>		

<sup>&</sup>lt;sup>34</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.21. Runway 23 Arrival Vectors only

shows

vectoring swathe. Visualisation of option to be developed at Stage 3

once further information around

airspace above 7000ft is known

alongside more information about

departures and CAS arrangements.

Note:

Image

# Runway 23 Westerly Arrivals Vectors only Whilst PBN arrivals enable system environmentally optimal. The former runway spacing requirements using by vectoring. The latter because the and, in the case of Glasgow would favour the 'spreading' of arrivals to principle 6

existing

Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. The former, because it is difficult for ATC to deliver accurate final approach spacing to varying runway spacing requirements using PBN only and they can often require more Controlled Airspace than is required by vectoring. The latter because they can often result in longer final approach joining points than vectoring caters for and, in the case of Glasgow would see c.85% of all Westerly arrivals on a single path. Communities can sometimes favour the 'spreading' of arrivals to mitigate against potential adverse effects of concentration as seen in Design Principle 6.

This option would see all arrivals continuing to be vectored with no PBN paths available for routine use.

Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet, so there is not an illustration for this option.

For the Design Principle Evaluation and this Initial Options Appraisal, we will assume similar impacts as the baseline however for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment					
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise da qualitative assessment has considered this modal split with daily movements averaged across the year.	ata and				
		In this vectoring option, aircraft arriving at Glasgow would continue to be tactically controlled (vectored) by ATC before joining final approach. Today aircraft typically join the runway 23 final approach between 7nm and 13nm before landing although when undertaking an ILS approach they can be as close as 6nm. This option would continue to see aircraft joining the final approach at these distances, although there is a small possibility that this could be influenced by changes to the airspace above 7000ft and departures – this will be explored in further detail at Stage 3 should this option progress.					
		Unlike PBN routes, tactical controlling of aircraft typically leads to higher levels of dispersion of flights and the sharing of the noise. The NTK data shown in figure 31, demonstrates the large swathe of overflight created by t vectoring. It shows that there are wide areas that are overflown between 1-10 times per day on average ind Weymess Bay, Fort Glasgow, Inverkip, Helensburgh, Cardross, Boglestone, Birdgend, Greenock, Dumbarton, E Balloch, Balfron, Cumbernauld, Kilsyth, Airdrie, Wishaw, Carluke, Udston, Blantyre, East Kilbride, Newton M Clarkstone, and eastern parts of the city centre of Glasgow. There is some concentration which occurs from a easterly direction, before aircraft join the final approach which overflies Larkhall, Motherwell, Belishill, Coath Gartcosh, Moddlesburn, Muirhead, eastern parts of Kirkintilloch, Milton of Campsie, and Lennoxtown.	today's cluding Bonhill, Iearns, south-				
		2019 baseline avisurmer day over swathe:					
Communities	Noise impact on health and quality of life						

and size of the CAS volume.

For the purposes of this IOA, we will use the baseline data as the closest representative data for this option. The technical appendix includes NTK and centreline data for the baseline. It's important to note that the NTK data is not modelled in the same way as the other data, however it does provide a preliminary means of comparison between this baseline and the airspace change options.

Table 99 below includes data based on the NTK heat map as shown in figure 33 above:

Table 99 Westerly arrivals baseline overflight data 0-7000ft

System	Area (km²)	Population
RWY 23 Arrivals Baseline - Vectoring (NTK data)	1659.74	1250066

In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals and places of worship:

		System		Schools count	Hospitals count	Care homes count	Places of worship count		
		RWY 23	Baseline	399	23	206	695		
			juency of o	verflight will be low			npared to most of the PE pring. This is something v		
		<b>60dB and 65dB</b> Technical Apper and the options. the baseline, ho centreline data. to equivalent PB	ELAMax dix A includ Similar to t wever this It also does N routes. V	des 60dB L <sub>AMax</sub> con he overflight data a data does not curr not articulate the /e will explore this	above, the populatio ently take into acco frequency of overflig in further detail a Sta	n within the 60dB LAMa unt the full vectored swa ht which would be lowe age 3 should the option p	arison between the baselin ox contours is highest with athe, as it is modelled fro r for some areas compare progress. The 65dB LAM main the same between a		
		Table 100 Wester	ly arrivals ba	seline L <sub>AMax</sub> data					
					60dB LAMax				
		System		Area (km²	) Popula	tion			
		RWY23 Arrival Baseline (Co Optioneering to	entreline	- 57.86	6828	9			
		option is expected option to alter the	ed to see ai le shape or	rcraft continue to j	oin final approach as	they do today and ther	the landing threshold. The fore we do not expect the option will be refined furth		
	Air Quality					red to the baseline and airspace design option.	so there are no anticipate.		
	Greenhouse gas impact	compared to the	e baseline.	We therefore exp	ect neutral benefit/i		track mileage and fuel bu jas emissions. This will t		
	Capacity /	This option would be expected to cope with future demand. The peak hourly landing rate already experienced in today's airspace through vectoring could be expected to be delivered through vectoring in the future subject to some potential changes to the vectoring patterns as a result of the changes to surrounding structures.							
	resilience	a NERL UK wid	le programr	ne under the Airs		programme, Glasgow w	sion of the VORs as part vill only have ILS precision		
Wider Society	Table 101 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and baseline. For the purposes of this IOA we have assumed the vectoring swathe to be similar today he this option progress, at Stage 3 we will refine it further and undertake further analysis on the impacts to								
	Tropouillity	Table 101 Wester	ly vectors on	ly – Tranquil areas c					
	Tranquillity	System		NSA count NSA	area National Par count	ks National Parks area	DQA count DQA area		
		RWY 23 Bas (Vectorin	ng)	1 17.	51 5	79.21	8 2.29		
		RWY2 Baseline (Cer	-	1 23.	63 1	34.52	0 0		
	Biodiversity	This option is unlikely to change where aircraft join the final approach compared to today. As impacts to biodiversit are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at aroun 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline							
General Aviation	Access				bottlenecks outside uce the total volume		on can be contained with		
	Economic impact from increased effective capacity	today's airspace	through ve	ctoring could be e	xpected to be delive	red through vectoring in	ate already experienced the future subject to son stures.		
General	effective capacity         potential changes to the vectoring patterns as a result of the changes to surrounding structures.           Table 102 provides baseline centreline data for westerly arrivals. For the purposes of this IOA we have vectoring swathe to be similar today however, should this option progress, at Stage 3 we will refine undertake further analysis on the benefits and impacts to fuel burn.								
Aviation / Commercial airlines	E all as	Table 102 Westerly Arrival Track Mileage							
	Fuel burn	Track Mileage			Track	miles (Weighted			
		Option		Track miles (nm	i) 69% (S	outh), 13% (North) on 2019 modal split)			
		Baseline (centre	,	58.2	2380.6				
Commercial airlines	Training costs		according	y and undertake tr			of this cycle, airlines upda is not anticipated to requi		
	Other costs	No other airline					andmente kannen '		
Airport / Air	Infrastructure costs					system engineering ame the airport or the ANSP.	endments however beyor		
navigation service provider	Operational costs	PBN approaches is the potential for	s provides a or the existir	in alternative appro	each procedure along s to be removed whi	gside the current ILS app ch reduces Glasgow's de	osts. The implementation proaches. This means the ependency on convention erational costs as it enable		

		VOR rationalisation <sup>35</sup> ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	No safety concerns have been identified at this stage.
All	Interdependencies, conflicts and tradeoffs	As detailed in our Stage 2A documentation on the CAA airspace change portal there are currently interdependencies between Westerly arrivals to Glasgow and Easterly arrivals to Edinburgh. We expect some dependencies and airspace buffer arrangement will continue to be required based on the geography of the airports and runways. Any changes to vectoring practices would only be as a result to changes to surrounding airspace and route structures enabled by other options.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. Vectoring of arrivals in the future would not deliver a PBN arrival solution, nor reduce the numbers of people overflown / affected by noise from Glasgow's arrivals. However it is unlikely to change the adverse effects which would be measured within the LOAEL which would not extend out to the final approach joining point. This option would meet future demand however it may not be the best future-proofed option should technological enhancements become available in the future to better rely on a pure PBN arrival solution for Glasgow.

<sup>&</sup>lt;sup>35</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.22. Runway 23 Arrival Vectors and PBN hybrid

Runway 23 We	esterly Arrivals Vect	tors and PBN hybrid
	1 13	Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. There are however the benefits of PBN for arrivals.
		This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.
		The PBN arrival(s) would likely be the 'best performing' of Options C-E above which are then optimised in Stage 3 to balance CO <sub>2</sub> , noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.
Note: Image shows existing vectoring swathe alongside the overflight contours for Options A-D. Visualisation of option to be developed at Stage 3 once PBN shortlist is known and there is further information around vectoring arrangements.		For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.
		The PBN arrival component could be any of the PBN options already assessed; the option taken forward will depend on the shortlisting as part of this IOA and the outcome of the Stage 3 Full Options Appraisal.
		Below provide links to the four assessments for the PBN Options: Initial Options Appraisal – Runway 23 Arrival Option C Initial Options Appraisal – Runway 23 Arrival Option D
		Initial Options Appraisal – Runway 23 Arrival Option E
		The PBN option assessments linked above have shown that there is the potential for PBN routes to reduce the number of people and noise sensitive sites overflown, however due to the concentration created by PBN routes, areas overflown would likely be at a higher frequency than today.
		By combining with vectoring, some of this concentration from PBN routes could be mitigated, as some aircraft would continue to be tactically controlled and would therefore see the dispersion that occurs today. This dispersion has been described in the vectoring option linked below: Initial Options Appraisal – Runway 23 Arrival Vectors only
		As described in the Vectoring assessment, the shape/size of the vectoring swathe will be dependent on a number of factors which are yet to be determined including the airspace above 7000ft, the departure options, and the CAS arrangements. We will explore this further at Stage 3.
		For this IOA, we have included an image which shows all of the potential PBN options alongside the vectoring swathe. In Stage 3 we will refine this in further detail as described above and we will also quantify when we would expect to see the PBN and vectoring used.
Communitie s	Noise impact on health and quality of life	PBN Options Overflight Contours (Black outline) with estimated % of overall arrivals
		2019 baseline average summer day overflight swathe:



Figure 32 Runway 23 PBN (All potential options) and Vectoring. Note only one PBN option would be proposed alongside vectoring.

**Overflight Data** The individual sections of the PBN Options linked above provide more detailed information on the areas overflown and overflight data. Table 103 below shows the comparison between the baseline NTK vectoring data and the different options. Although the NTK vectoring data is not modelled in the same way as the centreline data, it does provide a preliminary means of comparison between the baseline and the airspace change options.

		System	Area	Population	Schools count	Hospitals count	Carehomes count	Places c worship count		
		RWY23_BASE (Vectoring NTK data)	1659.74	1250066	399	23	206	695		
		RWY23_BASE (Centreline)	184.13	139113	66	0	22	83		
		RWY23_C	180.49	129769	58	0	20	82		
		RWY23_D	178.24	118103	51	1	18	79		
		RWY23_E	175.89	115858	50	1	15	80		
		Overall, the data suggests tha vectoring baseline however the articulated in the data tables a	ese options	will result in sor						
		This suggests that the combinat would mitigate some of the im routes would mean that when t will be explored in further deta	pacts of con traffic allowed	ncentration for the	lose communi umber of peop	ties living unde	er the PBN routes	s, and the PBN		
		<b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A includes At this stage we do not have L data shows that the PBN arri although at this stage, this da Similar to the overflight assess mitigate the impacts of PBN w this will be explored further in S	AMax data fo vals routes Ita does no sment abov ith some of	r the vectoring o result in a redu t take into acco e, by offering a h the benefits of v	r overall N60 r ction in area unt the freque nybrid PBN/ve rectoring whic	metrics - we wi and population ency of overflic ctoring option, h may result in	Il quantify these and n within the 60dl ght which would there would be on favourable LAMax	at Stage 3. The 3 L <sub>AMax</sub> contou likely increase opportunities to		
		L <sub>Aeq</sub> The north-east component of th of the PBN Options and the V the LAeq contour and therefore	ectors only e this hybric	option have sug d option is also u	gested that th nlikely to sign	ere will be no ificantly impac	impact to the sha t the shape or siz	ape and size o e.		
	Air Quality	This option has no change to changes to local air quality (po	sitive or ne	gative) as a resu	It of this airsp	ace design opt	tion.			
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated this option will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity / Option is expected to enhance Glasgow's operational performance in the future. This is because ATC can use th arrivals when traffic levels are low-medium and this will also facilitate the use of combined Tower and Approach se (Radar In Tower) offering additional resilience to ATC resource.									
Wider Society		The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
wide society	Tranquillity	This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that there are benefits to areas of tranquillity for all runway 23 PBN options. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this component of a hybrid option would offer neutral benefits/impacts to areas of tranquillity. Overall, at this stage, the IOA suggests there may therefore be some benefits to the overall hybrid option owing to the use of the PBN routes. We will explore this tranquillity assessment further in Stage 3 should this option progress.								
	Biodiversity This option is unlikely to change where aircraft join the final approach compared to today. The P the final approach from at 10 or 11nm. As impacts to biodiversity are typically associated with which when flying a standard 3 degree approach occur at around 5nm before landing, this op have an impact on biodiversity or present a change from the baseline.						ted with changes	s below 1640ft		
General Aviation	Access	Option is likely to contribute to existing CAS whilst offering so					option can be c	ontained within		
General Aviation (	Economic impact from increased effective capacity This option would be expected to cope with future demand. The peak hourly landing rate already experience airspace through vectoring could be expected to be delivered through vectoring in the future and the feature the solution would best future-proof Glasgow in the case of technological enhancements that may allow for of PBN, if desired by Glasgow and its stakeholders.						ature of PBN i			
Aviation       /         Commercial airlines       Fuel burn         Fuel burn       This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN options. For the assumed the vectoring swathe to be similar today and therefore this component of a benefits/impacts to fuel burn. Overall, at this stage, the IOA suggests there may therefore as a result of a hybrid option although these will be less than operating purely PBN articles					options. For th mponent of a h ere may therefo	e purposes of thin hybrid option wou ore be some impa	is IOA we have Ild offer neutra			
Commercial airlines	Training costs	Flight procedures are updated their procedures accordingly a any additional training costs fo	and underta							
	Other costs	No other airline costs are fores								
	Infrastructure							owever beyon		
Airport / Air navigation service provider	Costs Operational costs	This airspace change proposa PBN approaches provides an a is the potential for the existing	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP. This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>36</sup> .							
	Deployment costs	This option is expected to re Prestwick and Glasgow Airpor								

<sup>&</sup>lt;sup>36</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	Use of a PBN solution to RWY 23 may reduce the number of false GPWS alerts occasionally experienced by some arrivals.
		No other safety issues identified with this option.
All	Interdependencies, conflicts and tradeoffs So long as future Edinburgh GOSAM departures can ensure CCO to be above MSL there should be dependences with Edinburgh below 7000ft. There would not be any dependencies with the network desired option assuming LANAK stays where it is however that stack may require re-alignment to enable some departure options which could affect the upper portions of this hybrid-PBN arrival option.	
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option is considered to best meet the requirements of the AMS for Westerly arrivals. It introduces a PBN arrival solution without being reliant on it which ensures that demand can be met but allowing improved CDA for arrivals using the PBN structure. The feature of PBN in the solution would best future-proof Glasgow in the case of technological enhancements that may allow for greater use of PBN, if desired by Glasgow and its stakeholders. It would help to reduce the number of people overflown by Glasgow's arrivals without concentrating all arrivals permanently onto 2 routes.

# 4.23. Runway 05 Easterly Arrivals Baseline

# Runway 05 Easterly Arrivals Baseline

The majority of aircraft are vectored to join final approach between approximately 8nm and 11nm from touchdown however they are allowed to join final approach as close as 2000ft/6nm when using the ILS. The tracks shown which join final approach inside 6nm are likely performing a visual approach.

For more information on our do nothing scenario, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment				
Communitie	Noise impact on health and quality of life	Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.				
		Aircraft arriving at Glasgow are tactically controlled (vectored) by ATC before joining final approach which is aligned with the extended runway centreline. Aircraft typically join the runway 05 final approach between 8nm and 11nm before landing although when undertaking an ILS approach they can be as close as 6nm. Aircraft may also undertake visual approaches closer than 6nm.				
		The NTK data shown in figure 33, demonstrates the large swathe of overflight created by today's vectoring. It shows that there are wide areas to the south of the airport that are overflown between 1-10 times per day on average including Darvel, Newmilns, Galston, Kilmarnock, Kilmaurs, Dunlop, Kilwinning, Dalry, and Kilbirnie. There is some concentration which occurs from a south-easterly direction, before aircraft join the final approach which overflies Fenwick, Stewarton and Beith:				
		Figure 33 Runway 23 Departure Vectoring Swathe 2 The technical appendix to this document include to note that this data is not modelled in the sam means of comparison between this baseline and	des a larger version of this map al ne way as the overflight contours,			
		The technical appendix also includes a baseline arrivals centreline contour and associated data. Glasgow Airport does not have any published PBN arrivals and therefore this centreline has been generated by reviewing 92 day summer NTK data for 2019 and analysing the arrivals concentration which occurred across the vectored swathe. The output centreline has then been processed through the optioneering tool in order to output the data tables and contours. Table 104 below includes data based on the NTK heat map as shown in figure 33 above, and data output from the				
		optioneering tool for if aircraft were to follow one centreline arrival: <i>Table 104 Easterly arrivals baseline overflight data 0-7000ft</i>				
		System	Area (km²)	Population		
		RWY 05 Arrivals Baseline - Vectoring (NTK	691.95	140596		
		data) RWY 05 Arrivals Baseline (Centreline –	182.63	51256		
		optioneering tool)				
		The data from these tables will be used to compare the easterly arrival options against the 'do nothing' baseline. In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals and places of worship; the full data around these is shown in technical appendix a, and as part of this IOA we will provide a qualitative statement around this data.				
		<b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A includes 60dB L <sub>AMax</sub> cont and the options. Although we have shown a 6 options as the scope of the contour is only on the N60/N65 metrics which will be quantified at the	65dB L <sub>AMax</sub> contour in the appendine the final approach. 60dB and 65dB	x, this does not change between the		

System	Area (km²)	Population
RWY 05 Arrivals Baseline - Vectoring (NTK data)	691.95	140596
<b>RWY 05 Arrivals Baseline (Centreline – optioneering tool)</b>	182.63	51256
The data from these tables will be used to com In addition to population overflown, we also has hospitals and places of worship; the full data ar will provide a qualitative statement around this <b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A includes 60dB L <sub>AMax</sub> cont and the options. Although we have shown a 6 options as the scope of the contour is only on t N60/N65 metrics which will be quantified at the	ave data on the overflight of nois ound these is shown in technical data. tours and data for the baseline, to 55dB L <sub>AMax</sub> contour in the append he final approach. 60dB and 65dB	e sensitive buildings such as schools appendix a, and as part of this IOA w aid comparison between the baselin dix, this does not change between the

				60dB L	-AMax			
		System	Area	(km²)	Population			
		RWY 05 Arrivals Baseline (Centreline optioneering tool)	- 56	.96	34798			
		The data from these tables	will be used to	o compare the	e easterly arriva	ls options aga	inst the 'do no	thing' baseline.
		L <sub>Aeq</sub> Easterly arrivals make up a contours from 2017, as an i						
		Impacts to air quality are considered for changes below around 1000ft (200m). Aircraft flying above this are unlikely have a significant impact on local ground air quality.						
	Air Quality	Aircraft arriving at Glasgow fly a standard 3.0 degree approach and are aligned with the runway centreline at 1000. This is when they are very close to landing. It's therefore highly unlikely that any of our arrival's options will have a lateral changes below 1000ft however we will compare this baseline against each option.						
Wider Society		Emissions of greenhouse gases arise from the combustion of aviation fuel, and as the combustion of aviation fuel linked to track length, we have initially looked at the track length for the baseline westerly arrivals. The greenhouse g assessment is therefore linked to the fuel burn assessment detailed in the section below.						
	Greenhouse gas impact	We will estimate the differences between the baseline and the option, to understand if there are any anticipate advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today. As CO <sub>2</sub> emissions are linked to the difference in aviation fuel burnt, this will allow us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data tables are shown is technical appendix a.						
	Capacity / resilience	In future, increased forecast movements across the Scottish TMA are anticipated to result in capacity and resilient disbenefits. Although vectoring of arrivals is expected to be able to meet the forecast demand, we anticipate change to the vectoring practices may be required to facilitate the wider changes to CAS, the network and the departures. addition to this, no change to the airspace around Glasgow may also inhibit the wider FASI programme of change and AMS benefits associated with the programme.						
		For some approaches, Gla which are currently unde decommissioned as part of approaches will remain avail event on an ILS outage.	rgoing a rati a NERL UK v	onalisation p	rogramme by ne under the Air	NATS NERL	This equipr	nent is due to amme. Although
		CAP1616 outlines the consideration of impacts upon tranquillity is with specific reference to National Parks and A of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic Areas (NSA we've therefore included overflight data around these, National Parks and designated quiet areas (DQA) as part of Tranquillity assessment. At this stage of the ACP we will qualitatively assess whether the option differs from current and whether this has the potential to impact tranquillity with regards to noise and AONB.						
		Table 106 shows data on the overflight of these areas, based on the NTK heatmap and if aircraft were to foll Glasgow's existing SID centrelines. The data from this table will be used to compare the westerly arrivals to the baseline of the						
	Tranquillity	Table 106 Westerly arrival bas	seline – Tranqui	illity overflown (	0-7000ft			
		System	NSA count	NSA area	National Parks count	National Parks area	DQA count	DQA area
		RWY 05 Arrival Baseline - Vectoring (NTK data)	0	0	0	0	0	0
		RWY05 Arrival Baseline (Centreline – optioneering tool)	0	0	0	0	0	0
	Biodiversity	The effects of airspace char general, airspace change p ground-based infrastructure legislation." Though there is that disturbance effects ass 500m (~1,640ft). Considera Special Protection Areas, S Scientific Interest, particular	proposals are b. As such the b limited resea sociated with a ation will there Special Areas	e unlikely to h y are unlikely rch available of aircraft can oc fore be given of Conservati	ave an impact to have a direct on the effects of cur during take- to the effects o on, National Pa	upon biodive impact that v aircraft noise off and landir n ecology and	rsity because vould engage t on wildlife, the ng where aircra d biodiversity w	they do not inv he Birds or Hab re is some evide aft are below arc /here aircraft ov

		this typically occurs at around 5nm (9-10km) from landing. The NTK vectoring baseline shows some low frequency overflight of Castle Semple and Barr Lochs SSSI below 2000ft (Located north of the extended runway centerline). It's highly unlikely that any of our arrival's options will have any lateral changes between 5nm and landing however we will compare this baseline against each option.
General Aviation	Access	This baseline scenario would not offer any change from the existing Controlled Airspace (CAS) arrangements in place today. The options will be qualitatively compared against this existing scenario. Within c.35nm of Glasgow airports are Edinburgh and Glasgow Prestwick Airport each with their own Controlled Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports' airspace which generates the volumes shown in Figure 34. The controlled airspace at Glasgow has varying lower and upper limits with the volume closest to the airport going down to ground level. This is the Glasgow CTR shown in red outline. Also, in this figure can be seen Cumbernauld Airport approximately 15nm to the east of Glasgow airport which sits outside CAS where the base of the CTA is 3000ft. This is indicated with a yellow dot.

		It is apparent from previo CAS structures to suppo Whilst the existing base arrivals would constrain	rt Glasgow Airport's operation line scenario will not result in departure options and there	Chart (See eAIP for full of the second of date and on are out of date and not the requirement for fore offers less oppo	AA's Airspace Classification Review the CTR itself can likely be reduced more airspace, doing nothing with rtunity to simplify the airspace bound	d in size wester daries e
		reduce the size of CAS achieve.	which is something Glasge	ow has been specific	ally working with GA stakeholders	to try 1
	Economic impact from increased effective capacity		se to effective capacity by cong would constrain the ability		sterly arrivals (in isolation to the re departures.	st of th
		As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline easterly arrivals.				
General		is varied from flight to flight we have used the NTK then used the track milea a weighting based on an	ght. For the purposes of con vectoring baseline data and age from this centreline as ar	nparing our westerly a information from ATC i initial indication of 'd verall total track milea	final approach. This means that trac arrival options against the baseline s C to estimate an arrivals centreline; o nothing' track length. We have the age for the system. At the Stage 3 ful	scenario we hav n applie
General Aviation / Commercial		Table 107 Easterly Arrival	Track Mileage			
airlines	Fuel burn	Track Mileage		Track miles	(Weighted	
		Option	Track miles (nm)	69% (South), based on 2019	13% (North)	
		Baseline (centreline)	50	428.4		
		with other traffic in the a We will qualitatively est anticipated advantages/	rspace. imate the differences betwe disadvantages of the optior	en this baseline and against current day	descending due to the tactical coo d the option, to understand if there y. This estimation will consider whe also consider the opportunity for co	are ar ether th
Commercial	Training costs		in operation, there are no tra rence between our options a		d as there will be no change; later in	this IO
airlines	Other costs		in operation, there are no o rence between our options a		as there will be no change; later in	this IO
	Infrastructure costs				ticipated as there will be no change line.	; later i
Airport / Air navigation service providerCoststhis IOA we will estimate the difference between our options and this baseline.Airport / Air navigation service providerAs this option is already in operation, there are no operational costs anticipated as there will be not in IOA we will estimate the difference between our options and this baseline. For some approaches, Glasgow Airport is dependent on conventional ground based navigation which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is current substitution to mitigate VOR rationalisation however this is considered an interim measure and long term solution may result in additional operational costs.				, pround based navigation equipment RL. Glasgow is currently investigatin	t (VORs ng RNA	
	Deployment costs		in operation, there are no de difference between our opti		pated as there will be no change; lat	ter in thi
All	Safety	could however result in in	ncreased complexity and wo	kload for Air Traffic C	angements at Glasgow. Future traffi ontrollers and pilots, which may lead g in order to maintain safety.	0
All	Interdependencie s, conflicts and tradeoffs		in constraining some of Gla elocation of the LANAK hold		e options as well as some of NERL's	s option
All	AME	CAP1711 describes the Deliver quicker, quieter UK airspace.		ore capacity for the l	penefit of those who use and are aff	fected b
All	AMS	Easterly departures will	not align with the AMS as it	would constrain othe	operating environment, doing nother options. Limiting our options to or change CAS boundaries and impro	ne whic

# 4.24. Runway 05 Arrival Option A

Runway 05 Ea	sterly Arrivals Optio	on A
	/ 7/	PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway
		For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route from the south, which would also join the final approach at around 11nm, and would be used by 15% of overall arrivals.
		Control of the second of the s
Communitie s	Noise impact on health and quality of life	<ul> <li>Figure 35 Easterly Arrivals Option A Overflight and 2019 baseline NTK data</li> <li>Route from the North         This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are not heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would then turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated with the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then join the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach over the same areas as they do today.     </li> <li>Route from the South         The route from the south would see aircraft start a continuous descent from 7000ft starting from around Whitelee Forest. Aircraft would then route slightly west, largely avoiding Kilmarnock and Stewarton, before turning to the northwest, avoiding Dalry, and then joining the final approach at around 11nm. This largely avoids dense areas of population with the exception of the southern parts of Fenwick. The NTK heatmap in figure 35 shows that this route remains south of the existing areas of concentration however by doing so, it avoids the densely populated area of Stewarton. Aircraft then join today, but in doing so, aircraft are aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final approach. Beyond this point, aircraft overfly the same areas as they do today.     </li> </ul>

areas as they do today.

#### Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

### Table 108 Easterly arrivals option A overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option A	174.72	21006

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data.

		There is a significant decre- none of the data considers in number of buildings over something that will be explo The full data tables and co appendix A.	the frequence erflown, those ored further a	cy of overflight se that are ov is part of the S	; although conc erflown will like stage 3 full optio	entrated PBN ely be at a hi ns appraisal a	l flight paths w gher frequend analysis shoul	vill result in a reductic cy than today. This d this option progress		
		are an indicator of the N60 in table 109 shows a decre	<b>OdB and 65dB L<sub>AMax</sub></b> Technical Appendix A includes 60dB which compare Option A against the centreline baseline. These 60dB con are an indicator of the N60 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as s in table 109 shows a decrease in the area and population within the 60dB L <sub>AMax</sub> contour. The 65dB L <sub>AMax</sub> con- emain the same between the baseline and this option.							
		Table 109 60dB L <sub>AMax</sub> Data – I	able 109 60dB L <sub>AMax</sub> Data – Rwy05 Arrival Option A							
		60dB L <sub>AMax</sub>								
		System	Are	a (km²)	Populatio	'n				
		RWY05 Baseline (Centreline Optioneering tool)	- 5	6.96	34798					
		RWY 05 Dep Option A	Ę	52.74	27292					
		LAeq The south-west component Option A sees turns onto fir of the LAeq contours.								
	Air Quality	This option has no change changes to local air quality						ere are no anticipate		
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option A will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
		Table 110 shows data on the baseline:	ne overflight	of areas of tra	inquillity based	on the NTK v	ectoring base	line and the centrelir		
Wider		Table 110 Easterly arrival A –	Tranquil area	s overflown 0-7						
Society		System	NSA count	NSA area	National Parks count	National Parks area	DQA coun	t DQA area		
	Tranquillity	RWY 05 Baseline - Vectoring (NTK data) RWY 05	0	0	0	0	0	0		
		Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0		
			0	0	0	0	0	0		
		The data shows that there today.	will be no cl	nange in area	s of tranquillity	overflown – a	all areas will b	e avoided as they a		
	Biodiversity	associated with changes be	The routes that form part of Arrival Option A join the final approach at 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.							
General Aviation	Access	The design option may req quite be contained within S positioning the route closer than the PBN route in its ex	CTMA 5 in a to final appre	accordance wi bach in line wi	th the CAA CA	S containmer	nt policy. This	could be mitigated b		
	Economic impact from increased effective capacity	Use of PBN transitions alor less accurate final approact								
		We estimate that Option A track mileage.	when comp	ared to basel	ine nominal cer	ntrelines, will	result in a sm	all overall increase i		

	Track Mileage		
	Option	Track miles (nm)	Track miles (Weighted 15% (South), 3% (North) based on 2019 modal split)
General	Baseline (centreline)	50	428.4
Aviation /	A	57.5	492.9
	A. The southern route also t		can be seen in the maps shown in technical apper populated areas and noise sensitive sites; it joins f

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>37</sup> .
<b>P</b> . • · · • •	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and trade-offs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into juyst 2 arrival routes to each runway.

<sup>&</sup>lt;sup>37</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.25. Runway 05 Arrival Option B

Runway 05 Ea	sterly Arrivals Optio	n B
		PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm.
		For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route from the north which would is the first would route from
		the south, which would join the final approach at around 10nm, and would be used by 15% of overall arrivals.
		Option Overflight Contours (Black outline with estimated % of overall arrivals
		2019 baseline average summer day overflight wath: 1
		Figure 36 Easterly Arrivals Option B Overflight and 2019 baseline NTK data
Communitie s	Noise impact on health and quality of life	<b>Route from the North</b> This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are not heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would then turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated with the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then join the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach over the same areas as they do today.
		<b>Route from the South</b> The route from the south would see aircraft start a continuous descent from 7000ft starting from around Whitelee Forest. Aircraft would then route slightly west, overflying Fenwick and Waterside but largely avoiding Kilmarnock and Stewarton, before turning to the north-west, avoiding Dalry, and then joining the final approach at around 10nm. The NTK heatmap in figure 36 shows that this route remains south of most of the existing areas of concentration however by doing so, it avoids the densely populated area of Stewarton. Aircraft then join the final approach at around 10nm. This join occurs slightly earlier than the NTK data shows the majority of aircraft join today, but in doing so, aircraft are aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final approach. Beyond this point, aircraft overfly the same areas as they do today.

# **Overflight Data**

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 111 Easterly arrivals option B overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option B	176.02	21242

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction

		in number of buildings overf						
		something that will be explore The full data tables and cour appendix A.						
		<b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A includes 60dB which compare Option A against the centreline baseline. The are an indicator of the N60 metrics which will be quantified at the Stage 3 Full Options Appraisal. T in table 112 shows a decrease in the area and population within the 60dB L <sub>AMax</sub> contour. The 65 remain the same between the baseline and this option.						
		Table 112 60dB L <sub>AMax</sub> Data - Rw	/y23 Arrival Op	otion B				
				60dB L	.AMax			
		System	Area	(km²)	Population			
		RWY05 Baseline (Centreline · Optioneering tool)	- 56.	96	34798			
		RWY 05 Dep Option B	53.	79	27446			
		L <sub>Aeq</sub> The south-west component of Option A sees turns onto fina shape or size of the L <sub>Aeq</sub> cont	al approach					
	Air Quality	This option has no change to changes to local air quality (p						e are no anticipated
	Greenhouse gas impact	Our fuel burn assessment (se to the baseline. We therefor explored in further detail in th	e expect to	see a corres	ponding increa	ise to greenh	ouse gas emi	
	Capacity /	Use of PBN transitions alone less accurate final approach					lding would inc	rease as a result of
	resilience	The introduction of PBN appr part of a NERL UK wide pr precision approach and NDB	ogramme ur	der the Airs	pace Modernis	ation program		
		Table 113 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:						
Vider	Tranquillity	Table 113 Easterly arrival B – Tr	ranquil areas c	overflown 0-700	DOft			
Society		System N	ISA count	NSA area	National Parks count	National Parks area	DQA count	DQA area
		RWY 05 Baseline - Vectoring (NTK data)	0	0	0	0	0	0
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0
		Runway 05 Option A	0	0	0	0	0	0
		The data shows that there w today.	ill be no cha	nge in areas	of tranquillity o	verflown – all	areas will be a	avoided as they are
	Biodiversity	The routes that form part of A typically associated with char before landing, this option is	nges below 1	640ft, which v	when flying a st	andard 3 degi	ree approach c	ccur at around 5nm
General Aviation	Access	The design option may require changes to the existing CAS boundaries. The arrival routes as illustrated would not quite be contained within ScTMA 5 in accordance with the CAA CAS containment policy. This could be mitigated by positioning the route closer to final approach in line with existing arrangements although this would overfly more people than the PBN route in its existing position.						
	Economic impact from increased effective capacity	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as less accurate final approach spacing meaning lower runway utilisation. There would be a negative econom						
		We estimate that Option B when compared to baseline nominal centrelines, will result in a small overall increase in track mileage.						
		Track Mileage				Track m	niles (Weigh	ted 15%
		Option	Tracl	k miles (nm)			3% (North)	
General Aviation /		Baseline (centreline) B	50 56.3			428.4 474.9		
Commercial airlines	Fuel burn	This increase in driven largely by the northern arrival route, which takes a less direct route to join final approach compared to today in order to avoid noise sensitive sites. This can be seen in the maps shown in technical appendix A. The southern route also takes a longer path to avoid some populated areas and noise sensitive sites; it joins final approach at around 10nm which is further than most arrivals typically join today.						
		All arrival options have been airspace above 7000ft).	designed to	continuously	descend from	7000ft (subje	ct to the NATS	NERL ACP for the
		As part of Stage 3, should th review whether we can balar to understand the impacts of CO <sub>2</sub> and noise.	nce noise and	d CO2 on the	northern route	. We will also	quantify fuel b	ourn in further detail
Commercial	Training costs	Flight procedures are updated	d or introduce	ed worldwide	as part of an A	IRAC cycle. A	s part of this c	vcle, airlines update

airlines		their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>38</sup> ;
provider	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

<sup>&</sup>lt;sup>38</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.26. Runway 05 Arrival Option C

Runway 05 Ea	sterly Arrivals Optic	on C
		PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway. Slightly different track to Option A above 5000ft. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route from the south, which would also join the final approach at around 11nm, and would be used by 15% of overall arrivals. The southerly route option differs slightly from option A above 5000ft.
Communitie s	Noise impact on health and quality of life	<ul> <li>Route from the North         This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are not heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would then turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated with the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then join the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach over the same areas as they do today.     </li> <li>Route from the South         The route from the south would see aircraft start a continuous descent from 7000ft starting from around Whitelee Hill. Aircraft would then route west, avoiding Kilmarnock and Stewarton, before turning to the north-west, avoiding Dalry, and then joining the final approach at around 11nm. This avoids dense areas of population with the exception of Fenwick. The NTK heatmap in figure 37 shows that this route remains south of the existing areas of concentration however by doing so, it avoids the densely populated area of Stewarton. Aircraft then join the final approach at around 11nm. This avoids dense areas as they do today.     </li> <li>Overflight Data         The exchical appendix to this document includes a baseline image which shows a PBN centreline created using     </li> </ul>

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

### Table 114 Easterly arrivals option C overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option C	174.44	21211

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction

		in number of buildings ov something that will be expli- The full data tables and ca appendix A. <b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A inclu- are an indicator of the N60 in table 115 shows a deca remain the same between	ored further a ounts of nois udes 60dB w ) metrics whic rease in the a	s part of the St e sensitive bui hich compare th will be quan area and popu	age 3 full option Idings such as I Option C agains tified at the Stag Ilation within the	s appraisal an hospitals and at the centrelin je 3 Full Optio	alysis should th schools, are d ne baseline. Th ns Appraisal.	nis option progress. etailed in technical ese 60dB contours The data, as shown		
		Table 115 60dB LAMax Data –			I.					
				60dB						
		System	Are	a (km²)	Population					
		RWY05 Baseline (Centreline Optioneering tool)		6.96	34798					
		RWY 05 Dep Option C	5	2.74	27292					
		LAeq The south-west componer Option C sees turns onto f of the LAeq contours.								
	Air Quality	This option has no change changes to local air quality						are no anticipated		
	Greenhouse gas impact	Our fuel burn assessment to the baseline. We there explored in further detail in	fore expect t	o see a corre	sponding increa	se to greenho	ouse gas emis			
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
M/ day		Table 116 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:         Table 116 Easterly arrival C – Tranquil areas overflown 0-7000ft								
Wider Society	Tranquillity	System	NSA count	NSA area	National Parks count	National Parks area	DQA count	DQA area		
		RWY 05 Baseline - Vectoring (NTK data)	0	0	0	0	0	0		
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0		
		Runway 05 Option C	0	0	0	0	0	0		
		The data shows that there will be no change in areas of tranquillity overflown – all areas will be avoided as they are today.								
	Biodiversity	The routes that form part of Arrival Option C join the final approach at 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.								
General Aviation	Access	The design option may requite be contained within s positioning the route closer than the PBN route in its e	ScTMA 5 in a to final appro	ccordance wit	h the CAA CAS	containment	policy. This co	uld be mitigated by		
	Economic impact from increased effective capacity	Use of PBN transitions alo less accurate final approact								
		We estimate that Option C when compared to baseline nominal centrelines, will result in a small overall increase in track mileage.								
		Track Mileage				Track m	iles (Weigh	ted 15%		
		Option	Tra	nck miles (nm)	)		3% (North) I			
Comonal		Baseline (centreline)	50	2		428.4				
General Aviation / Commercial airlines	Fuel burn	C57.8497.4This increase in largely driven by the northern arrival route, which takes a less direct route to join final approach compared to today in order to avoid noise sensitive sites. This can be seen in the maps shown in technical appendix A. The southern route also takes a longer path to avoid some populated areas and noise sensitive sites; it joins final approach at around 11nm which is further than most arrivals typically join today. Compared to Option A, which also joins at 11nm, this route is slightly longer when considering connectivity with the network, due to the positioning of the 7000ft point.								
		All arrival options have be airspace above 7000ft).	Ū.							
		As part of Stage 3, should review whether we can ba to understand the impacts $CO_2$ and noise.	lance noise a	nd CO2 on the	e northern route	. We will also	quantify fuel b	urn in further detail		

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>39</sup> ;
p	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

<sup>&</sup>lt;sup>39</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.27. Runway 05 Arrival Option D

Runway 05 Ea	sterly Arrivals Optic	on D	
		PBN arrivals from the north joining final approach at approximately 11nm from the runway and from approximately 10nm. Slightly different track to Option B above 5000ft For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	m the south at
Group	Impact	Qualitative Assessment	
			r. nal approach at ould route from
Communitie s	Noise impact on health and quality of life	<ul> <li>Figure 38 Easterly Arrivals Option D Overflight and 2019 baseline NTK data</li> <li>Route from the North This route would see aircraft continuously descending from 7000ft starting from around Levan. The in route overflies areas not typically overflown by arrivals today. The population heat map shows these heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircr turn and fly south-east; this part of the route again overflies new areas however these are not heavily the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the over the same areas as they do today. </li> <li>Route from the South The route from the south would see aircraft start a continuous descent from 7000ft starting from ar Forest. Aircraft would then route west, overflying Fenwick and Waterside and the very southern parts of avoiding Kilmarnock, before turning to the north-west, avoiding Dalry, and then joining the final approach at some existing however then heads slightly further west than the concentration seen today. In doing so, the route avoid populated area of Stewarton. Aircraft then join the final approach at around 10nm. This join occurs slight the final approach at as howe the mainty of aircraft then join the final approach at around 10nm. </li> </ul>	e areas are not raft would then populated with would then join final approach ound Whitelee f Stewaton, but pach at around g concentration ids the densely ntly earlier than

### Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

the NTK data shows the majority of aircraft join today, but in doing so, aircraft are aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final

Table 10 Westerly departures baseline overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

### Table 117 Easterly arrivals option D overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option B	176.01	21379
Data on the number of noise sensitive buildin number of schools, care homes, hospitals and There is a significant decrease compared to the	d places of worship overflown comp	pared to the centreline baseline data

approach. Beyond this point, aircraft overfly the same areas as they do today.

		none of the data considers in number of buildings over something that will be explo The full data tables and co appendix A.	erflown, t ored furth	hose that are ove er as part of the S	erflown will likely tage 3 full option	/ be at a high s appraisal an	er frequency alysis should t	than today. This his option progress			
		are an indicator of the N60 in table 118 shows a decr	<b>0dB and 65dB LAMAX</b> Technical Appendix A includes 60dB which compare Option D against the centreline baseline. These re an indicator of the N60 metrics which will be quantified at the Stage 3 Full Options Appraisal. The in table 118 shows a decrease in the area and population within the 60dB LAMAX contour. The 65dB emain the same between the baseline and this option.								
		Table 118 60dB L <sub>AMax</sub> Data - I	Rwy23 Arr	ival Option B							
				60dB	L <sub>AMax</sub>						
		System	,	Area (km²)	Population						
		RWY05 Baseline (Centreline Optioneering tool)	-	56.96	34798						
		RWY 05 Dep Option D		53.88	27446						
		L <sub>Aeq</sub> The south-west componen Option D sees turns onto shape or size of the L <sub>Aeq</sub> co	final appr								
	Air Quality	This option has no change changes to local air quality						e are no anticipate			
	Greenhouse gas impact	Our fuel burn assessment to the baseline. We there explored in further detail in	fore expe	ect to see a corre	sponding increa	se to greenh	ouse gas emi				
	Capacity /	Use of PBN transitions alou less accurate final approact					ding would inc	rease as a result o			
	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.									
		Table 119 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and centreline baseline.									
Wider	Tranquillity	Table 119 Easterly arrival D – Tranquil areas overflown 0-7000ft									
Society		System	NSA co	ount NSA area	National Parks count	National Parks area	DQA count	DQA area			
		RWY 05 Baseline - Vectoring (NTK data)	0	0	0	0	0	0			
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0			
		Runway 05 Option D         0									
		The data shows that there will be no change in areas of tranquillity overflown – all areas would be avoided as they are today.									
	Biodiversity	The routes that form part of Arrival Option D join the final approach at 11nm and 10nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.									
General Aviation	Access	The design option may red quite be contained within S positioning the route closer than the PBN route in its ex	ScTMA 5	in accordance wit pproach in line wit	th the CAA CAS	containment	policy. This co	uld be mitigated b			
	Economic impact from increased effective capacity	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result o less accurate final approach spacing meaning lower runway utilisation. There would be a negative economic effect.									
		We estimate that Option D when compared to baseline nominal centrelines, will result in a small overall increase i track mileage.									
		Track Mileage				Trook m	iles (Weigh	ted 15%			
		Option		Track miles (nm	)		3% (North)				
General Aviation /	Fuel burn	Baseline (centreline) D		50 56.5		428.4 477.9					
Commercial airlines		This increase in largely dr compared to today in orde A. The southern route also approach at around 10nm joins at 10nm, this route is 7000ft point.	r to avoid takes a which is	noise sensitive s longer path to avo further than most	ites. This can be bid some popula arrivals typically	seen in the n ted areas and i join today. C	naps shown in noise sensitiv ompared to C	technical append e sites; it joins fin ption B, which als			
		All arrival options have bea airspace above 7000ft).	en design	ed to continuousl	y descend from	7000ft (subjed	t to the NATS	NERL ACP for th			
		As part of Stage 3, should review whether we can bal to understand the impacts of	lance nois	se and CO2 on th	e northern route	. We will also	quantify fuel b	ourn in further deta			

		CO <sub>2</sub> and noise.
Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation <sup>40</sup> ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. Howevrr the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into juyst 2 arrival routes to each runway.

<sup>&</sup>lt;sup>40</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 4.28. Runway 05 Arrival Vectors only

Runway 05 Eas	sterly Arrivals Vecto	ors only
Note: Image vectoring swat option to be de once further airspace above alongside more		<ul> <li>Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. The former, because it is difficult for ATC to deliver accurate final approach spacing to varying runway spacing requirements using PBN only and they can often require more Controlled Airspace than is required by vectoring. The latter because they can often result in longer final approach joining points than vectoring caters for and, in the case of Glasgow would see c.85% of all Easterly arrivals on a single path. Communities can sometimes favour the 'spreading' of arrivals through vectoring to mitigate against potential adverse effects of concentration.</li> <li>This option would see all arrivals continuing to be vectored with no PBN paths available for routine use.</li> <li>Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet so there is not an illustration for this option.</li> <li>For the Design Principle Evaluation and Initial Options Appraisal we will assume similar impacts as the baseline however, for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft.</li> <li>For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.</li> </ul>
•	-	
Group	Impact	Qualitative Assessment         Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.         In this vectoring option, aircraft arriving at Glasgow would continue to be tactically controlled (vectored) by ATC before joining final approach. Today aircraft typically join the runway 05 final approach between 8nm and 11nm before landing although when undertaking an ILS approach they can be as close as 6nm. This option would continue to see aircraft joining the final approach at these distances, although there is a possibility that this could be influenced by changes to the airspace above 7000ft and departures – this will be explored in further detail at Stage 3 should this option progress.         Unlike PBN routes, tactical controlling of aircraft typically leads to higher levels of dispersion of flights and therefore sharing of the noise. The NTK data shown in figure 33, demonstrates the large swathe of overflight created by today's vectoring. It shows that there are wide areas to the south of the airport, and some areas to the north, that are overflown between 1-10 times per day on average including Darvel, Newmilns, Galston, Kilmarnock, Kilmaurs, Dunlop, Kilwinning, Dalry, and Kilbirnie. There is some concentration which occurs from a south-easterly direction, before aircraft join the final approach which overflies Fenwick, Stewarton and Beith:
	Noise impact on	2019 baseline average summer day overflight swither
Communities	health and quality of life	Figure 39 Runway 23 Departure Vectoring Swathe 2019 The vectoring swathe as seen in Figure 39 is influenced by how aircraft arrive from the airspace above 7000ft, how departures operate, and by the structure of the surrounding CAS. This option will therefore evolve as further details are known about where aircraft will enter at 7000ft, where and how the departures might be operated, and the shape and size of the CAS volume.

For the purposes of this IOA, we will use the baseline data as the closest representative data for this option. The technical appendix includes NTK and centreline data for the baseline. It's important to note that the NTK data is not

modelled in the same way as the other data, however it does provide a preliminary means of comparison between this baseline and the airspace change options.

Table 120 below includes data based on the NTK heat map as shown in figure 39 above:

Table 120 Easterly arrivals baseline overflight data 0-7000ft

System			Area (km²)		Population					
RWY 05 Arrivals Baseline - Vectoring (NTK data)			691.95		140596					
hospitals and place	addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, ospitals and places of worship:									
System		Schools count	Hospitals count	Care non	nes count	count				
RWY 05 (Vectoring)	Baseline	51	0	32		77				
Although the date	a shows a	higher number of	noise sensitive building	ns are ove	rflown compar	ed to most of the				

		will explore in further detail	at Stage 3.							
		<b>60dB and 65dB L</b> <sub>AMax</sub> Technical Appendix A inclu and the options. Similar to the baseline, however this centreline data. It also does to equivalent PBN routes. V contours extend partially a options.	the overflight d data does not s not articulate Ve will explore	lata above, th currently take the frequency this in further	e population with e into account the y of overflight whi detail a Stage 3	in the 60dB l e full vectore ich would be should the o	LAMax contou ed swathe, as lower for son ption progress	urs is highest within it is modelled from ne areas compared s. The 65dB LAMax		
		Table 121 Westerly arrivals ba	aseline L <sub>AMax</sub> dat	ła						
				60dB L	AMax					
		System	Area	(km²)	Population					
		RWY 05 Arrivals Baseline (Centreline Optioneering tool)	- 56.	96	34798					
		L <sub>Aeq</sub> The south-west componen option is expected to see ai We therefore do not expect	ircraft continue	to join final a	pproach as they o	do today whi	ch typically oc			
	Air Quality	This option has no change changes to local air quality						e are no anticipated		
	Greenhouse gas impact	Our fuel burn assessment ( compared to the baseline. explored in further detail in	We therefore	expect neutr	ral benefit/impact	to greenho	use gas emis			
	Capacity / resilience	today's airspace through ve potential changes to the ve	This option would be expected to cope with future demand. The peak hourly landing rate already experienced in oday's airspace through vectoring could be expected to be delivered through vectoring in the future subject to some potential changes to the vectoring patterns as a result of the changes to surrounding structures.							
		Vectoring only would not improve Glasgow Airport's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
Wider Society		Table 122 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline. For the purposes of this IOA we have assumed the vectoring swathe to be similar today however, should this option progress, at Stage 3 we will refine it further and undertake further analysis on the impacts to tranquillity.								
	Tranquillity	Table 122 Easterly arrival vectors only – Tranquil areas overflown 0-7000ft								
		System	NSA count	NSA area		National Parks area	DQA count	DQA area		
		RWY 05 Baseline - Vectoring (NTK data) Runway 05 Baseline	0	0	0	0	0	0		
		Centreline	0	0	0	0	0	0		
	Biodiversity	This option is unlikely to ch are typically associated with 5nm before landing, this option	h changes belo	ow 1640ft, wh	ich when flying a	standard 3 d	legree approa	ach occur at around		
General Aviation	Access	This option can be contain result of enabling changes				unity to redu	ce the total v	olume of CAS as a		
	Economic impact from increased effective capacity	This option would be expe today's airspace through ve potential changes to the ve	ectoring could	be expected t	to be delivered th	rough vector	ring in the futu			
General Aviation /		Table 123 provides baseline centreline data for easterly arrivals. For the purposes of this IOA we have assumed the vectoring swathe to be similar today however, should this option progress, at Stage 3 we will refine it further and undertake further analysis on the benefits and impacts to fuel burn.								
Commercial airlines	Fuel burn	Table 123 Easterly Arrival Track Mileage								
		Track Mileage			Track miles	s (Weighte	ed			
		Option Baseline (centreline)	Track miles	(nm)	69% (South), based on 201 428.4					
Commercial airlines	Training costs	Flight procedures are updat their procedures according any additional training cost	ly and underta							
	Other costs	No other airline costs are fo								
	Infrastructure costs	The initial deployment phase this there are not expected						ts however beyond		
Airport / Air navigation service	Operational costs	This airspace change prop PBN approaches provides a is the potential for the existi ground based navigation eo VOR rationalisation <sup>41</sup> ;	an alternative a ng VOR approa	approach proc aches to be re	edure alongside t moved which red	he current IL uces Glasgo	S approaches	s. This means there ncy on conventional		
provider	Deployment costs	This option is expected to Prestwick and Glasgow Air 3 Full Options Appraisal wh the network above 7000ft a	port. The scale	e and nature o praising our sl	of this training rec hortlist of options	uires furthei	r exploration a	as part of the Stage		

<sup>&</sup>lt;sup>41</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

All	Safety	ATC advised that with any option which sees a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05, a PBN waypoint to direct RWY 05 arrivals to would be preferable to help them ensure separation. This would not be available in a vectoring only option. No other safety concerns have been identified at this stage.
AII	Interdependencies, conflicts and tradeoffs	To accommodate a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05 may also require a relocation of the LANAK hold in the network. This could slightly change the vectoring swathe to Runway 05 but most likely above 5/6000ft. There are not expected to be tradeoffs between arrivals below 7000ft and NERL or Edinburgh's options.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. Vectoring of arrivals in the future would not deliver a PBN arrival solution, nor reduce the numbers of people overflown / affected by noise from Glasgow's arrivals. However it is unlikely to change the adverse effects which would be measured within the LOAEL which would not extend out to the final approach joining point. Conversely a PBN arrival to RWY 05 in the lowest areas of population would require additional CAS to ensure CAS containment therefore a vectoring solution may be preferable from a CAS perspective. This option would meet future demand however it may not be the best future-proofed option should technologoical enhancements become available in the future to better rely on a pure PBN arrival solution if desired by Glasgow and its stakeholders.

# 4.29. Runway 05 Arrival Vectors and PBN hybrid

Runway 05 Ea	sterly Arrivals Vect	ors and PBN hybrid
vectoring swa overflight conto Visualisation developed at a shortlist is kn	shows existing the alongside the purs for Options A-D. of option to be Stage 3 once PBN town and there is prmation around gements.	<ul> <li>Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. There are however the benefits of PBN for arrivals. In addition, from an operational perspective for RWY 05, due to the interaction of NORBO departures with arrivals, ATC have advised than the option of PBN for arrivals would be extremely desirable. This is because it would provide a Waypoint for use which, when combined with an altitude restriction, could be used to guarantee separation against NORBO departures.</li> <li>This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.</li> <li>The PBN arrival(s) would likely be the 'best performing' of Options A-D above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.</li> <li>For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.</li> </ul>
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.
		The PBN arrival component could be any of the PBN options already assessed; the option taken forward will depend on the shortlisting as part of this IOA and the outcome of the Stage 3 Full Options Appraisal.
		Below provide links to the four assessments for the PBN Options: <u>Initial Options Appraisal – Runway 05 Arrival Option A</u> <u>Initial Options Appraisal – Runway 05 Arrival Option B</u> <u>Initial Options Appraisal – Runway 05 Arrival Option C</u> Initial Options Appraisal – Runway 05 Arrival Option D
		Initial Options Appraisal – Runway 05 Arrival Option D The PBN option assessments linked above have shown that there is the potential for PBN routes to reduce the number of people and noise sensitive sites overflown, however due to the concentration created by PBN routes, areas overflown would likely be at a higher frequency than today.
		By combining with vectoring, some of this concentration from PBN routes could be mitigated, as some aircraft would continue to be tactically controlled and would therefore see the dispersion that occurs today. This dispersion has been described in the vectoring option linked below: Initial Options Appraisal – Runway 05 Arrival Vectors only
		As described in the Vectoring assessment, the shape/size of the vectoring swathe will be dependent on a number of factors which are yet to be determined including the airspace above 7000ft, the departure options, and the CAS arrangements. We will explore this further at Stage 3.
		For this IOA, we have included an image which shows all of the potential PBN options alongside the vectoring swathe. In Stage 3 we will refine this in further detail as described above and we will also quantify when we would expect to see the PBN and vectoring used.
Communitie s	Noise impact on health and quality of life	PBN Options Overfilight Contours (Black outline with estimated % of overall arrivals
		2019 baseline average summer day overflight swathe: 1



		The individual sec overflight data. Ta options. Although preliminary means	able 124 belo the NTK veo s of comparis	bw shows the ctoring data is on between t	e comparison be s not modelled he baseline and	etween the ba in the same v I the airspace	aseline NTK ve way as the cent	ctoring data an treline data, it d	d the different		
		Table 124 Easterly a	arrivals Vector	s and PBN hyb	Population	Schools	Hospitals	Carehomes	Places worship		
		RWY05_BASE	(Vectoring	9 691.95	140596	count 51	count 0	count 32	count 77		
		RWY05_BAS (Ce RWY05_A RWY05_B	entreline)	182.63 174.72 176.02	51256 21006 21242	19 7 6	2 0 0	9 5 5	26 10 10		
		RWY05_C RWY05_D		174.44 176.01	21211 21211 21379	7 6	0	5 6	10 10 10		
		Overall, the data s the vectoring how articulated in the c	vever these d data tables at	options will re this stage of	esult in some p the process.	opulation be	ing overflown r	nore frequently	, which is not		
		This suggests that would mitigate so routes would mea will be explored in	me of the imp n that when t	pacts of concernation of concernation of concernation of the conce	entration for tho , a far lower nun	se communiti	es living under	the PBN routes	, and the PBN		
		60dB and 65dB L Technical Append At this stage we d data shows that th at this stage, this o overflight assess impacts of PBN w further in Stage 3	lix A includes o not have L <sub>4</sub> le PBN arriva data does no nent above, I <i>i</i> ith some of t	AMax data for the sources results routes results take into accurs to be offering a the benefits of the benefit	he vectoring or o Ilt in a reduction count the freque hybrid PBN/vec of vectoring white	overall N60 m in area and p ncy of overflig toring option, ch may result	etrics - we will of opulation within ght which would there would be in favourale La	quantify these a the 60dB L <sub>AMax</sub> l likely increase opportunities t	t Stage 3. The <sub>contour</sub> although . Similar to the to mitigate the		
		LAeq The south-west co of the PBN Optior the LAeq contour	ns and the Ve	ectors only op	tion have sugg	ested that the	re will be no im	pact to the sha	pe and size of		
	Air Quality	This option has no changes to local a							no anticipated		
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated this option will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.									
	Capacity /	Option is expected to enhance Glasgow's operational performance in the future. This is because ATC can use the PBN arrivals when traffic levels are low-medium and this will also facilitate the use of combined Tower and Approach services (Radar In Tower) offering additional resilience to ATC resource.									
Wider Society	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.									
	Tranquillity	This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that all of the options will continue to avoid NSAs, DQAs and National Parks, as they do today. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this too avoids these areas. We therefore expect there to be no change to overflight of tranquil areas as a result of a hybrid PBN/vectoring scenario.									
	Biodiversity	This option is unlikely to change where aircraft join the final approach compared to today. The PBN options also all join the final approach from at 10 or 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.									
General Aviation	Access	All of the existing I in accordance with middle of the exist being overflown c	n CASA's pol	icy on CAS co hich would av	ontainment. This void any increas	s could be avo	oided by position	ning a PBN arriv	/al route in the		
	Economic impact from increased effective capacity	This option would airspace through the solution would of PBN, if desired	vectoring cou best future-p	lld be expecte proof Glasgov	ed to be delivere v in the case of t	ed through ve	ctoring in the fut	ture and the fea	ture of PBN in		
General Aviation / Commercial airlines	Fuel burn	of PBN, if desired by Glasgow and its stakeholders. This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that there may be increases in track mileage and fuel burn as a result of all of the PBN options. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this component of a hybrid option would offe neutral benefits/impacts to fuel burn. Overall, at this stage, the IOA suggests there may therefore be some impacts to fuel burn as a result of a hybrid option although these will be less than operating purely PBN arrivals alone. There is scope to position a PBN arrival route in the middle of the existing swathe which would avoid any increase in CO2 emissions although it would result in more people being overflown compared to any of the existing PBN options.									
Commercial airlines	Training costs	Flight procedures their procedures a any additional trai	accordingly a	nd undertake							
	Other costs Infrastructure	No other airline co The initial deployr			ay require som	e ATC svster	n engineering a	mendments ho	wever bevond		
Airport / Air navigation service provider	Operational costs	this there are not This airspace cha PBN approaches is the potential for	expected to b nge proposal provides an a	be any change I is not anticip alternative app	es to infrastructo pated to change proach procedu	ure for the air airport or AN re alongside t	port or the ANS SP operational he current ILS a	P. costs. The imp approaches. Thi	lementation of s means there		

		VOR rationalisation <sup>42</sup> .
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	ATC advised that with any option which sees a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05, a PBN waypoint to direct RWY 05 arrivals to would be preferable to help them ensure separation. This would be available with this option. No other safety concerns have been identified at this stage.
All	Interdependencies , conflicts and tradeoffs	To accommodate a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05 may also require a relocation of the LANAK hold in the network. This could slightly change the position of the upper portion of the PBN arrival options to Runway 05 but most likely above 5/6000ft. There are not expected to be tradeoffs between arrivals below 7000ft and NERL or Edinburgh's options.
AII	AMS	<ul> <li>CAP1711 describes the objective as:</li> <li>Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.</li> <li>This option is considered to best meet the requirements of the AMS for Easterly arrivals. It introduces a PBN arrival solution without being reliant on it which ensures that demand can be met but allowing improved CDA for arrivals using the PBN structure. The feature of PBN in the solution would best future-proof Glasgow in the case of technological enhancements that may allow for greater use of PBN, if desired by Glasgow's arrivals without concentrating all arrivals permanently onto 2 routes. However it could require additional CAS to contain the arrival routes in accordance with CAA policy.</li> </ul>

<sup>&</sup>lt;sup>42</sup> Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

# 5. IOA Summary and Conclusion

The following sections provide an overview of the outcome of the IOA before explaining whether an option has been progressed into Stage 3 and the rationale around this. Within this document, we have identified that further qualitative assessment is required for some categories; details have been included, where applicable, in the full IOA tables and is also summarised in the 'preferred option' section below.

### **Discounting Methodology**

When discounting or progressing an option, each category within the IOA for each option has been reviewed in detail before being summarised as per the categories shown in table 125 below. The summary tables shown in the following sections for each runway mode provide an overview of this categorisation and show how the option has performed overall as part of the IOA.

### Table 125 IOA Summary Table Key

ΙΟΑ	IOA Summary Key					
		Anticipated overall net impacts/costs; the option may have only impacts or may have a mix of benefits and impacts where the impacts outweigh the benefits				
		Neutral; the option either offers neutral benefit, or may have a mix of benefits and impacts				
		Anticipated overall net benefits/costs; the option may have only benefits or may have a mix of benefits and impacts where the benefits outweigh the impacts				

We have used the detailed IOA assessment as well as the summary tables as the basis for determining whether to continue or discount an option. Alongside this, we have considered the Design Principles developed with stakeholders at Stage 1 as well as the requirement to meet the Airspace Modernisation Strategy (AMS). The threshold for discounting an option cannot be based on quantitative assessments alone but must also come down to the qualitative appraisals and professional judgment, as there are many factors to balance - many of which will not be quantified until the Full Options Appraisal at Stage 3. Therefore, alongside the summary tables shown in the sections below, we have included the rationale for discounting or progressing an option which explains these qualitative elements.

## 5.1. Runway 23 Westerly Departures

Group	Impact	Option A	Option B	Option C	Option D	Option E
Communities	Noise impact on health and quality of life					
	Air Quality					
	Greenhouse gas impact					
Wider Society	Capacity / resilience					
·····	Tranquillity					
	Biodiversity					
General Aviation	Access					
General Aviation / Commercial	Economic impact from increased effective capacity					
airlines	Fuel burn					
Commercial	Training costs					
airlines	Other costs					
Airport / Air	Infrastructure costs					
navigation service	Operational costs					
provider	Deployment costs					
All	Safety					
All	Interdependencies, conflicts and trade-offs					
All	AMS					
Option progressed to	o Stage 3	$\checkmark$	X	X	X	$\checkmark$

Today, all of Glasgow's SIDs turn at 5nm however in order to deliver CO<sub>2</sub> reductions through reduced track mileage and delays, all of Glasgow design options require SIDs to turn before 5nm which unavoidably means overflying new communities and more people overall. All the options were generated to explore the pros and cons of various configurations alongside their positive and negative effects. The options being taken forward into Stage 3 are those believed to best balance the range of competing environmental and operational requirements for Glasgow and its stakeholders.

Option	Is the option being progressed	Rationale
		This option is progressed on the basis of it (along with Option E) best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route.
		It is not the most optimal in CO <sub>2</sub> reductions owing to one of the NORBO tracks being slightly longer than today but it is still expected to offer significant CO <sub>2</sub> reductions overall. It also does not overfly the fewest people compared to other options but that would result in greater frequency of overflight for communities.
Runway 23 Departure Option A	Yes	It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3.
		It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated $CO_2$ emissions and cater for future demand throughout the day.
		As articulated within the appraisal, the track adjustments on departure followed by another immediate turn could be too technically challenging to achieve but this will be investigated in more detail in Stage 3. If they are a viable feature, the FOA will then help Glasgow to determine if the track adjustments increase or decrease population numbers within the 63db L <sub>Aeq. 16hr</sub> contour.
Bunway 22 Departure		This option is discontinued as it does not meet future demand and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown.
Runway 23 Departure Option B	No	It would overfly the fewest people as well as performing well in reducing track miles compared to other options but in turn would lead to greater frequency of overflight for those communities under the new routes and could result in increased ground delay in the future, offsetting some of those gains in track mileage reductions.
Runway 23 Departure Option C	No	This option is discontinued as it does not meet future demand and would concentrate Glasgow's busiest departure route over the same populations for the majority of the day who would be newly overflown. We attempted to mitigate the overflying of new communities by introducing a SID switching feature but that would have resulted in the same communities (to the south of final approach) being overflown even more than without the SID switch, albeit to the benefits of other communities.
		The SID switching feature is assessed as being not operationally viable for safety reasons, as articulated in the appraisal.
Runway 23 Departure Option D	No	This option is discontinued as it does not meet future demand due to the dual NORBO tracks only being available for part of the day. Like with Option C, the single NORBO track would then overfly the same communities all day and in this option those communities are under final approach and are therefore overflown the majority of the time. The result is this option overflies the most people below 4000ft compared to Options A-E.
		The SID switching feature is assessed as being not operationally viable for safety reasons, as articulated in the appraisal.
		This option is progressed on the basis of it best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route.
		It is the most optimal in CO <sub>2</sub> reductions. The route positioning means it scored 2 <sup>nd</sup> best in terms of population overflown below 4000ft whilst still splitting NORBO departures across 2 different routes.
Runway 23 Departure	Yes (preferred	It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3.
Option E	option)	It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO <sub>2</sub> emissions and cater for future demand throughout the day. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. This NORBO route would also reduce the frequency of overflight for those communities to the north of final approach who may experience increased overflight (compared to today) from the northbound departures.
		The data suggests that the lack of a track adjustment on departure would result in lower population numbers overflown below 4000ft compared to Option A but more granular analysis is required in the FOA.

# 5.2. Runway 05 Easterly Departures

Group	Impact	Option A	Option B	Option C	Option D	Option E	Option F	Option G	Option H	Option I
Communities	Noise impact on health and quality of life									
	Air Quality									
	Greenhouse gas impact									
Wider Society	Capacity / resilience									
White Society	Tranquillity									
	Biodiversity									
General Aviation	Access									
General Aviation / Commercial	Economic impact from increased effective capacity									
airlines	Fuel burn									
Commercial	Training costs									
airlines	Other costs									
Airport / Air	Infrastructure costs									
navigation service	Operational costs									
provider	Deployment costs									
All	Safety									
All	Interdependencies, conflicts and tradeoffs									
AMS	A qualitative (high-level) assessment of how the Design Options perform against the vision and parameters / strategic objectives of the AMS									
Option progres	Option progressed to Stage 3			X	X	X	X	X	$\checkmark$	$\checkmark$

Today, all of Glasgow's SIDs turn at 5nm however in order to deliver CO<sub>2</sub> reductions through reduced track mileage and delays, all of Glasgow design options require SIDs to turn before 5nm which unavoidably means overflying new communities and more people overall. All the options were generated to explore the pros and cons of various configurations alongside their positive and negative effects. The options being taken forward into Stage 3 are those believed to best balance the range of competing environmental and operational requirements for Glasgow and its stakeholders.

Option	ls the option being progressed	Rationale
Runway 05 Departure Option A	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO <sub>2</sub> emissions (compared to other options) and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown, albeit areas of relatively low population compared to under the other SIDs. The Southbound SIDs turn earlier than today, overflying new communities but without offering other benefits. The option would have delivered significant CO <sub>2</sub> savings but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
Runway 05 Departure Option B	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO2 emissions (compared to other options) and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown, albeit areas of relatively low population compared to under the other SIDs. The option would have delivered significant CO <sub>2</sub> savings but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
Runway 05 Departure Option C	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO2 emissions (compared to other options) and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown, albeit areas of relatively low population compared to under the other SIDs. The Southbound SIDs turn earlier than today, overflying new communities but without offering other benefits. The option would have delivered significant CO <sub>2</sub> savings but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
Runway 05 Departure Option D	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO <sub>2</sub> emissions (compared to other options) and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown, albeit areas of relatively low population compared to under the other SIDs. The option would have delivered significant CO <sub>2</sub> savings but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
Runway 05 Departure Option E	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO <sub>2</sub> emissions (compared to other options) and would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown as well as those areas being highly populated This option performed least optimal in CO <sub>2</sub> emissions from track mileage reductions.

Runway 05 Departure Option F	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO <sub>2</sub> emissions (compared to other options) and would concentrate Glasgow's busiest departure route over areas of very high population for ½ of the day. This option performed similarly to Option E in terms of CO <sub>2</sub> emissions from track mileage reductions. Whilst the SID switch is assessed as being not operationally viable for safety reasons articulated in the appraisal, it would have also increased CO <sub>2</sub> performance compared to keeping the Period 1 SID as a permanent arrangement.
Runway 05 Departure Option G	No	This option is discontinued as it does not meet future demand, resulting in increased delays and associated CO <sub>2</sub> emissions (compared to other options) and would concentrate Glasgow's busiest departure route over extremely dense population for most of the day with high numbers of newly overflown people. Whilst the SID switch is assessed as being not operationally viable for safety reasons articulated in the appraisal, it would have resulted in the highest numbers of population overflown 0-4000ft and 0-7000ft although would have delivered the greatest CO <sub>2</sub> reductions based on track length.
Runway 05 Departure Option H	Yes	This option is progressed on the basis of it best meeting the needs of the airport (along with option I), airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route. It performs very well in terms of CO <sub>2</sub> reductions. The route positioning means it scored similar to Options A-C in terms of overflight below 4000ft but without overflying new population to the south at low altitude but it still splits NORBO departures across 2 different routes. It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3. It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO <sub>2</sub> emissions and caters for future demand throughout the day. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. This NORBO route would also reduce the frequency of overflight for those under final approach who may experience increased overflight (compared to today) from the northbound departures.
Runway 05 Departure Option I	Yes (preferred option)	<ul> <li>This option is progressed on the basis of it best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route.</li> <li>It performs very well in terms of CO<sub>2</sub> reductions. The route positioning means it scored similar to Options D in terms of overflight below 4000ft but without overflying new population to the south and low altitude but it still splits NORBO departures across 2 different routes.</li> <li>It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3.</li> <li>It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO<sub>2</sub> emissions and caters for future demand throughout the day. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. This NORBO route would also reduce the frequency of overflight for those communities to the north of final approach who may experience increased overflight (compared to today) from the northbound departures.</li> <li>The data suggests that the lack of a track adjustment on departure would result in lower population numbers overflown below 4000ft compared to Option H but more granular analysis is required in the FOA.</li> </ul>

# 5.3. Runway 23 Westerly Arrivals

Group	Impact	Runway 23 Arrival Option C		Runway 23 Arrival Option E	Runway 23 Arrival Vectors only	Runway 23 Arrival Hybrid Vectors and PBN
Communities	Noise impact on health and quality of life					
Communities	Air Quality					
	Greenhouse gas impact					
Wider Society	Capacity / resilience					
wider Society	Tranquillity					
	Biodiversity					
General Aviation	Access					
General Aviation /	Economic impact from increased effective capacity					
Commercial airlines	Fuel burn					
Commercial airlines	Training costs					
Commercial airmes	Other costs					
Airport / Air	Infrastructure costs					
navigation service	Operational costs					
provider	Deployment costs					
All	Safety					
All	Interdependencies, conflicts and tradeoffs					
AMS	A qualitative (high-level) assessment of how the Design Options perform against the vision and parameters / strategic objectives of the AMS					
Option progressed to	o Stage 3	Х	× 🗸	Х	$\checkmark$	$\checkmark$

As articulated in our Stage 2A document, use of pure PBN for arrivals into Glasgow does not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. Therefore, this option was discounted in the DPE. However, the option of a mix of PBN and vectoring does come through very favourable. In this scenario, we would want to use the best performing PBN routes so we will take the PBN arrival options (other than the ones discounted above) into the Full Options Appraisal for further assessment to help inform the Hybrid vectors and PBN options.

Option	Is the option being progressed	Rationale
Runway		This option was the best performing PBN arrival option in terms of $CO_2$ but the poorest performer in terms of population numbers, overflying more than double the numbers of people 4000ft and below than Option E.
23 Arrival Option C	No	The final positioning of a PBN route to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including FAF positioning, consideration of 'The Campsie Line GPWS issues' as well as a balancing of CO <sub>2</sub> versus noise impacts. This will likely result in PBN arrival routes in the close vicinity of Option C, D or E. At this stage we consider Option D to be the preferred compromise.
Pupwov	No (proferred for	This option overflies considerable fewer population numbers than Option C 0-4000ft and 0-7000ft with much better CO <sub>2</sub> performance compared to Option E.
Runway No (preferred for 23 Arrival Hybrid Vectors and Option D PBN option)		The final positioning of a PBN route to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including FAF positioning, consideration of 'The Campsie Line GPWS issues' as well as a balancing of CO <sub>2</sub> versus noise impacts. This will likely result in PBN arrival routes in the close vicinity of Option C, D or E. At this stage we consider Option D to be the preferred compromise but will look to further optimise in Stage 3.
Dummer		This option was the worst performing PBN arrival option in terms of CO <sub>2</sub> but the best performer in terms of population numbers, overflying more than half the numbers of people 4000ft and below than Option C.
Runway 23 Arrival Option E	No	The final positioning of a PBN route to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including FAF positioning, consideration of 'The Campsie Line GPWS issues' as well as a balancing of CO <sub>2</sub> versus noise impacts. This will likely result in PBN arrival routes in the close vicinity of Option C, D or E. At this stage we consider Option D to be the preferred compromise.
Runway 23 Arrival Vectors only	Yes	Vectoring is a proven and ever flexible method of efficiently managing arrivals. It is likely that changes to the network as well as to the rest of Glasgow's route structure will result in a change to vectoring practices and this option is carried forward to accommodate those changes.
Runway 23 Arrival Hybrid Vectors and PBN	Yes (preferred)	This is Glasgow's preferred option as the availability of PBN arrivals to RWY 23 may be able to address some of the GPWS issues, greatly reduce the numbers of people overflown by avoiding population centers, enhance CDA performance and reduce controller workload to support operation concepts such as Radar In The Tower. Retention of vectoring still enables ATC to deliver accurate and variable spacing, mitigates the increase in track miles that a Permanent PBN arrival may require but also ensure some track variation on the ground compared to pure PBN.

# 5.4. Runway 05 Easterly Arrivals

Group	Impact	Runway 05 Arrival Option A	Runway 05 Arrival Option B	Runway 05 Arrival Option C	Runway 05 Arrival Option D	Runway 23 Arrival Vectors only	Runway 23 Arrival Hybrid Vectors and PBN
Communities	Noise impact on health and quality of life						
	Air Quality						
	Greenhouse gas impact						
Widen Coniety	Capacity / resilience						
Wider Society	Tranquillity <sup>43</sup>						
	Biodiversity						
General Aviation	Access						
General Aviation / Commercial	Economic impact from increased effective capacity						
airlines	Fuel burn						
Commercial	Training costs						
airlines	Other costs						
Airport / Air	Infrastructure costs						
navigation service	Operational costs						
provider	Deployment costs						
All	Safety						
All	Interdependencies, conflicts and trade-offs						
AMS	Performance against the vision and parameters / strategic objectives of the AMS						
Option pro	gressed to Stage 3	Х	X 🗸	Х	Х	$\checkmark$	$\checkmark$

As articulated in our Stage 2A document, use of pure PBN for arrivals into Glasgow does not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. Therefore, this option was discounted in the DPE. However, the option of a mix of PBN and vectoring does come through very favourably. In this scenario, we would want to use the best performing PBN routes so we will take the PBN arrival options (other than the ones discounted above) into the Full Options Appraisal for further assessment to help inform the Hybrid vectors and PBN options.

Option	ls the option being progressed	Rationale
Runway 05 Arrival Option A	No	Options A-D performed similarly in the IOA with very small variations between them in terms of population, noise sensitive receptors and $CO_2$ . On balance, Option B is Glasgow's preferred option to take forward although this will need refinement due to FAF positioning and the desire to mitigate any increase in CAS boundaries to the West.
Runway 05 Arrival Option B	No (preferred for Hybrid Vectors and PBN option)	Options A-D performed similarly in the IOA with very small variations between them in terms of population, noise sensitive receptors and $CO_2$ . On balance, Option B is Glasgow's preferred option to take forward although this will need refinement due to FAF positioning and the desire to mitigate any increase in CAS boundaries to the West.
Runway 05 Arrival Option C	No	Options A-D performed similarly in the IOA with very small variations between them in terms of population, noise sensitive receptors and CO <sub>2</sub> . On balance, Option B is Glasgow's preferred option to take forward although this will need refinement due to FAF positioning and the desire to mitigate any increase in CAS boundaries to the West.
Runway 05 Arrival Option D	No	Options A-D performed similarly in the IOA with very small variations between them in terms of population, noise sensitive receptors and CO <sub>2</sub> . On balance, Option B is Glasgow's preferred option to take forward although this will need refinement due to FAF positioning and the desire to mitigate any increase in CAS boundaries to the West.
Runway 23 Arrival Vectors only	No	Vectoring is a proven and ever flexible method of efficiently managing arrivals. It is likely that changes to the network as well as to the rest of Glasgow's route structure will result in a change to vectoring practices and this option is carried forward to accommodate those changes.
Runway 23 Arrival Hybrid Vectors and PBN	Yes	This is Glasgow's preferred option as the availability of PBN arrivals to RWY 05 may be able to reduce the numbers of people overflown by avoiding population centres, enhance CDA performance and reduce controller workload to support operation concepts such as Radar In The Tower. However, all of options A-D could require additional CAS to contain the routes in accordance with CAA policy. This CAS requirement will be investigated in Stage 3 to try and avoid the need for any additional CAS through alternative mitigation. Retention of vectoring still enables ATC to deliver accurate and variable spacing, mitigates the increase in track miles that a Permanent PBN arrival may require but also ensure some track variation on the ground compared to pure PBN.
		The availability of a PBN waypoint to ensure separation between RWY 05 arrivals and departures is currently considered to be a requirement in the final solution.

<sup>&</sup>lt;sup>43</sup> All options avoid overflight of tranquil areas which is the same as the vectoring and centreline baseline.

# 5.5. Preferred option and information to collect as part of the Full Options Appraisal

We have outlined which options we plan to take forward to Stage 3 as part of our <u>IOA Summary and conclusion section above</u>. As part of this, we have also indicated our preferred options however it's important to note that we will revisit our preferred options following the Full Options Appraisal. All airspace design options in this document are subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.

Throughout this Initial Options Appraisal, we have highlighted where we plan to undertake further detailed appraisal as part of our Stage 3 Full Options Appraisal, in order to further assess the benefits and impacts of an option. This is particularly the case with the primary noise metric data, where at Stage 3 we will fully quantify the L<sub>Aeq</sub> contours associated with each option to CAP2091 standards, allowing us to quantify the benefits and impacts. We have also identified other categories where further quantitative appraisal work is required.

We plan to collect the following data and undertake the additional assessments as part of our Full Options Appraisal assessment and following this assessment we will outline the options that we intend to take to Consultation:

- Quantify the baseline year (pre-implementation and 10 years post implementation)
- Quantitative LAeq contours, population counts and size (km<sup>2</sup>)
- WebTAG assessment
- Quantitative overflight contours that detail frequency of overflight including 100% easterlies and westerlies, and cumulative impacts from arrivals/departures and other airports
- Detailed track length comparison
- Detailed fuel burn and equivalent CO<sub>2</sub> emissions data
- Further information around interdependencies with the upper network and neighbouring airports
- ATC deployment / training costs
- Quantitative capacity information
- Quantified CAS requirements
- Further information following engagement with gliding areas around airspace availability

## 5.6. Impacted Audiences

At the 'Develop and assess' gateway, the IOA must set out impacted audiences, as this information will be a key feature in developing the consultation strategy required during Step 3A and at the 'Consult' gateway.

The following figures show our options on one map image, displayed using overflight contours and the vectoring NTK heatmap. We will use this mapping as a starting point to identify our impacted audiences and ensure that this is considered when developing our consultation strategy at Stage 3. We're aware that other factors also need to be taken into account when identifying the audience such as other noise metrics, changes to controlled airspace etc and we will ensure these are also factored in.

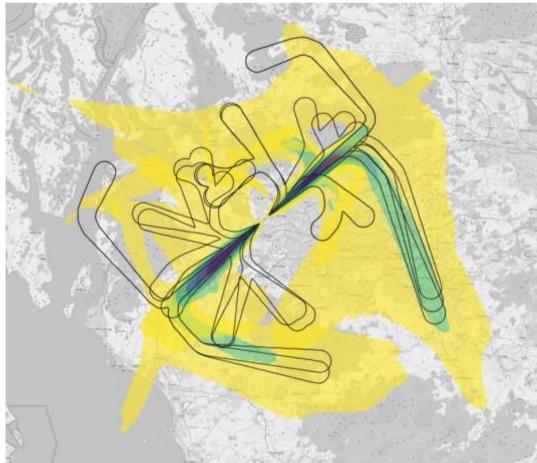


Figure 43 All Options for Stage 3 (Overflight Contours)

Figure 44 All Options for Stage 3 (Overflight Contours)