Southampton Airport FASI-S Airspace Change Proposal

Step 2B
Initial Options Appraisal

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CAA Feedback	Southampton Airport Response	Location
A Table in Section 2 of the IOA lists the four options under consideration, and each is described in a Table. Two additional options, the 'Do Nothing' option and Option 2, were discounted, and hence not included in the Table. The change sponsor should therefore include 'Do Nothing' and Option 2 in the Table, and state why they are not under consideration (i.e. for safety reasons). [CAP 1616 E12].	The information requested by the CAA is already included in the text prior to the table (paragraph 2 and 3, page 19) This explains the outcomes of the Design Principle Evaluation and outlines why Option 2 and the 'do nothing' did not proceed to the IOA. The following paragraph then states 'The following section summarises the airspace change options we have taken through to this IOA'. Although based on the above we believe we have met the requirements of CAP1616 E12, to satisfy the CAA feedback we have included an extra section within the table. This duplicates the information already contained within the original submission documents.	Page 22
Option 3 is discounted as part of the IOA exercise in the summary Table in Section 5 of the IOA. However, the explanation in that Table is not clear. The change sponsor should therefore clarify the explanation for discounting Option 3 in the Table. [CAP 1616 E19]	We have added further clarification around the discontinuing of components of Option 3 to the conclusion table.	Page 65-66
Section 5 contains a bulleted list of the information the sponsor plans to collect but does not indicate how this will be collected. Further information on the evidence to be gathered could be useful. The change sponsor should therefore clarify how the data required to fill in all such evidence gaps identified at Stage 2 will be gathered and used to develop the options appraisal at Stage 3. [CAP 1616 E12]	We have added a table with further information about how we plan to collect additional quantitative evidence as part of the Stage 3 Full Options appraisal to the 'Preferred Option & Information to collect as part of Full Options Appraisal at Stage 3' section.	Page 67-68

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Glossary

Acronym	Term	Description
ACOG	Airspace Change Organising Group	Established in 2019 at the request of the Department for Transport and Civil Aviation Authority to coordinate the delivery of key elements of the UK's Airspace Modernisation Strategy.
ACP	Airspace Change Proposal	To carry out any permanent change to the published airspace, the Civil Aviation Authority (CAA) requires the change sponsor to carry out an airspace change proposal in accordance with CAP1616.
ADS-B	Automatic Dependent Surveillance Broadcast	A means by which aircraft can automatically transmit and/or receive data such as identification, position, and additional data, as appropriate in a broadcast mode via a data link.
AIP	Aeronautical Information Publication	A publication which contains details of regulations, procedures and other information pertinent to the operation of aircraft in the particular country to which it relates.
AMS	Airspace Modernisation Strategy	UK Government has tasked the aviation industry to modernise airspace in the whole of the UK. The long-term strategy of the CAA and the UK Government is called the Airspace Modernisation Strategy (AMS). Its CAA document reference number is CAP1711.
AMSL	Above Mean Sea Level	
ANSP	Air Navigation Service Provider	An organisation that provides the service of managing the aircraft in flight or on the manoeuvring area of an airport and which is the legitimate holder of that responsibility.
AONB	Area of Outstanding Natural Beauty	
ATC	Air traffic control	The ground-based personnel and equipment concerned with controlling and monitoring air traffic within a particular area.
ATZ	Aerodrome Traffic Zone	An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.
CAA	Civil Aviation Authority	The UK Regulator for aviation matters
CAP1616	Civil Aviation Publication 1616	The airspace change process regulated by the CAA
	Capacity	A term used to describe how many aircraft can be accommodated within an airspace area without compromising safety or generating excessive delay
CAS	Controlled Airspace	Generic term for the airspace in which an air traffic control service is provided as standard; note that there are different sub classifications of airspace that define the particular air traffic services available in defined classes of controlled airspace.

Acronym	Term	Description
-	Centreline	The nominal track for a published route
-	Concentration	Refers to a density of aircraft flight paths over a given location, this generally refers to high density where tracks are not spread out; this is the opposite of dispersal
CCO	Continuous Climb Operations	An aircraft operating technique facilitated by the airspace and procedure design and assisted by appropriate ATC procedures, allowing the execution of a flight profile optimised to the performance of aircraft, leading to significant economy of fuel and environmental benefits in terms of noise and emissions reduction
CDO	Continuous Descent Operations	An aircraft operating technique in which an arriving aircraft descends from an optimal position with minimum thrust and avoids level flight to the extent permitted by the safe operation of the aircraft and compliance with published procedures and ATC instructions
-	Conventional navigation	The historic navigation standard where aircraft fly with reference to ground-based radio navigation aids
-	Conventional route	Routes defined to the conventional navigation standard, i.e. using ground based radio navigation beacons to determine their position.
CTA	Control Area	Controlled airspace extending upwards from a specified limit above the earth. Control Areas are situated above the Aerodrome Traffic Zone (ATZ) and afford protection over a larger area to a specified upper limit.
CTR	Control Zone	Controlled airspace extending upwards from the surface of the earth to a specified upper limit. Aerodrome Control Zones afford protection to aircraft within the immediate vicinity of aerodromes
dB	Decibels	A unit used to measure the intensity of a sound (or the power level) of an electrical signal by comparing it with a given level on a logarithmic scale.
DER	Declared End of Runway	
-	Dispersal	Refers to the density of aircraft flight paths over a given location, this generally refers to lower density – tracks that are spread out; this is opposite of Concentration
DPE	Design Principle Evaluation	A evaluation of each option against each design principle which forms part of Stage 2A of the CAP1616 process
-	Easterlies	When a runway is operating such that aircraft are taking off and landing in an easterly direction
-	Final Approach	The final part of an arrival flight path that is directly lined up with the runway
FL	Flight Level	The Altitude above sea-level in 100 feet units measured according to a standard atmosphere. A flight level is an indication

Acronym	Term	Description
		of pressure, not of altitude. Only above the transition level (which depends on the local QNH but is typically 6000 feet above sea level) are flight levels used to indicate altitude; below the transition level feet are used.
FLARM	Flight Alarm	FLARM (an acronym based on 'flight alarm') is the proprietary name for an electronic device which is in use as a means of alerting pilots of small aircraft, particularly gliders, to potential collisions with other aircraft which **are similarly equipped.**
FUA	Flexible Use Airspace	Airspace which is not solely designated for a single purpose, but can be allocated flexibly according to need, or switched entirely on/off according to a schedule or agreed process.
-	Flight-path	The track flown by aircraft when following a route, or when being directed by air traffic control
ft	Feet	The standard measure for vertical distances used in air traffic control
FASI	Future Airspace Implementation Strategy	Under the Government's Airspace Modernisation Strategy (AMS, ref 15) airports in the UK are required to update their airspace and routes in a coordinated way.
GA	General Aviation	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. The most common type of GA activity is recreational flying by private light aircraft and gliders, but it can range from paragliders and parachutists to microlights, balloons, and private corporate jet flights.
IFP	Instrument Flight Procedures	A published procedure used by aircraft flying in accordance with the instrument flight rules, which is designed to achieve and maintain an acceptable level of safety in operations and includes an instrument approach procedure, a standard instrument departure, a planned departure route and a standard instrument arrival.
ILS	Instrument Landing System	An ILS operates as a ground-based instrument approach system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals to enable a safe landing even during poor weather.
IOA	Initial Options Appraisal	A qualitative appraisal of an option against a baseline 'do nothing' scenario, as required at Step 2B of CAP1616
L_{Aeq}		The most common international measure of noise, meaning, 'equivalent continuous sound level'. This is a measurement of sound energy over a period of time.
$L_{Aeq\ 16h}$		The A-weighted Leq measured over the 16 busiest daytime hours (0700-2300) is the normal time-period used to develop the Airport Noise Contours for day-time operations.

Acronym	Term	Description
$L_{Aeq\ 8h}$		The A-weighted Leq measured over the 8 night-time hours (2300-0700) is the normal time-period used to develop the Airport Noise Contours for night-time operations.
-	Lower Airspace	Airspace in the general vicinity of the airport containing arrival and departure routes below 7,000ft. Airports have the primary accountability for the design of this airspace, as its design and operation is largely dictated by local noise requirements, airport capacity and efficiency
NAP	Noise Abatement Procedures	Noise abatement procedures are designed to minimise exposure of residential areas to aircraft noise, while ensuring safety of flight operations
NATS (ATC)		NATS ATC - the air navigation service provider at Southampton Airport under commercial contract for the aerodrome control provision.
NATS NERL		NATS NERL - The UK's licenced air traffic service provider for the en route airspace (upper network) that connects airports with each other, and with the airspace of neighbouring states.
nm	Nautical Mile	Aviation measures distances in nautical miles. One nautical mile (nm) is 1,852 metres. One road mile ('statute mile') is 1,609 metres, making a nautical mile about 15% longer than a statute mile.
-	Network Airspace / Upper network	En route airspace above 7,000ft in which NATS has accountability for safe and efficient air traffic services for aircraft travelling between the UK airports and the airspace of neighbouring states.
NTK	Noise Track Keeping	A system that monitors and records radar data to monitor aircraft operations and report statistics focused around noise.
PANS OPS	Procedures for Air Navigation Services Aircraft Operations	PANS-OPS is contained in an ICAO Document 8168 which sets out the design criteria and rules for instrument flight procedures which include approach and departure procedures.
PBN	Performance Based Navigation	Referred to as PBN; a generic term for modern standards for aircraft navigation capabilities including satellite navigation (as opposed to 'conventional' navigation standards)
RMA	Radar Manoeuvring Area	An ATC operational area articulated as a volume of airspace by the ANSP. It facilitates the close-in radar vectoring by ATC that is required to take the aircraft safely from a holding stack and established onto final approach.
RNAV RNAV 1	/aRea NaVigation	This is a generic term for a particular specification of Performance Based Navigation. The suffix '1' denotes a requirement that aircraft can navigate to within 1nm of the centreline of the route 95% or more of the time. In practice the accuracy is much greater than this.

Acronym	Term	Description
RNP-RF	Required Navigation Performance – Radius to fix	An advanced navigation specification under the PBN umbrella. The suffix '1' denotes a requirement that aircraft can navigate to within 1nm of the centreline 95% or more of the time, with additional self-monitoring criteria. In practice the accuracy is much greater than this. The RF means Radius to Fix, where airspace designers can set extremely specific curved paths to a greater accuracy than RNAV1.
RNP-AR	Required Navigation Performance – Authorisation required	An advanced navigation specification under the PBN umbrella. 'Authorisation required' refers to aircraft and operators complying with specific airworthiness and operational requirements. RNP-AR allow airspace designers to set extremely specific curved paths to a greater accuracy than RNAV1, these can be designed before and after the Final Approach Fix.
-	Separation	Aircraft under Air Traffic Control are kept apart by standard separation distances, as agreed by international safety standards. Participating aircraft are kept apart by at least 3nm or 5nm lateral separation (depending on the air traffic control operation), or 1,000ft vertical separation.
SID	Standard Instrument Departure	Usually abbreviated to SID; this is a route for departures to follow straight after take-off.
	Tactical Intervention	Air traffic control methods that involve controllers directing aircraft for specific reasons at that particular moment (see Vector)
TMA /LTMA	Terminal Manoeuvring Area (Terminal Airspace) / London Terminal Manoeuvring Area	An aviation term to describe a designated area of controlled airspace surrounding a major airport or cluster of airports where there is a high volume of traffic. The airspace surrounding Southampton airports is described as the London TMA (LTMA).
TMZ	Transponder Mandatory Zone	Airspace of defined dimensions where the carriage and operation of transponder equipment is mandatory.
VFR	Visual Flight Rules	Visual Flight Rules (VFR) are the rules that govern the operation of aircraft in Visual Meteorological Conditions (VMC) (conditions in which flight solely by visual reference is possible)
VMC	Visual Meteorological Conditions	Visual meteorological conditions (VMC) are the meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima
VSA	VFR Significant Area	A volume of airspace which has been identified as being particularly important to VFR operations. A VSA might take the form of a route, a zone, or an area chosen for its particular importance to GA users. These areas do not have any official status but are intended to highlight the importance of a particular area so that future airspace development plans can take account of the GA activity.

Acronym	Term	Description
-	Vector / vectoring	An air traffic control method that involves directing aircraft off the established route structure or off their own navigation – ATC instruct the pilot to fly on a compass heading and at a specific altitude. In a busy tactical environment, these can change quickly. This is done for safety and for efficiency.
-	Westerly operation	When a runway is operating such that aircraft are taking off and landing in a westerly direction

1. Introduction

Following the publication of the strategic rationale for airspace modernisation[1], 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)[2], 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 Q4 2022.

One of the most important initiatives required to achieve the AMS objective is known as FASI (Future Airspace Strategy Implementation). 22 airports in the UK comprise FASI and Southampton 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 22 airports (for the local arrival and departure routes below 7000ft) and by NERL (for the airspace structures and route network above 7000ft).

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 route options that can distribute the impacts more equitably, or be configured to offer relief from noise, must be considered in consultation with local stakeholders when routes are being developed for deployment at lower altitudes.

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.

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[1] Upgrading UK Airspace Strategic Rationale
[2] UK Airspace Modernisation Strategy, CAA CAP1711, 2018

Given the large number of organisations involved (22 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[3] was accepted by CAA on 27th 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[4]. 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 next section.

Iteration 2 places Southampton Airport in the 'LTMA[5] regional cluster' alongside Biggin Hill, Bournemouth, Heathrow, Gatwick, London City, Manston, RAF Northolt, Southampton, Southend and Stansted airports. In September 2022, Farnborough Airport were also accepted into the Masterplan and we would expect Farnborough Airport will now form part of the LTMA regional cluster going forwards.

Southampton Airport began their ACP to modernise their airspace in January 2019 and passed through Stage 1 of CAP1616 in August 2019. In April 2020, 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 Southampton Airport to recommence their ACP in June 2021.

This document forms part of Southampton Airport's Stage 2 submission to the CAA. It sets out how Southampton Airport has developed its Comprehensive List of Options for the ACP and how it tested those options and their development with their stakeholders. It then explains the methodology used to evaluate the options against the Design Principles as well as containing a summary of that evaluation.

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.

[3] Link to Iteration 2
[4] CAA CAP 1616, edition 4, March 2021
[5] London Terminal Manoeuvring Area

The CAP1616 Airspace Change Process

In December 2017 the Civil Aviation Authority (CAA) published CAP1616[6] 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;

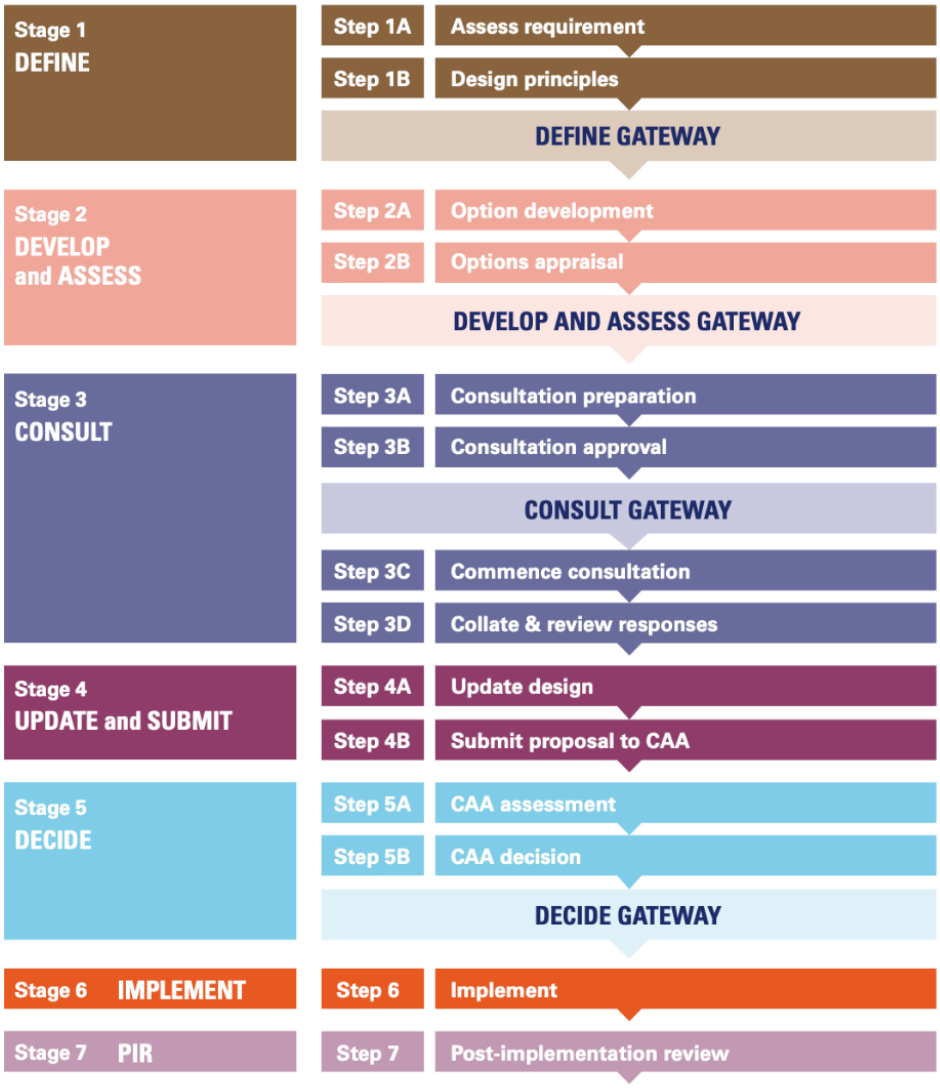


Figure 1: CAP1616 Process

[6] CAP1616

Where Southampton Airport is in their 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.

Airspace Change Stage	Summary	Link to Documents (Also available on the ACP portal)
Stage 1A	In January 2019, Southampton Airport submitted their Statement of need (SoN) to the CAA	Statement of Need on CAA's Airspace Change Portal
	Southampton Airport participated in an assessment meeting with the CAA on the 22nd January 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
Stage 1B	At Stage 1B Southampton developed a set of design principles with identified Stakeholders. 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, are also shown here in this document.	Stage 1B Design Principle Submission Report
Stage 2A	Stage 2A requires change sponsors to develop and assess options for the airspace change. 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. 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 2A DPE Submission 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

Table 1: Southampton ACP to date

UK Airspace Change Masterplan Iteration 2

The number, complexity and overlapping scope of the individual airspace ACPs needed to deliver the Programme requires a strategic coordination mechanism in the form of a single joined up implementation plan or Masterplan. In their capacity as co-sponsors of the AMS, the Department for Transport and CAA commissioned NERL to create the Masterplan.

Airspace modernisation is a long and complex process. Larger ACPs with many interdependencies can take several years longer to develop than smaller ones with fewer interactions. As a consequence, ACOG proposed (and the co-sponsors accepted) that the final Masterplan is developed through a series of iterations. The iterative approach recognises that different information and levels of detail will be available at different times. ACOG may have an insufficient level of detail about some ACPs to make firm conclusions and need to make assumptions that are refined in later iterations. It also means that the Masterplan remains flexible and responsive to accommodate the evolving context for airspace modernisation, such as changes arising from the AMS review, new policy directions or unanticipated events.

ACOG envisages a minimum of four iterations of the Masterplan. The iterations broadly align with the regulatory gateways of the CAP 1616 process. Each iteration must be accepted separately into the AMS, except Iteration 1, which was a high-level plan that has already been assessed and published[7].

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. The assessment of the interdependencies between the constituent ACPs remains at a high level in Iteration 2 because most of the sponsors were yet to produce a comprehensive list of airspace design options at the time of its creation.

The Masterplan becomes, together with the CAP 1616 process, the legal basis against which individual airspace change decisions are made by the CAA. Therefore, the CAA's decisions on airspace change proposals will need to ensure that there is no misalignment with the Masterplan. The CAA must apply its airspace change decisions in accordance with the Masterplan and therefore in the best interests of the overall Airspace System and not just in the interests of the individual ACP sponsor.

The timeline and sequencing of the Masterplan ACPs are complex issues. It is not considered feasible for all the constituent ACPs in the Programme to be developed and deployed at the same time. The Masterplan takes a modular approach to deployment and requires coordination and strong programme management discipline to mitigate the risks of design conflicts, technical misalignments and a lack of transparency for external stakeholders. To help with this, the Masterplan has placed each of the ACPs into a regional cluster and Iteration 2 places Southampton Airport in the 'LTMA regional cluster' alongside Biggin Hill, Bournemouth, Heathrow, Gatwick, London City, Manston, RAF Northolt,

[7] Airspace Masterplan Iteration One (Southern UK): co-sponsor assessment, CAA CAP 1884, February 2021.

Southampton, Southend and Stansted airports. As previously mentioned, we would expect Farnborough Airport will now form part of the LTMA regional cluster going forwards.

Large scale ACPs are usually difficult to develop and deploy because of the complexity of the existing airspace design, the intensity of the current operation and the potential impacts on communities, the environment and other airspace users. The Masterplan ACPs bring additional deployment challenges associated with airspace design interdependencies and the widespread introduction of PBN routes, which will replace well established ATC procedures based on controller vectoring with the comparatively new concept of systemisation. Other factors being equal, the greater the complexity of the existing airspace design, and the more interdependencies, the more difficult the ACPs will be to deploy.

Iteration 2 advises that the LTMA cluster will require a minimum of three separate 'core LTMA' deployment windows to implement the full set of proposed changes (within the LTMA) because of the very large size, high complexity and extensive interdependencies of the constituent ACPs.

As a result, Iteration 3 has identified that core LTMA deployments that include Heathrow, must be divided into a minimum of three windows, separated by 12-month intervals and cannot begin before Spring 2027. Noting Southampton's dependencies with Bournemouth, Farnborough and to a lesser extent Heathrow (that are explored more here in this document), this means that any change to Southampton's route structure that has dependencies on those airports are not expected before this date. Southampton's deployment date could therefore be somewhere between 2027 and 2029, subject to the wider programme remaining on track.

Southampton's Potential Interdependencies Identified within Iteration 2

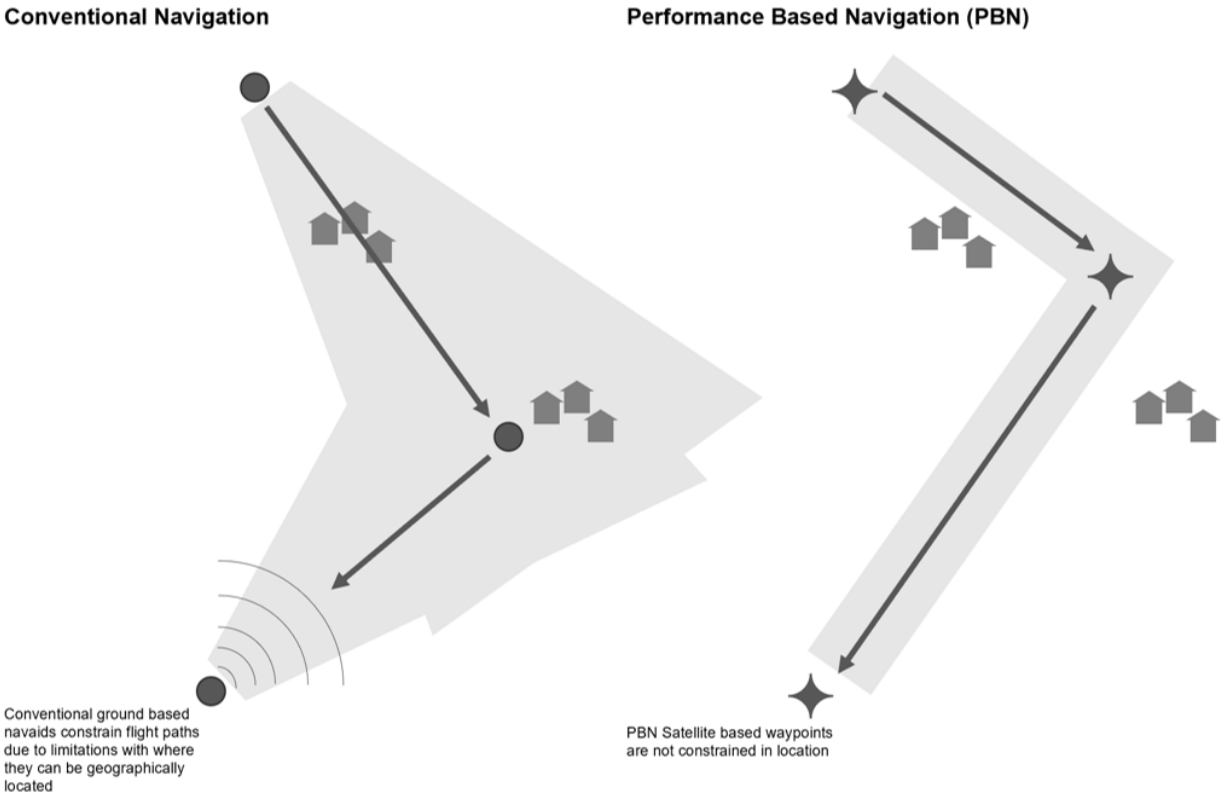
The Masterplan identifies the interdependencies between the constituent ACPs based on an analysis of the broad sections of airspace where a flight path could 'conceivably be positioned' below 7000ft within the scope of each proposal. Based on this broad assessment, the Masterplan identifies that Southampton Airport has potential dependencies below 7000ft with flight paths to and/or from Bournemouth airport and to a lesser extent Heathrow airport.

Iteration 2 pre-dates Farnborough airport's acceptance into the Masterplan however ACOG have updated the interdependency analysis conducted for Masterplan Iteration 2 to incorporate Farnborough. This analysis confirmed interaction with Farnborough airport's routes are likely to be prevalent in future designs. This is as we would expect, as explained in the next section of this document.

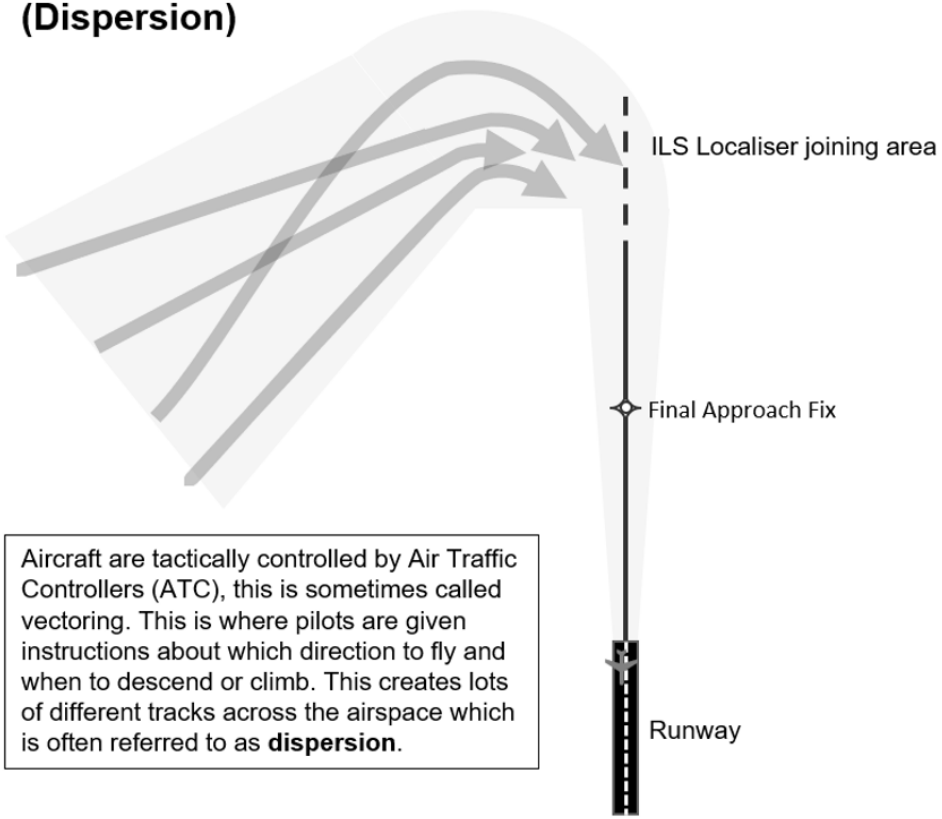
Understanding Performance Based Navigation (PBN)

Performance based navigation (PBN) improves the accuracy of where aircraft fly by using modern satellite navigation rather than outdated, less accurate, ground-based navigation aids (conventional navigation). This means that when aircraft fly a PBN route, they are typically more concentrated over a narrower area compared to when they are tactically controlled (vectored) by ATC.

Performance Based Navigation (PBN) improves the accuracy of where aircraft fly by moving away from outdated and conventional navigation using ground-based beacons to modern satellite navigation.

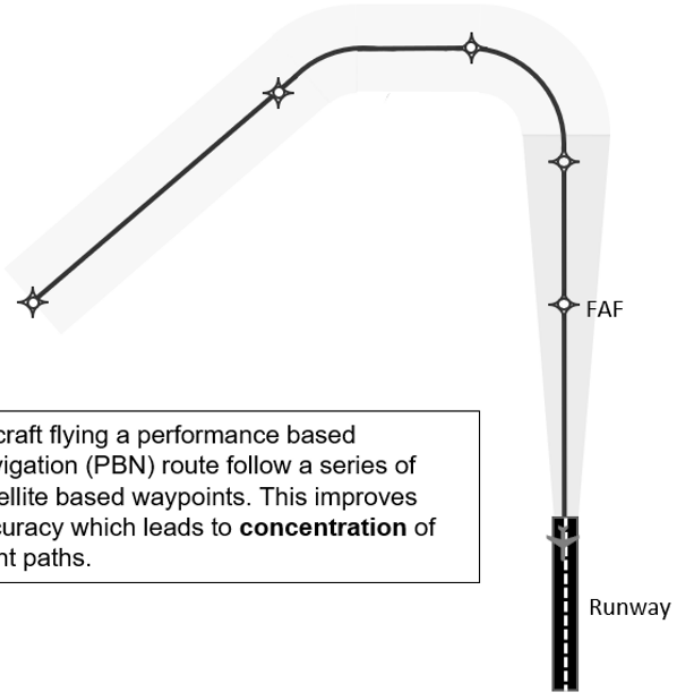


Vectoring (Dispersion)



Aircraft are tactically controlled by Air Traffic Controllers (ATC), this is sometimes called vectoring. This is where pilots are given instructions about which direction to fly and when to descend or climb. This creates lots of different tracks across the airspace which is often referred to as **dispersion**.

Performance Based Navigation (Concentration)



Aircraft flying a performance based navigation (PBN) route follow a series of satellite based waypoints. This improves accuracy which leads to **concentration** of flight paths.

Potential area of overflight

2. Overview of Options Under Assessment

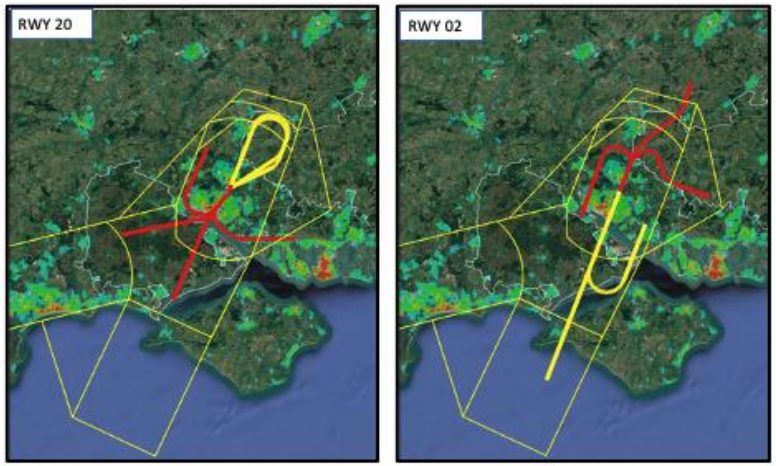
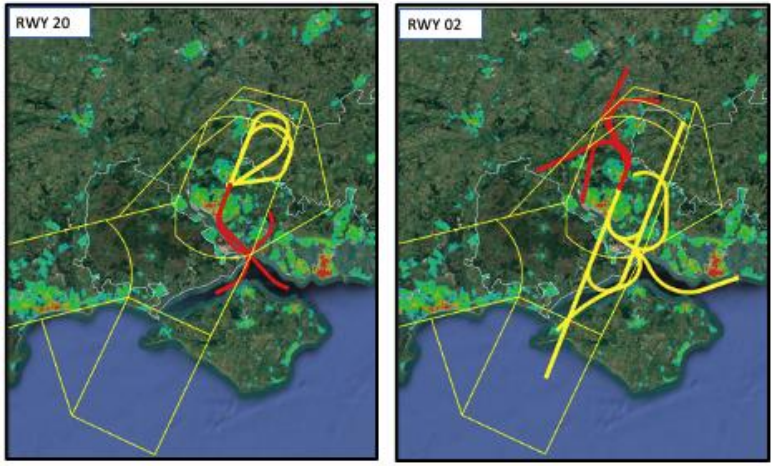
Our comprehensive list of options included five Airspace change options, Options 1 to 5, and a 'do nothing' option. All the options were developed as systems (Runway 02 and runway 20, arrivals and departures) as this was the only way to enable assessment of the design principles that couldn't be evaluated as individual routes (DP3, 8, 9, 10 and 13).

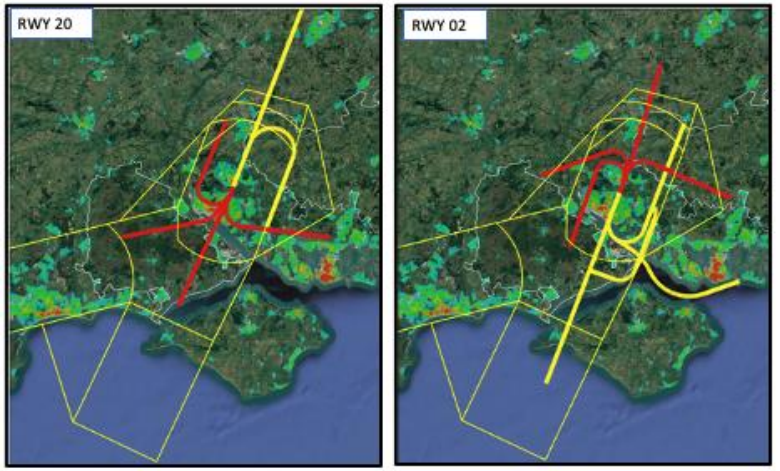
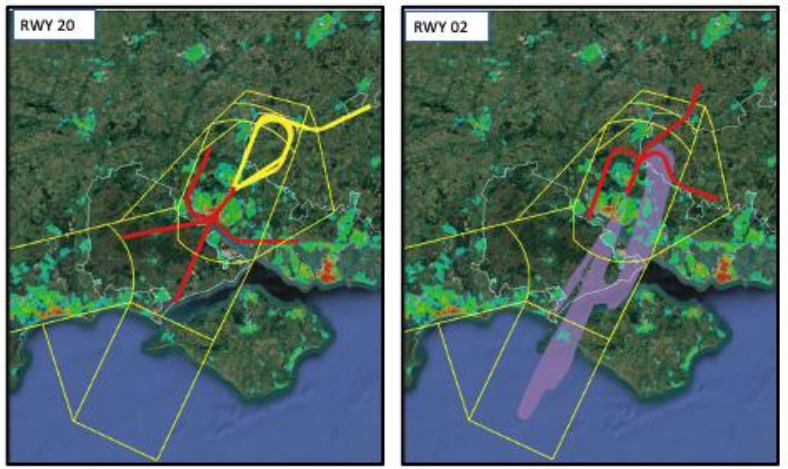
As part of Stage 2A, we undertook a Design Principle Evaluation where we evaluated each option against each Design Principle. This was the first opportunity to shortlist options before we progress to this IOA. The outcome of our Stage 2A Design Principle Evaluation was that Option 2 was discontinued on the basis of Safety, and the 'do nothing' option was also discontinued as it did not meet the AMS design principle, nor did it address the statement of need or enable any environmental, CAS or operational benefits. The other four Options, Option 1, 3, 4, and 5 all progressed to this IOA.

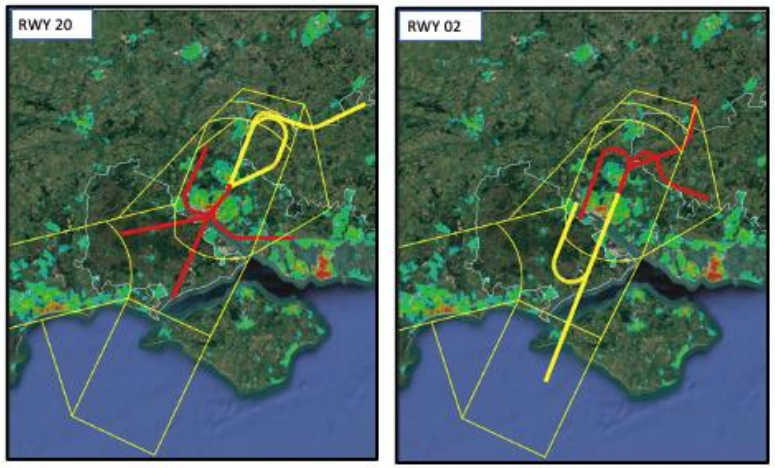
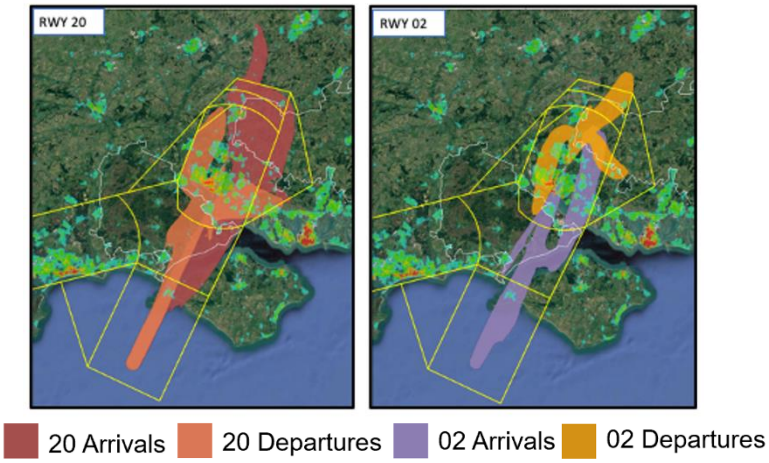
Although the 'do nothing' scenario did not progress as an option, CAP1616 requires the baseline scenario to be appraised in this IOA as it provides a means of testing the options against the current day operations to better understand and highlight the benefits and impacts of each new option. The baseline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

The following section summarises the airspace change options we have taken through to this IOA. Whilst they are presented as system options, we wish to highlight that we will consider merging some elements of the presented options to create alternative options in a final design solution if that is considered to provide greater benefit to Southampton Airport, their stakeholders and/or the wider FASI programme. More information about how we have developed and evaluated these options is available in our Stage 2A submission document on the CAA Airspace Change Portal. The Initial Options Appraisal section of this document and technical appendix A also contain larger images and 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.

Option	Description	Image
Option 1	This option would see a suite of SIDs (red), PBN arrival transitions to each runway end plus an RNP APCH to RWY 20 (yellow). Route centrelines generally follow the typical centrelines of today's vectored swathes. The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density. (Note, actual centrelines are likely to change throughout the process).	
Option 3	This option would see a suite of SIDs (red), PBN arrival transitions to each runway end, an RNP APCH to RWY 20 as well as an RNP-AR curved arrival to RWY 02 (yellow). This option maximises use of the Solent, seeks to avoid The New Forest and also has RWY 02 departure routes positioned to the west of Winchester. The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density. (Note, actual centrelines are likely to change throughout the process).	

Option	Description	Image
Option 4	This option would see a suite of SIDs (red), PBN arrival transitions to each runway end, an RNP APCH to RWY 20 as well as an RNP-AR curved arrival to RWY 02 (yellow). This option also sees a straight in approach to RWY 20 to reduce CO_2 emissions and use of the 'Winchester Orbit'. SIDs from both runway ends turn to NORRY, GOODWOOD, THRED and GIBSO as soon as possible to reduce CO_2 emissions. The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density. (Note, actual centrelines are likely to change throughout the process).	
Option 5	This option was generated to address Stage2A engagement feedback. This option is similar to option 2 (which was discounted in the DPE) but excludes a PBN arrival transition to RWY 02 to reduce the requirement for CAS. The existing RNP APCH to runway 02 will remain alongside the existing NDB approach. The existing VOR approach will be withdrawn as the SAM DVOR is being removed as part of the NATS DVOR rationalisation programme. (Please see the Stage 2A document for more details). The RWY 02 Northbound SID follows a path more similar to today to avoid increasing population numbers within the LOAEL but would still avoid Winchester by tracking to the East of RWY 20 final approach. The option images show the illustrative route centrelines up to 7000ft. SIDs are shown in red, and the 20 arrival transitions and RNP approach are yellow. The existing Solent and Bournemouth CTRs/CTAs are shown in yellow, National Park outlines in white, as well as areas of population density. (Note, actual centrelines are likely to change throughout the process).	

Option	Description	Image
Discontinued at the Design Principle Evaluation (DPE)		
Option 2	This option would see a suite of SIDs, PBN arrival transitions to each runway end plus an RNP APCH to RWY 20. Similar to Option 1 but with the RWY 02 arrival transition positioned to the West of final approach over the New Forest, to reduce the amount of CAS required compared to Option 1. The Northbound RWY 02 SID is positioned to the East of the existing swathe to generate more mileage to reduce CAS requirement to cater for slower climbers. A tactical shortcut is shown, using the Farnborough CAS, as suggested by GA stakeholders in early engagement sessions. The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density. **The outcome of our Stage 2A Design Principle Evaluation was that Option 2 was discontinued on the basis of Safety.**	
Do nothing	The 'do nothing' option was also discontinued as it did not meet the Airspace Modernisation Strategy (AMS) design principle, nor did it address the statement of need or enable any environmental, CAS or operational benefits. More details of the 'do nothing' are provided in the Stage 2A document published on the CAA's Airspace Change Portal. Although the 'do nothing' scenario did not progress as an option, 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.	

Controlled Airspace and other Procedures

Controlled Airspace (CAS)

Airspace containment of Instrument Flight Procedures (IFPs) is very closely related to the design characteristics as well as track performance (flyability) along the route centrelines. IFPs are all required to be contained inside Controlled Airspace in accordance with the CAA Policy for the Design of Controlled Airspace Structures. There is an expectation[8] that PBN can reduce the volume of CAS required owing to the smaller protection areas compared to conventional IFPs. However, where no IFPs exist to begin with, implementation of IFPs, even if PBN, can lead to an increase in the volume of CAS required.

As described previously, the illustrative route centrelines are likely to move as options are refined throughout the project. Refinement will be on the basis of integration with the wider airspace network below and above 7,000ft, reacting to stakeholder engagement, increasing environmental and operational performance and in accordance with more detailed IFP design and validation in Stages 3 and 4.

The CAS construct needs to be based on both easterly and westerly operations and there could be many differing CAS designs to support every combination of airspace design options being considered. It is therefore not proportionate at this stage to design CAS structures to support each possible option and configuration, especially when the fine details of interactions, climb gradients and precise network connectivity are not known.

Our options include designs that aim to require as little additional CAS as possible as well as options that look to prioritise environmental performance, without being constrained by extant CAS structures. Even the options that aim to require as little additional CAS as possible will inevitably require changes to boundaries to ensure the IFPs can be appropriately contained. Whilst we haven't designed specific CAS structures, we did provide stakeholders with indications of where more CAS would be required to support each options in order to enable feedback and we will also provide qualitative assessment as part of this IOA. In Stage 3 of the process when our preferred option(s) is/are being refined, we will generate CAS proposals and engage with GA stakeholders on those plans ahead of our public consultation.

[8] CAP2298a (draft) Page 65 " Performance-based navigation (PBN) is an important element that provides highly accurate and repeatable flightpaths, reducing the need for large areas of containment through the use of controlled airspace."

Missed Approaches

These procedures are part of an Instrument Approach Procedure and enable aircraft to safely reposition for another approach under certain circumstances if they are unable to land from their first approach. This is a safe and routine part of operations for all pilots and controllers. There are many reasons for a pilot, or a controller, to initiate a missed approach.

The design of the Missed Approach is very specific to the type of approach and the airspace construct and sometimes, the initial departure tracks. We do not yet know if we will need to change the Missed Approach procedures and if we do, cannot attempt to estimate what they will look like due to all the variables and it would not be proportional to attempt to do so.

After the Full Options Appraisal concludes and Southampton Airport's preferred options are chosen, we can then consider the Missed Approaches to support the safe operation of the design and include the considerations in the consultation material in Stage 3. Note that missed approaches are flown so infrequently that they are highly unlikely to have any material impact to the environmental metrics of CAP1616.

Noise Abatement Procedures (NAPs)

Implementation of SIDs from Southampton's runways could lead to changes in the NAPs (sometimes referred to as Noise Preferred Routes (NPRs)). Options for NAP definitions have not been included in Options Development at this stage, but we will incorporate new dimensions for our NAPs in the public consultation material in Stage 3. As per the Section 106 agreement, any changes to the NAPs will need to be approved by the Civil Aviation Authority with the mechanism of approval being the airspace change process.

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 Section 2 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.

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.

At Step 2B, the IOA is required to be a minimum of a qualitative appraisal and 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.

Current estimations of Southampton's deployment date is somewhere between 2027 and 2029, subject to the wider Airspace Change Masterplan programme remaining on track (please see 'UK Airspace Change Masterplan Iteration 2' section of the Stage 2A document for further details). For the purposes of this IOA, we will assume an implementation date of 2027.

Southampton Airport have recently been granted planning permission for a runway extension, and current timelines suggest that this will be built and in operation by 2023. Our baseline 'do nothing' pre implementation scenario will therefore describe the expected airspace operation in 2027 with the runway extension in operation.

At Stage 2 of the CAP1616 process, the Initial Options Appraisal requires a mainly qualitative assessment of the airspace change options against the 'do nothing pre-implementation baseline. Owing to the runway extension planning application, we have forecast and noise data for 2033 we are able to use when describing the baseline and the expected benefits and impacts of each option, however it's important to note that this has been sourced from the runway

extension planning application, and therefore the years modelled do not perfectly align with the requirements of CAP1616. For the purposes of this IOA, where the assessments are qualitative, to use the 2033 data is considered to be a proportionate approach, however as part of Stage 3, we will undertake quantified analysis for the year of implementation and the future 10 year forecast.

Traffic Forecast

Southampton's runway extension planning application incorporates a cap of up to 3 million passengers per annum. As part of the planning process, traffic forecasts were published up to 2048 however these were generated before the cap of 3 million passengers was applied. These traffic forecasts predicted that Southampton Airport would reach 3 million passengers by 2033. They were generated in 2019 using actual 2019 data as a starting point and since then, Southampton has a further two years of actual flight data which helps to build a picture of the airport's recovery from Covid-19.

Southampton still expect to meet the 3 million passenger cap by 2033 and therefore we have applied this to our forecast for this ACP. We have adjusted the forecast from now until 2032 to reflect the expected recovery from Covid-19. Beyond 2033 movement numbers remain consistent as the passenger cap will have been reached.

It is not intended that this Airspace Change will facilitate any future growth for the airport or offer any increased capacity (Southampton Airport is required by the government to undertake this change to meet the requirements of the Airspace Modernisation Strategy), and therefore this traffic forecast applies with or without the ACP.

Table 2 Southampton Airport 10 Year Traffic Forecast

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Total Movements	29,812	30,966	32,165	33,410	34,704	36,047	37,443	37,443	37,443	37,443	37,443	37,443

Modal Split

The runway extension planning application applied a 5-year average runway modal split of 72% RWY 20 / 28% RWY 02 across the noise modelling assessments and for the purposes of the qualitative assessments that form part of this IOA, we will also use this split.

Fleet Mix

As part of the runway extension planning application, Southampton Airport published an expected future fleet mix in 2033. For the purposes of this qualitative IOA, we will consider this fleet mix when assessing the benefits and impacts of each option against the baseline. As part of the full options appraisal in Stage 3, we will fully quantify the anticipated fleet mix at the year of implementation and the year of implementation plus 10 years.

Table 3 Southampton Airport Fleet Mix Forecast (2033)

Aircraft Type	ANCON Code	2033 Average Summer Day Forecast Movements
Airbus A320 with CFM engines	EA320C	43.1
Airbus A320 with IAE V2500 engines	EA320V	4.8
Embraer ERJ 135/145	ERJ	5.0
Embraer E-170/175	ERJ170	4.2
Embraer E-190	ERJ190	4.2
Large twin turboprop	LTT	57.0

Planned developments

As part of our preparation of the baseline, we have identified planned developments in the area surrounding Southampton Airport so that these can be considered as part of appraisal of the benefits and impacts of each option. The population number increases that could come with these development has not yet been factored into population counts. Where appropriate, new developments will be factored into assessments at Stage 3.

Figure 2 Planned Developments

Table 4 Planned Developments

Local Council	Type of Development	Size of Development	Status	Location	Links	Additional Info	Google Earth Ref
Basingstoke & Dean	Residential Development	130 houses	Registered May 2022	Worting Park, Worting Road, Basingstoke	Planning		A
East Hampshire	Residential Development	56 dwellings	Permission Granted (March 2022)	Lovedean Lane, Horndean, Waterlooville	Planning	Bargate Homes	B
Fareham	Residential/School etc	4000+ homes	Environmental Status Required (Feb 21)	Tipner West & Hornsea Island	Planning	Consultation Doc	C
Fareham	New School	Change from existing care home	Approved (May 22)	SO31 7HE	Planning		D
Gosport	Residential & Marina	70 houses	Approved (Nov 21)	PO12 1AH	Planning		E
Gosport	Residential	99 dwellings	Approved (June 21)	Brookers Lane	Planning	Bargate Homes	F
Havant	Residential	34 (additional to exisiting)	Approved	Forty Acres Farm, Havant	Planning		G
Isle of Wight	Residential	127 dwellings	Application Validated (Jun 22)	Camp Road, IOW	Planning		H
Isle of Wight	Residential	474 dwellings	Approved (Jul 21)	Appley Road, IOW	Planning	Article	I
New Forest	Residential	22 dwellings	Registered (Aug 22)	SO45 4ZB	Planning		J
Southampton	Residential & Leisure	400+	Approved (Mar 22)	Opposite Southampton Central Railway	Article		K
Test Valley	Residential	326	Underway	Fenn Meadow, Nursling	New Neighbourhoods		L
Test Valley	Residential	320	Underway	Broadleaf Park, Rownhams	New Neighbourhoods		M
Test Valley	Residential	300	Planned	Hoe Lane, North Baddesley	New Neighbourhoods		N
Winchester	Residential	482 homes	In progress	Botley Road, Curbridge	Article		O

Initial Options Appraisal Methodology

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 5 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-S 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. The table below also presents the IOA methodology that will be followed. This methodology will be used to compare the airspace change options against the baseline.

Table 5 IOA Assessment criteria and methodology

Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative
Noise: Our noise assessment for each airspace change option includes a qualitative description of the expected benefits and impacts of noise on health and quality of life, supported by some proportionate quantitative analysis: **L_{Aeq} contours (Primary Metric)** 51dB $L_{Aeq,16hr}$ (daytime noise) and 45dB $L_{Aeq,8hr}$ (night time noise) contours form part of the primary CAP1616 metrics used to evaluate the benefits and impacts of airspace changes. These contours represent the daytime and night-time lowest observable adverse effect level (LOAEL) contour defined in UK airspace policy. L_{Aeq} contours, are the equivalent sound level of aircraft noise in dBA. This is based on the daily average movements that take place in the 16-hour period (07:00-23:00 local time) or 8-hour period (23:00-07:00) during the 92-day period 16 June to 15 September inclusive. This metric is the measure of noise exposure adopted by Government for the purposes of considering adverse effects 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 at a system level. This requires a complete system design of arrivals and departures modelled with a forecast schedule and fleet mix which is very detailed and complex work. At this stage in the process, given the number of options, it is not proportionate to quantify the L_{Aeq} metrics. We will however make a qualitative assessment of the anticipated benefits or impacts to the daytime L_{Aeq} as a result of each option. Full quantitative analysis will be undertaken in the Full Options Appraisal in Stage 3 on Southampton's shortlisted options.		

For the purposes of this Initial Options Appraisal (IOA), we will qualitatively describe the expected changes to the L_{Aeq} contours using the 2033 Average Summer L_{Aeq} 16hr (day) contours with Runway Starter Extension, published as part of the runway extension planning application. These contours are shown in Appendix A. We have selected these 2033 contours, rather than either using contours based on actual 2021 movements or those used in the Noise Action Plan, because they most closely represent the scenario immediately before implementation of this ACP (when the runway extension has been built, and Southampton has recovered from the impacts of Covid-19).

WebTAG (Primary Metric)

The data from L_{Aeq},16hr (daytime noise) and L_{Aeq},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 we will qualitatively describe the expected changes to the L_{Aeq} 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.

CAP2091

ERCD undertook noise modelling using ANCON on behalf of Southampton Airport as part of its planning application for the runway extension. The results of this modelling shows that in the 2020 baseline used for the environmental impact assessment for the runway application, the airport would fall within CAP2091 category D as the population within the 51dBL_{Aeq},16h contours was 11,450. Night-time contours were not modelled as part of that assessment due to the relatively small number of flights at Southampton Airport during the night-time period, and hence it is expected that the CAP2091 category will be dependent on the larger daytime contours. The assessment for the runway extension also modelled forecast noise contours in 2033 which estimated that the population within the 51dBL_{Aeq},16h contour could be 46,050 by this year. This suggests that the airport is likely to move from category D to category C at some point before 2033, which is within 10 years of the anticipated implementation date for this airspace change. The noise modelling undertaken for the Full Options Appraisal in Stage 3 will therefore be undertaken to CAP2091 category C standards.

Overflight contours (Secondary metric)

When considering noise impacts, the CAA will weight the outcomes from 'primary' metrics (see L_{Aeq} section above) over 'secondary' metrics. Primary metrics will be those that are used to quantity significant noise impacts, such as WebTAG outputs within Stage 3. Secondary metrics will be those that are not being used to determine significant impacts but which are still able to convey noise effects. CAP1616 explains that while not a 'noise metric', overflight contours will be a secondary metric for the purposes of decision-making.

Appendix B 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

- 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 aircraft is assumed to follow the 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 centrelines. The frequency and nature of any vectoring that may occur will be explored as part of Stage 3 following real time simulation of the options.

- The contours are generated using a standard AEDT (Aviation Environmental Design tool) profile of an Airbus A320 aircraft. We chose the Airbus A320 as the traffic forecast suggests that this will represent a significant majority of flights in the future, and is expected to be noisier than the 'large twin turboprop' so represents a reasonable worst-case approach. At Stage 3 the full baseline and future forecast fleet mix will be modelled.
- 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, Areas of Outstanding Natural Beauty (AONB), Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest have been collected from the UK Government's catalogue of spatial data (e.g. https://data.gov.uk/dataset/334e1b27-e193-4ef5-b14e-696b58bb7e95/national-parks-england). Overflown areas are quantified in km^2.
- 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.
- The contours also only consider a single route rather than the system as a whole and therefore, as well as not accounting for frequency, the 'population overflown' metric should not be summed with all routes in the system, as there may be double counting of population.
- 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. As part of our Stage 3 Full Options Appraisal noise modelling of the vectoring will be investigated.
- When considering the centreline data for the baseline, it's important to note that a centreline for the existing departures and arrivals does not actually exist in reality beyond the Noise Abatement Procedures. In order to offer some data based comparison between the baseline and the options, baseline typical centreline overflight contours have been generated. We created typical centrelines using radar track data based on the areas most frequently overflown by flights in today's airspace arrangement for comparative purposes. The default profiles in AEDT also offers a more optimistic view of continuous climb and continuous descent performance (CCO/CDO) than what occurs within the actual baseline vectoring heatmap. Departure and arrival profiles will be analysed, and updated if necessary, as part of the Stage 3 in line with CAP2091 recommendations.
- For the purposes of this IOA, we have used these baseline centrelines to compare against the equivalent option centreline. We have compared individual centrelines rather than combining centrelines together into the system as, at this stage, it helps highlight if there is a particular route as part of the system that performs poorly and this information may help us when drawing conclusions or developing and evolving the options following

this IOA. This is important to highlight when reading the data tables as they do not consider the system as a whole, or the frequency of overflight within the system.

- For purposes of the data tables, there are two scenarios where multiple baseline options are available:
  - Runway 02 approaches could be NDB, VOR or RNP and,
  - Runway 02 straight ahead departures include a fast climbing and slow climbing centreline.
- Within these Stage 2 data tables, we have picked the baseline scenario that the majority of aircraft use i.e. the RNP approaches for runway 02 arrivals and the slow climbing baseline for runway 02 straight ahead departures. Within the qualitative assessment we will consider all scenarios and as part of Stage 3 these will be fully quantified.

Vectoring

- 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 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 is the baseline heatmaps, which are shown in Technical Appendix B, 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.

65dB LAMax (Secondary metric)

As part of this IOA and included in Appendix B, we have calculated 65dB L_{Amax} (day) 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) (https://aedt.faa.gov/). 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 (https://www.aircraftnoisemodel.org/). Arrival and departure flight profiles for an Airbus A320 have been calculated as a function of track distance using the default departure / arrival procedural steps for Aircraft ID A320-211 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. For the purposes of this IOA, we have not modelled the 60dB L_{Amax} (night) contours owing to aerodrome's operating hours and how few flights occur within the night time period however when we get to full quantified analysis at Stage 3, we will include this information.

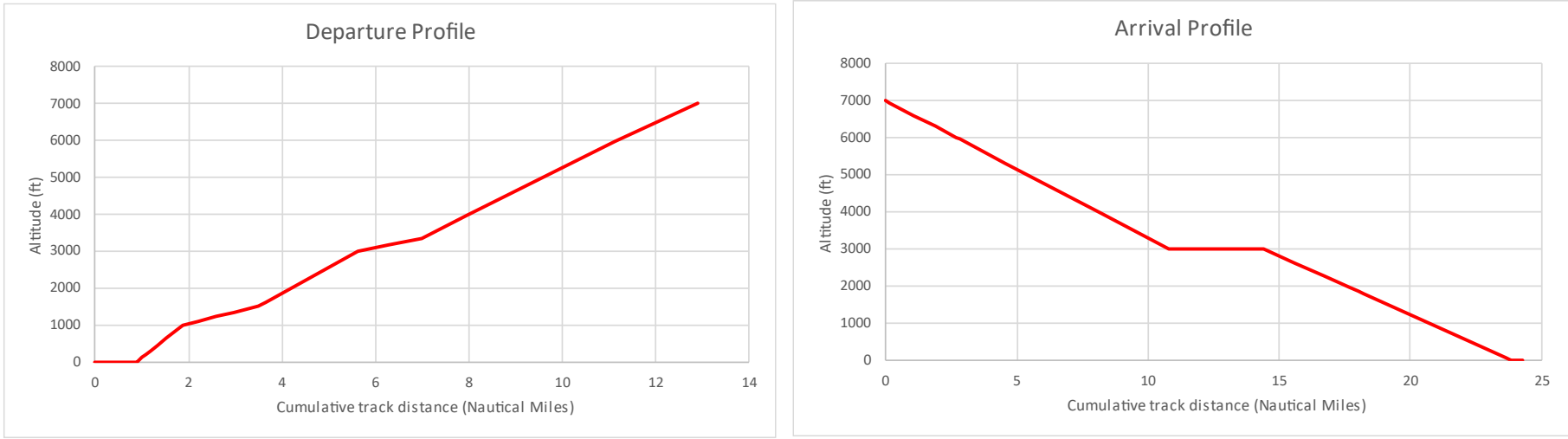


Figure 3 A320 Departure and Arrival Profile

Similar to the overflight contours, these L_{AMax} 65dB contours are based on a single noise event i.e. based on one departure or one arrival. 65dB L_{Amax} contours are an indication of the 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_{Aeq} metrics.

The 65dB L_{AMax} 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 or the cumulative overflight that occurs and for the option, it assumes that no vectoring will occur. As explained above, to model vectoring is complex and something that we will do as part of our Stage 3 Full Options Appraisal. Similar to the overflight contours above, we have compared individual centrelines rather than combining centrelines together into the system as, at this stage, it helps highlight if there is a particular route as part of the system that performs poorly and this information may help us when drawing conclusions or developing and evolving the options following this IOA. This is important to highlight when reading the data tables as they do not consider the system as a whole, or the frequency of overflight within the system. The 'population overflown' metric should not be summed with all routes in the system, as there may be double counting of population.

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; owing to the limitations with the data outlined above, the data tables should not be used as the sole basis when determining potential LAMax impacts.

Note that owing to the assumptions made and the level of noise modelling performed in this IOA, we have not discounted options based on the performance of noise metrics. However, such data has been included to help articulate the potential noise impacts from the different options.

Tranquillity: A qualitative assessment, supported by some quantitative overflight data, that considers any positive benefits or negative impacts to Areas of Outstanding Natural Beauty (AONB) and National Parks. There are no designated quiet areas (DQA) within the area of scope of the ACP.

Data from these has been sourced from the UK Government's catalogue of spatial data (e.g. https://data.gov.uk/dataset/334e1b27-e193-4ef5-b14e-696b58bb7e95/national-parks-england)

Biodiversity: A qualitative assessment of changes to biodiversity compared with the do-nothing baseline. Research shows Biodiversity disturbance effects associated with aircraft typically occur when an aircraft is flying at or below 500m (1,640 feet)[9]. This qualitative assessment will highlight if there could be lateral flight path changes below 1,640ft (compared to the baseline) which could therefore have an impact on Biodiversity. It will use the noise assessment as an indicator of potential impacts to biodiversity.

Communities	Air Quality	Qualitative
A qualitative assessment of changes to local air quality compared with the do-nothing baseline. Government guidance states that aircraft flying above 1,000ft are unlikely to have a significant impact on local air quality. This qualitative assessment will highlight if there could be lateral flight path changes below 1,000ft (compared to the baseline) which could therefore have an impact on Local Air Quality.		
Wider Society	Greenhouse Gas Impact	Qualitative and partly quantitative
As emissions of greenhouse gases/CO_2 arise from the combustion of aviation fuel, and combustion of fuel is linked to track length, we will qualitatively estimate the differences between the track length of the baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option. This will allow us to estimate the greenhouse gas impacts as a result of the option.		
Wider Society	Capacity/Resilience	Qualitative

[9] Drewitt, A. (1999) Disturbance effects of aircraft on birds. English Nature Birds Network Information Note

It is not intended that this Airspace Change will facilitate any future growth for the airport or offer any increased capacity; Southampton Airport is required by the government to undertake this change to meet the requirements of the Airspace Modernisation Strategy. Subject matter experts will therefore qualitatively assess any impacts to resilience against the baseline scenario.		
General Aviation	Access	Qualitative
A qualitative assessment of changes to GA access to controlled airspace compared with the do-nothing baseline. Assessment will consider whether each option has potential to require more/less CAS as well as offer opportunities for improved access to CAS for general aviation traffic (GAT).		
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
It is not intended that this Airspace Change will facilitate any future growth for the airport or offer any increased capacity; Southampton Airport is required by the government to undertake this change to meet the requirements of the Airspace Modernisation Strategy.		
General Aviation/ commercial airlines	Fuel Burn	Qualitative and partly quantitative
As fuel burn is linked to track mileage, this IOA will qualitatively describe the estimated differences in track miles between the baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option. This estimation will consider whether the proposed arrival tracks could be longer or shorter than a typical flight today and will also consider the effect on continuous climb and descent to/from 7000ft. The assessment will be rounded to the nearest 0.5 nautical mile.		
Commercial airlines	Training costs	Qualitative
A qualitative assessment of changes to commercial airline training costs compared with the do-nothing baseline.		
Commercial airlines	Other costs	Qualitative
A qualitative assessment of changes to other relevant commercial airline costs compared with the do-nothing baseline.		
Airport/ANSP	Infrastructure costs	Qualitative
A qualitative assessment of changes to ANSP infrastructure costs compared with the do-nothing baseline.		
Airport/ANSP	Operational costs	Qualitative
A qualitative assessment of changes to ANSP operational costs compared with the do-nothing baseline.		
Airport/ANSP	Deployment costs	Qualitative

A qualitative assessment of ANSP deployment costs compared with the do-nothing baseline.		
All	Safety	Qualitative
A qualitative safety assessment of each option will be undertaken which compares against the baseline.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
A qualitative assessment of how the design option strikes a balance, considering the AMS objectives of improved capacity, noise, and fuel/CO2 and reduced CAS and increased airspace integration compared with the do-nothing baseline.		
All	Interdependencies, conflicts and trade-offs	Qualitative

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 below 7000ft with other airspace change sponsors required during Stage 3. The illustration shows the potential areas of interdependencies below 7000ft between Southampton (Blue), Bournemouth (Green) and Farnborough (Pink).

4. Initial Options Appraisal

The following tables outline our Initial Options Appraisal for each option and the baseline scenario.

Baseline 'Do Nothing' Pre-implementation Scenario

This section describes the baseline 'do-nothing' scenario. More detail on the baseline is described in the Stage 2A submission document, published on the CAA's Airspace Change Portal.

Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative

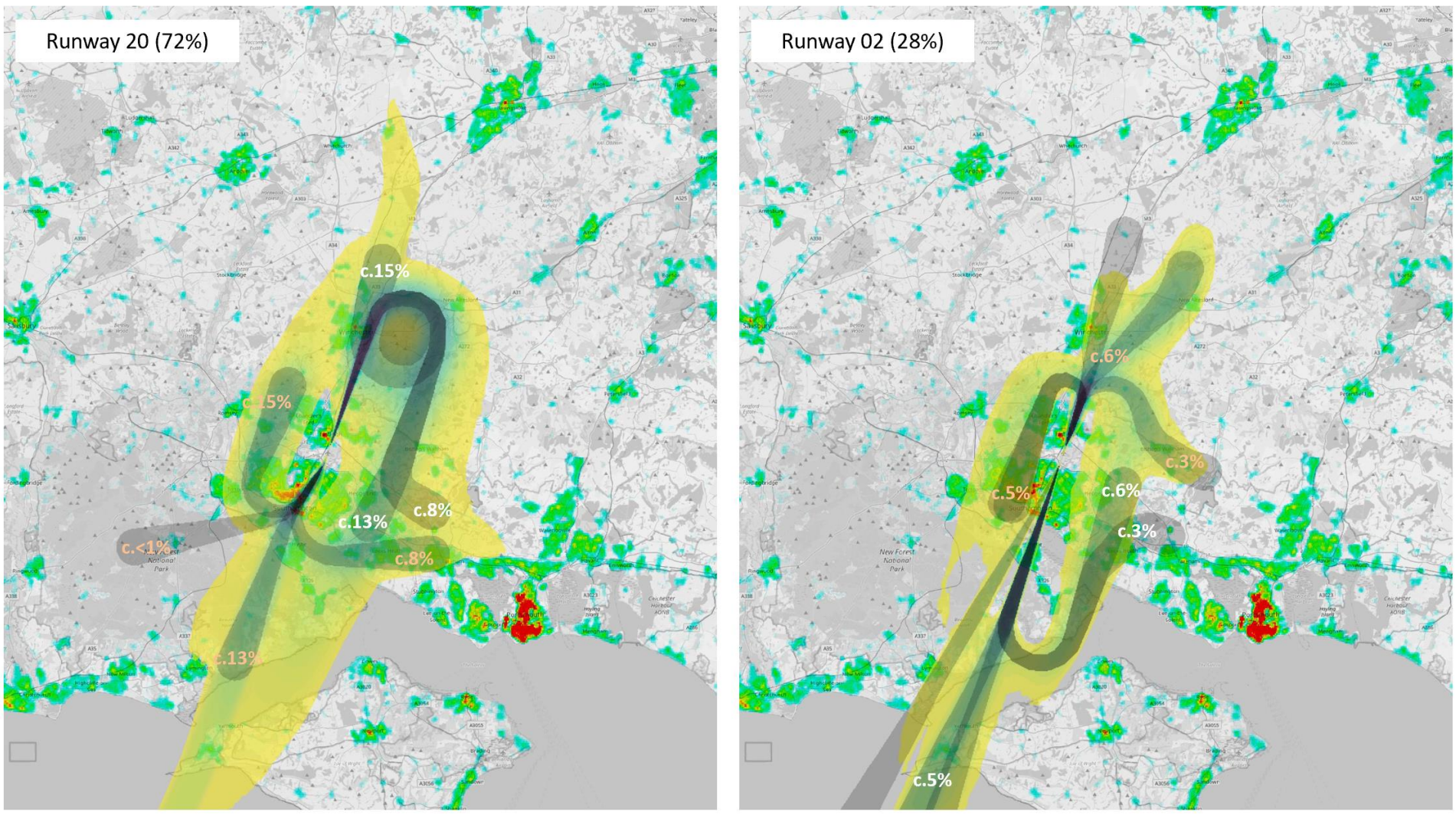


Figure 4 Baseline 'do nothing' overflight heatmap, population data, and average centreline baseline contours.

L_{Aeq}

The L_{Aeq} contours generated based on the 2033 forecast are shown in Appendix A. For the purposes of this IOA, we will use these as basis to describing any benefits or impacts against the baseline. These contours have been modelled based on a 5 year average modal split of 72% runway 20 and 28% runway 02.

Overflight

- **Runway 02 Arrivals:** Due to wind direction, runway 02 is operated approximately 28% of the year. Aircraft arriving onto runway 02 are vectored by ATC before either undertaking a PBN based approach (RNP APCH), or utilising the Non Directional Beacon (NDB), the Very High Frequency Omni-directional Range Finder with Distance Measuring Equipment (VOR/DME) or undertaking a visual approach. Vectoring creates broad dispersion across the airspace as shown in Figure 4. The RNP APCH and a visual approach are aligned with the runway centreline whereas the VOR/DME and NDB approaches are offset from the centreline; this results in different final approach paths compared to the RNP APCH. Note, the VOR approach is offset further than the NDB approach. (Please see the baseline section of the Stage 2A document for further details)
- **Runway 20 Arrivals:** Due to wind direction, runway 20 is operated approximately 72% of the year. Aircraft arriving onto runway 20 are vectored by ATC before either undertaking an Instrument landing System (ILS) 3.0˚ approach, a VOR approach or a visual approach. Vectoring creates broad dispersion across the airspace as shown in Figure 4 above. In order to ensure aircraft remain within CAS when arriving from the north, aircraft are instructed to fly four turns (sometimes called the Winchester orbit). This creates areas of cumulative overflight for some communities living under the approach path. Aircraft arriving from the south or south east, typically also overfly a similar turn pattern, without the cumulative overflight, which can be seen in the baseline contours in the figure above. The aircraft arriving from the south west, largely follow the same swathe below 7000ft as those arriving from the south.
  All turbo jet and all aircraft with a maximum take off weight (MTOW) of 5700kg or greater must follow the Noise Abatement Procedures. Aircraft flying an ILS approach will join the standard approach path from no less than 8 nautical miles and at a constant 3° angle of approach. Aircraft making a visual approach will be aligned with the centre line of the runway from not less than 2 nautical miles when arriving from a southerly point of origin, and at 5 nautical miles when from northerly, easterly or westerly directions.
- **Runway 20 Departures:** The majority of Runway 20 departures are required to initially follow Southampton's Preferred Departure Routes (PDRs) that form part of the Noise Abatement Procedures (NAPs). This requires departures to climb straight ahead to 500ft, before turning right to intercept VOR radial 217 until passing 2000ft. The point at which aircraft reach 500ft and 2000ft varies on a number of factors including, but not limited to, aircraft type, weight and weather conditions. With regards to noise, this means that there is dispersion around the initial right turn to intercept the VOR radial, and then broader dispersion when aircraft turn following reaching 2000ft. Beyond 2000ft, aircraft are vectored by ATC which creates dispersion across the airspace towards the various network waypoints.
- **Runway 02 Departures:** The majority of Runway 02 departures are required to initially follow Southampton's Preferred Departure Routes (PDRs) that form part of the Noise Abatement Procedures (NAPs). This requires departures to climb straight ahead for 2.5nm before turning. This 2.5nm point aims to avoid overflight of parts of Eastleigh, Chandlers Ford and Colden Common. Beyond this point, aircraft are vectored with broad dispersion towards the various network waypoints as seen in Figure 4.

The following tables show baseline vectoring (NTK heatmap) data (Table 6) and baseline average centreline data (Table 7). For the purposes of this IOA, we have assessed the routes within each option on a route by route basis, as we expect that as part of the evolution of the options, routes from various options may be combined together at a later stage. This means that the assessment focuses more on the average centreline data, than the vectoring NTK heatmap data. Later on in this IOA, we include data tables which show the difference between this baseline average centreline data and the option.

Table 6 Baseline Vectoring NTK Data

Baseline vectoring (NTK heatmap) data	Area	Population	AONB area	AONB count	Parks and gardens area	Parks and gardens count	National Parks area	National Parks count	Schools count	Hospitals count	Carehomes count	Places of worship count
RWY02_arrivals	387.7	61575	12.0	1	1.01	4	116.5	4	54	2	69	68
RWY02_departures	253.0	78555	0.0	0	6.4	9	102.5	2	73	7	64	121
RWY20_arrivals	725.3	121656	24.9	2	6.32	12	234.8	2	105	6	126	161
RWY20_departures	449.8	154285	5.0	1	4.41	13	101.1	2	139	11	134	183

Table 7 Baseline average centreline overflight data

Baseline average centreline overflight data	Population	AONB Count	AONB Area (km^2)	National Parks Count	National Parks Area (km^2)	Parks and Gardens Count	Parks and Gardens Area (km^2)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Baseline 20 Arrivals											
Runway 20 average baseline arrival from North	11700	0	0.0	1	47.9	1	1.5	14	0	11	36
Runway 20 average baseline arrival from South	14487	0	0.0	1	42.6	1	1.5	19	0	19	26
Runway 20 average baseline arrival from South East	7577	0	0.0	1	42.7	1	1.5	12	0	10	18
Baseline 02 Arrivals											
Runway 02 average baseline arrival from North	20679	0	0.0	1	23.0	2	0.1	19	2	28	17
Runway 02 average baseline RNP arrival from South	7880	1	7.4	1	15.3	1	0.0	6	1	10	11
Runway 02 average baseline NDB/DME arrival from South	9901	1	4.0	1	16.4	1	0.0	6	1	18	12
Runway 02 average baseline VOR/DME arrival from South	8481	0	0.0	1	26.4	2	0.1	7	0	5	17
Runway 02 average baseline arrival from South East	26072	0	0.0	1	23.0	2	0.1	20	3	32	17
Baseline 20 Departures											
Runway 20 average baseline north	24453	0	0.0	0	0.0	1	0.2	26	1	9	38
Runway 20 average baseline south	12070	0	0.0	1	38.3	2	1.6	14	1	3	42
Runway 20 average baseline south east	40072	0	0.0	0	0.0	2	0.5	38	3	43	51
Runway 20 average baseline south west	11651	0	0.0	1	38.0	1	0.2	12	3	7	34
Baseline 02 Departures											
Runway 02 average baseline north (Good climbers)	8831	0	0.0	1	13.7	0	0.0	11	0	8	26
Runway 02 average baseline north (Slower climbers)	1579	0	0.0	1	27.4	3	2.9	2	0	3	6
Runway 02 average baseline south	45564	0	0.0	1	1.4	3	1.1	38	5	45	48
Runway 02 average baseline south east	6415	0	0.0	1	32.6	0	0.0	6	0	5	11
Runway 02 average baseline south west	44309	0	0.0	1	1.4	2	1.0	33	5	39	41

Table 8 Baseline average centreline 65dB L_{AMax} data

Baseline average centreline 65dB LAMax data	Population	AONB Count	AONB Area (km^2)	National Parks Count	National Parks Area (km^2)	Parks and Gardens Count	Parks and Gardens Area (km^2)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Baseline 20 Arrivals											
Runway 20 average baseline arrival from North	5516	0	0	1	7.37	0	0	5	0	6	11
Runway 20 average baseline arrival from South	5516	0	0	1	7.37	0	0	5	0	6	11
Runway 20 average baseline arrival from South East	5516	0	0	1	7.37	0	0	5	0	6	11
Baseline 02 Arrivals											
Runway 02 average baseline arrival from North	15971	0	0	1	1.53	1	0.09	13	1	11	13
Runway 02 average baseline RNP arrival from South	15971	0	0	1	1.53	1	0.09	13	1	11	13
Runway 02 average baseline NDB/DME arrival from South	15971	0	0	1	1.53	1	0.09	13	1	11	13
Runway 02 average baseline VOR/DME arrival from South	15790	0	0	1	3.44	2	0.13	15	0	6	31
Runway 02 average baseline arrival from South East	15971	0	0	1	1.53	1	0.09	13	1	11	13
Baseline 20 Departures											
Runway 20 average baseline north	41331	0	0	0	0	2	0.35	37	2	24	66
Runway 20 average baseline south	19305	0	0	1	2.14	1	0.86	15	0	13	16
Runway 20 average baseline south east	13896	0	0	1	13.8	0	0	13	0	8	16
Runway 20 average baseline south west	19305	0	0	1	2.14	1	0.86	15	0	13	16
Baseline 02 Departures											
Runway 02 average baseline north (Good climbers)	18267	0	0	1	10.24	0	0	16	0	15	30
Runway 02 average baseline north (Slower climbers)	14547	0	0	1	14.22	0	0	12	0	10	16
Runway 02 average baseline south	19305	0	0	1	2.14	1	0.86	15	0	13	16
Runway 02 average baseline south east	13896	0	0	1	13.8	0	0	13	0	8	16
Runway 02 average baseline south west	19305	0	0	1	2.14	1	0.86	15	0	13	16

Noise Summary

No change as this is the baseline pre-implementation 'do nothing' scenario. The baseline therefore does not offer the opportunity to explore noise mitigations.

Tranquillity:

- Runway 20 arrivals overfly areas of the South Downs National Park and due to vectoring, there is a large amount of dispersion across these areas leading to large areas of overflight.
- Runway 20 departures overfly the New Forest National Park and the Isle of Wight AONB and due to vectoring, there is a large amount of dispersion across these areas leading to large areas of overflight. Although the centreline average baseline contours do not extend over the Isle of Wight AONB, the overflight heat map shows that aircraft are flying below 7000ft over this area.
- Runway 02 arrivals also overfly the New Forest National Park and the Isle of Wight AONB.
- Runway 02 departures overfly the South Downs National Park and due to vectoring, there is a large amount of dispersion across these areas leading to large areas of overflight.

Biodiversity:

- Below 1640ft, aircraft arriving onto runway 20 overfly the River Itchen SSSI/SAC and the South Downs National Park. At around 1640ft there may also be a very small areas of overflight of the St Catherine's SSSI.
- Aircraft departing 20 overfly the River Itchen SSSI/SPA/SAC, the Dibden Bay and Hythe to Calshot Marshes SSSI, Solent Maritime SAC, Solent and Southampton Water SPA and slow climbing aircraft may overfly the New Forest National Park however this would be at altitudes close to 1640ft.
- Aircraft arriving on runway 02 overfly the River Itchen SSSI/SPA/SAC, the Dibden Bay and Hythe to Calshot Marshes SSSI, Solent Maritime SAC, Solent and Southampton Water SPA and the New Forest National Park.
- Aircraft departing on runway 02 overfly the South Downs National Park and River Itchen SSSI/SAC.

Communities	Air Quality	Qualitative

- Runway 20 arrivals: Aircraft arriving at Southampton fly a standard 3-degree angle of approach and descend through 1000ft typically between 5 - 7km before the landing threshold. This is in the last stages of the final approach when aircraft are aligned with the runway centreline.
- Runway 20 departures: the Noise Abatement Procedures require aircraft to fly straight ahead to 500ft before turning right to intercept VOR radial 217. Aircraft are then required to maintain radial 217 until 2000ft. Some aircraft are already above 500ft before the end of the runway and the majority climb above 1000ft within the first 1-2nm from take off. When we consider the future fleet mix, we expect this to improve given better aircraft climb performance.
- Runway 02 arrivals: Aircraft arriving at Southampton fly a standard 3-degree angle of approach and descend through 1000ft typically between 5 - 7km before the landing threshold. This is in the last stages of the final approach when aircraft are aligned with the runway centreline. On runway 02, a small number of aircraft fly an offset VOR approach or an offset NDB approach. The VOR approach presents a greater offset than the NDB.
- Runway 02 departures: On runway 02, aircraft climb straight ahead and the vast majority of aircraft are well above 1000ft before turning.

Air Quality Management Areas:

The Air Quality Management areas surrounding Southampton Airport are shown in orange in Figure 5:

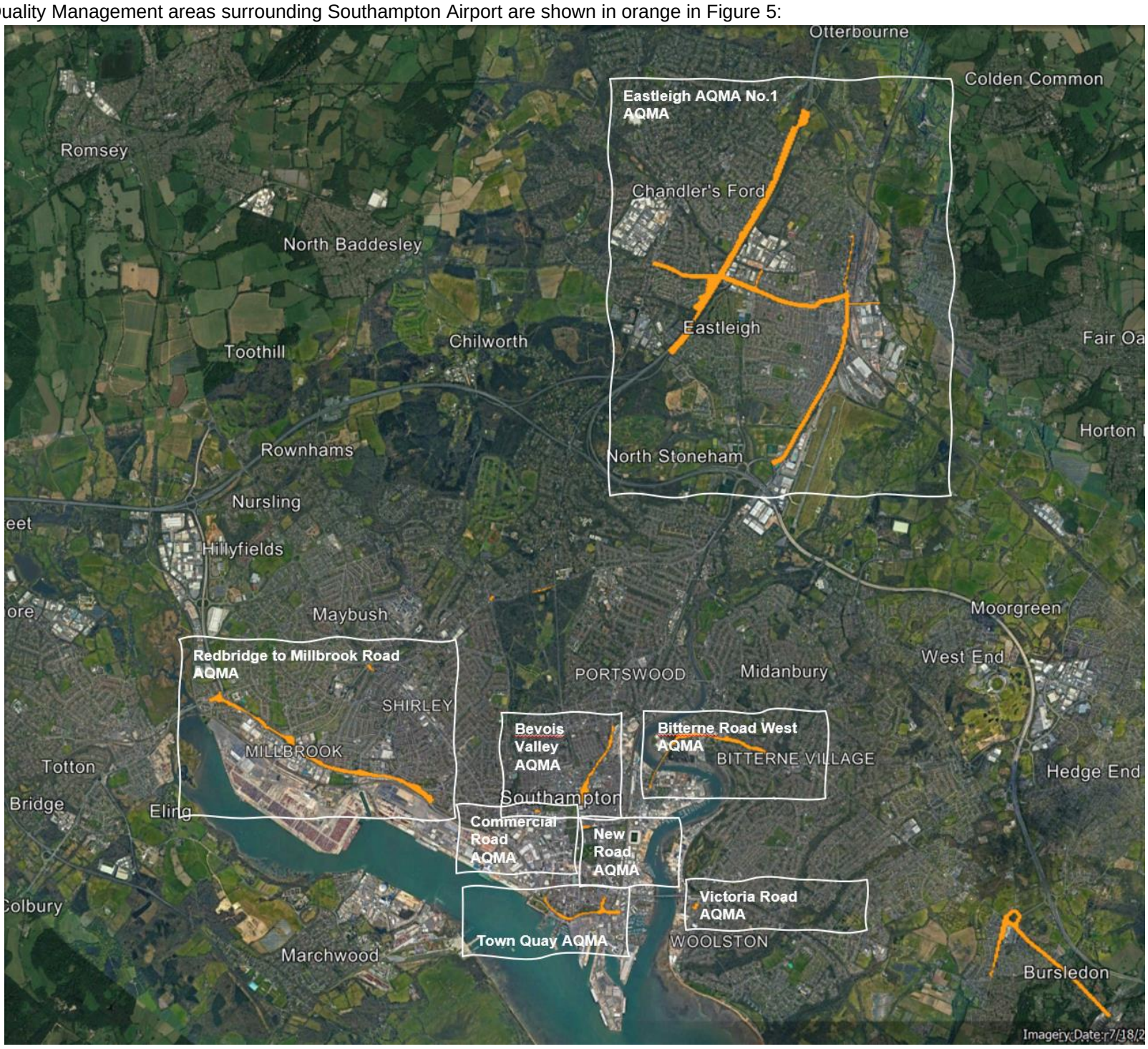


Figure 5 AQMA Southampton

Wider Society	Greenhouse Gas Impact	Qualitative

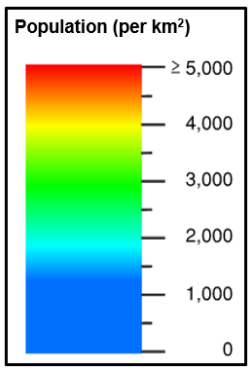
Emissions of greenhouse gases arise from the combustion of aviation fuel, and as the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline. The greenhouse gas assessment is therefore linked to the fuel burn assessment detailed in the section below. We will estimate the differences between the 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 or shorter than a typical flight today. As CO_2 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.

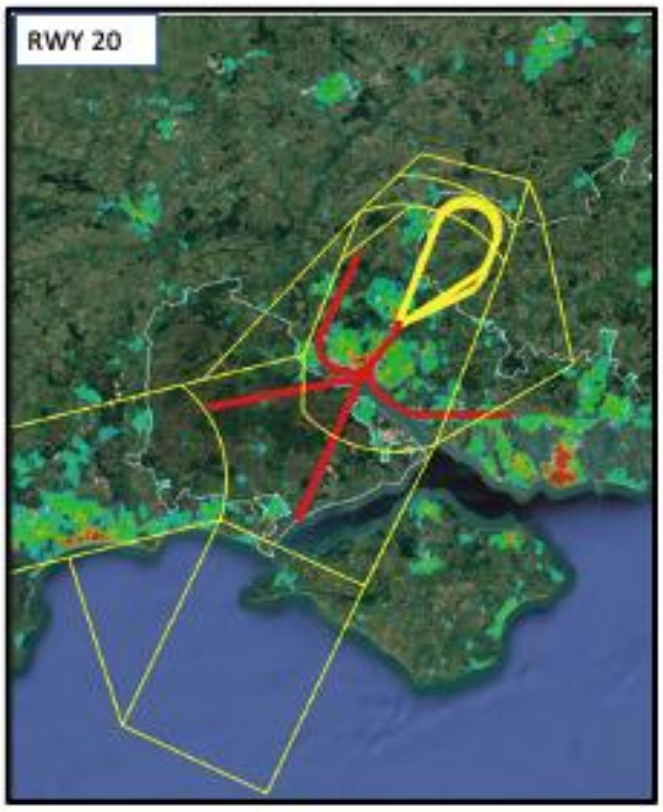
Wider Society	Capacity/Resilience	Qualitative
This ACP does not seek to increase capacity for Southampton Airport. This baseline is dependent on conventional ground-based navigation aids called VORs. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. Southampton Airport currently publish VOR approaches for both runways that offer resilience in the case of an ILS outage on Runway 20, or an alternative instead of the RNP approach on runway 02. The withdrawal of the VOR will result in loss of the VOR approaches (other than in an interim period when RNAV substitution may be suitable), and therefore Southampton will lose resilience, particularly in the case of Runway 20. Within the baseline 'do nothing' scenario aircraft are tactically controlled by ATC (sometimes called vectoring), this creates a lot of flexibility and subsequently resilience within the route structures.		
General Aviation	Access	Qualitative
This baseline scenario would not offer any change from the existing Controlled Airspace (CAS) arrangements in place today (please see 'Southampton's existing airspace arrangements' section of the Stage 2A document for further information). The options will be qualitatively compared against this existing scenario.		
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
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	Qualitative
As the combustion of aviation fuel is linked to track length, we have initially looked at the track length to understand whether an option increases or decreases track length compared to the baseline. Within the baseline, aircraft are vectored and this creates dispersion and variation in flight path lengths. For the purposes of this IOA, we have taken the average centreline baseline (where the overflight data suggests the most concentration occurs) and we have used this information to inform our assessment of the baseline track distances. Full track length details are shown in Technical Appendix B.		
Commercial airlines	Training costs	Qualitative
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.		
Commercial airlines	Other costs	Qualitative
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.		
Airport/ANSP	Infrastructure costs	Qualitative
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/ANSP	Operational costs	Qualitative
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, Southampton Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Southampton 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.		
Airport/ANSP	Deployment costs	Qualitative
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	Qualitative
At current traffic levels, there are no safety concerns with the current arrangements at Southampton Airport although there are opportunities to enhance safety performance. As described within the Stage 2A document, the vectoring of arrivals to Runway 20 generates high ATC workload involving four turn and descent instructions in relatively quick succession. ATC need to ensure that these turns are given to pilots in a timely manner to ensure CAS containment, with vectoring close to the edge of CAS a common occurrence. There is a high volume of CAS infringements within the NE corner of airspace which also significantly increases workload for ATC when an infringement occurs. Future traffic growth could result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the NERL airspace above 7000ft being capped, or increased aircraft holding on the ground, in order to maintain safety.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
Doing nothing will not align with the AMS. It will not enable any environmental benefits or maximise benefits from NERL's re-design of the airspace above 7000ft. No change and therefore no ACP submission will not enable any reduction in the volume of controlled airspace.		
All	Interdependencies, conflicts and trade-offs	Qualitative
The baseline scenario shares significant interdependencies below with Bournemouth Airport and Farnborough Airport. Southampton's CTA-2 is adjacent to Bournemouth's CTR boundary and sits above Bournemouth's CTR from 2000ft to 5500ft. Southampton Airport's ATC team, Solent Radar, provide an Approach Radar Control Service to Southampton Airports but also provide ATC services to some Bournemouth traffic owing to the combined standard arrivals routes (STARs) and interactions with Bournemouth's departures to the north, east and south. Solent CTA-6 is located adjacent to Farnborough's new CTA-8 4500-5500ft Class E with TMZ airspace. There is a delegated function for Southampton's Air Traffic Control team (Solent Radar) who coordinate some Farnborough traffic. At higher levels, there are some interdependencies between Heathrow and Gatwick traffic.		

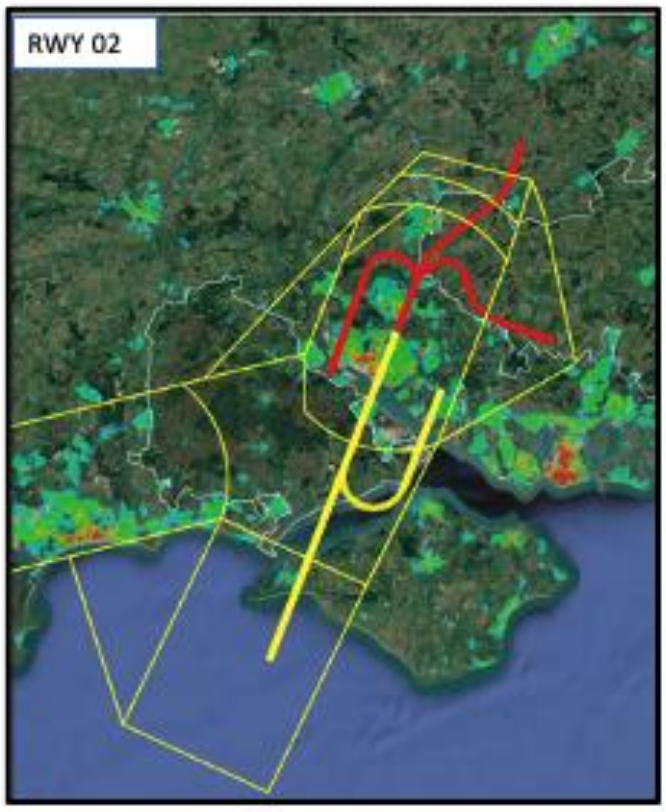
Option 1

This option would see a suite of SIDs (departures - red), PBN arrival transitions to each runway end plus an RNP APCH to RWY 20 (yellow). Route centrelines generally follow the typical centrelines of today's vectored swathes where PBN criteria allows.

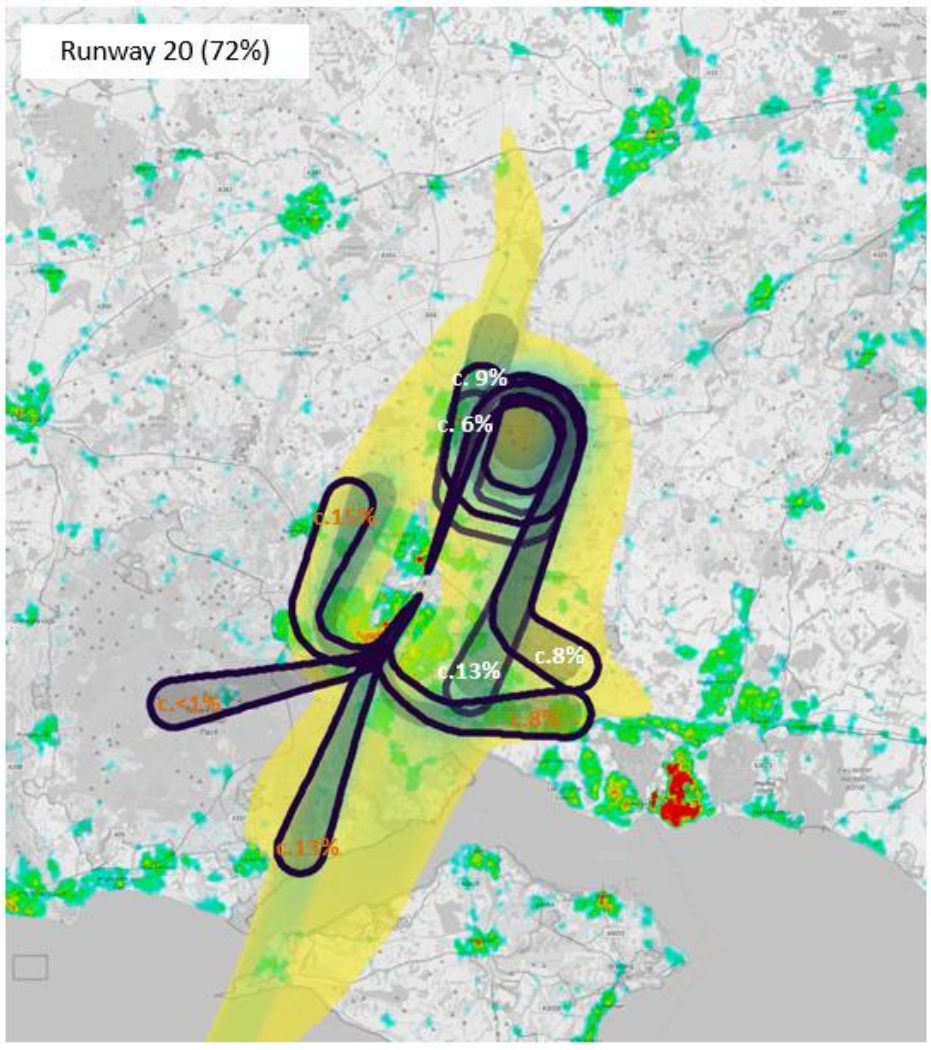
The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density (Note, actual centrelines are likely to change throughout the process).







Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative



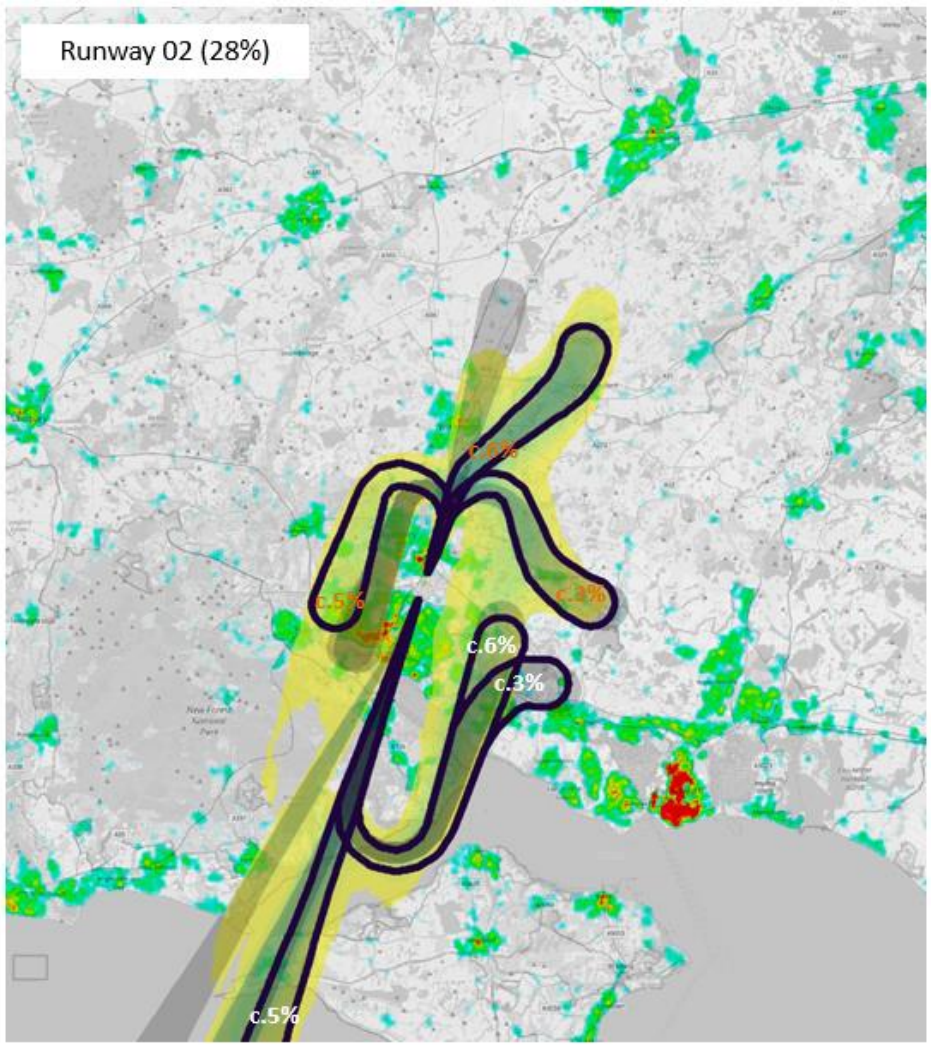


Figure 6 Runway 20 and Runway 02 Option 1. Baseline Heatmap (0-7000ft), Baseline overflight contour: Grey (0-7000ft), Option overflight contour: Black outline (0-7000ft)

Table 9 Option 1 comparison between option and baseline centreline overflight data 0-7000ft (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area (km²)	National Parks Count	National Parks Area (km²)	Parks and Gardens Count	Parks and Gardens Area (km²)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Option 1 20 Arrivals											
RWY20 IAP Arrival from South East (1)	-342	0	0	0	1.3	0	-0.7	2	0	-1	3
RWY20 IAP Arrival from South (1)	322	0	0	0	2.3	-1	-0.7	1	0	0	6
RWY20 IAP Arrival from North (1)	1501	0	0	0	-11.4	0	-0.4	-3	0	-4	-4
RWY20 IAP Arrival from North (2)	2774	0	0	0	-10.2	0	-0.7	-4	0	-4	1
Option 1 02 Arrivals											
RWY02 IAP RF Arrival from South East (1)	-2880	0	0	0	1.2	0	0	3	0	7	2
RWY02 IAP RF Arrival from North (1)	289	0	0	0	1.3	0	0	4	0	4	-2
RWY02 IAP Arrival from South (1)	105	0	0	0	-0.1	0	0	0	0	0	0
Option 1 20 Departures											
RWY20 SID South West (1)	-118	0	0	0	-0.1	0	0	1	0	2	4

RWY20 SID South (1)	-2029	0	0	0	-1.3	0	-0.1	3	0	2	10
RWY20 SID South East (1)	2952	0	0	0	0	0	-0.3	-1	1	-1	-7
RWY20 SID North (1)	-6900	0	0	0	0	-2	-0.4	10	0	1	6
Option 1 02 Departures											
RWY02 SID South West (3)	-22017	0.0	0.0	0	0.4	2	1.0	7	0	30	21
RWY02 SID North (1)	661	0.0	0.0	0	-0.6	-1	0.8	-1	0	0	-1
RWY02 SID South East (1)	-120	0.0	0.0	0	-0.7	0	0	0	0	0	1
RWY02 SID South (1)	-23196	0.0	0.0	0	0.4	3	1.1	12.0	0	36	28

LAeq

- **Runway 20 Arrivals:** Within the scope of the L_{Aeq} contours, the runway 20 arrivals are expected to remain very similar to today and therefore they are not expected to materially alter the L_{Aeq} contours.

- **Runway 20 Departures:** Although the runway 20 departures aim to replicate, due to CAA IFP requirements, a waypoint will be required at or near the Departure End of Runway (DER). This waypoint prevents departures from turning to follow the same path as the 217 VOR radial before the DER whereas in the baseline, some departures turn before the DER today. Subsequently it is expected that there would be a change to traffic patterns around the 500ft point which is likely to narrowly influence the shape of the L_{Aeq} contours. Beyond this, the initial parts of the routes overfly the densely populated areas of the city of Southampton and owing to the change in waypoint configuration, there is likely to be changes to the population within the L_{Aeq} contours which cannot be predicted without quantitative modelling. The concentration due to PBN is expected to change the shape of the contours. Given runway 20 is operated 72% of the year, lobes may extend along the PBN paths although with the exception of the left turn, the overflight contours suggest this will occur over less densely populated areas.

- **Runway 02 Arrivals:** Within the scope of the L_{Aeq} contours, the majority of runway 02 arrivals will fly the same extended runway centreline as within the baseline, however in this scenario, the VOR approach flown in the baseline will not be available and therefore there will be more aircraft flying a straight in RNP approach. As 02 is only used 28% of the time, this is likely to have a very small influence on the contours, most likely extending the southern lobe slightly south but in turn, reducing the southwest lobe slightly. The south west lobe extends over the most densely populated areas in Southampton therefore this may lead to a very small reduction in population but this would require confirmation via a quantitative noise model in Stage 3 should this option progress.

- **Runway 02 Departures:** Departures will fly a very similar straight ahead route to today before turning. Owing to runway 02 being in operation for around 28% of the year, these departure routes have a smaller influence on the shape of the contours compared to the runway 20 arrivals. Due to the concentration of PBN there may be slight lobes to the west and east to the outermost contours however these are not expected to be significant. This may impact the areas north of Otterbourne and Colden Common. The 51dB contour may also extend towards Twyford.

The extent of these contour changes would require further investigation as part of a quantified noise model in Stage 3 should this option progress.

Overflight

- **Runway 20 Arrivals:** In the baseline, aircraft arriving onto runway 20 are tactically controlled (vectored) via a series of turns to descend to land. From the north, this creates what's sometimes referred to as the 'Winchester Orbit' which results in some communities being overflown twice below 7000ft. At this stage, the data presented does not look at frequency of overflight and therefore the data in the table does not account for this cumulative effect. Option 1 aims to replicate what happens today within the constraints of PBN design and therefore this orbit continues to occur. The two options from the north begin broadly aligned with the concentrated areas of baseline but then turn east later than in the baseline; although these areas are overflown today, this will result in increased overflight of Colden Common, Shawford and Owslebury. When turning towards the north, the tracks then become largely aligned with the baseline where the final turns then join the extended centreline of final approach. Owing to the concentration of PBN, reduced overflight of New Alresford and Cheriton is expected. The earlier route (c.9% of traffic, shown as (1) in the data table)) is designed to RNAV1 standards and therefore we expect to see some dispersion around the centrelines, particularly within the turns. The later route (c.6% of traffic, shown as (2) in the data table) is designed to RNP standards and we expect to see a higher level of concentration with this route. Aircraft arriving from the south and south east broadly follow the baseline centreline contours however aircraft would turn slightly south of where the main areas of concentration occur in the baseline; this would still occur over areas frequently overflown today. It is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.

- **Runway 20 Departures:** In the baseline, there is broad dispersion across the airspace owing to the vectoring of departures. The PBN SIDs that form part of Option 1 will lead to concentration of flight paths which will reduce the overall population overflown, however those who are overflown would now likely experience an increase in overflight compared to the baseline. Initially, aircraft will continue to overfly the densely populated areas of Southampton City. Compared to the baseline, the left turn departure to the south east turns sightly earlier than today, this avoids Hythe however results in slightly more of Fareham being overflown at c.7000ft which the data suggests increases the population overflown. The straight ahead and south-west departures are broadly the same as within the baseline with the population data showing slightly reduced population overflown. The right turn to the north cannot be replicated to PBN standards and the Option 1 route avoids some of the densely populated areas of Southampton city and the western parts of Chandlers Ford, but does overfly the area of Totton and the eastern parts of Romsey. Totton and Romsey are overflown within the baseline but both are likely to see an increase in frequency of overflight.

- **Runway 02 Arrivals:** In the baseline, aircraft arriving onto runway 02 are tactically controlled (vectored) before joining one of Southampton's approach procedures. This creates broad dispersion across the airspace. The introduction of PBN transitions to join the approach procedures will lead to concentration and thus reduced population overflown however those who are overflown would now likely experience an increase in overflight compared to the baseline. When reviewing the baseline centreline overflight contours, this option does however aim to replicate the areas most frequently overflown today and there are only small differences between the baseline centreline contours and the option overflight contours which mainly occur over the sea. The overflight data suggests a decrease in population overflown for arrivals from the South East and marginal increases compared to the average baseline centrelines for aircraft arriving from the north and south. It's important to note that the baseline contour data does not reflect the vectoring that takes place today although it is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress. The removal of the VOR approach would benefit the areas around Lymington, Didben, however would lead to an increase in aircraft flying an RNP approach and thus more frequent overflight of Yarmouth and Hythe.

- **Runway 02 Departures:** In the baseline, the majority of aircraft departing runway 02 fly straight ahead for 2.5nm until turning. The departure routes in Option 1 also turn at 2.5nm before routing to the north, south and south east. The routes to the north and south east broadly replicate the most concentrated areas of the vectoring swathe within the constraints of PBN design guidelines. The route to the north slightly increases overflight of New Alresford, which is reflected in the overflight data, however this could refined in detailed IFP design at Stage 3 should this option progress. The route to the south, turns left and then tracks further west than the baseline overflight contour which avoids Chandlers Ford and the city centre of Southampton and still remains within the baseline overflight swathe; the data suggests that this would offer a significant decrease in population overflown. It's important to note that owing to the concentration of PBN, there would be a significant change in traffic patterns compared to the vectoring swathes today, and that the frequency of overflight would increase for those living under the routes.

- **Components combined (Cumulative Overflight).** When considering each mode of operation (20/02) the PBN arrivals/departure overflight contours largely do not overlap, however if arrivals are vectored then there may be the potential for cumulative overflight between arrivals and departures. The offset departure from runway 20 helps avoid cumulative overflight of the runway 02 final approach. The 02 departures turn away from final approach, although not as soon as possible, which does help reduce cumulative overflight of the 20 final approach.

L_{AMax}

Table 10 Option 1 comparison between option and baseline centreline L_{AMax} 65dB data (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area (km^2)	National Parks Count	National Parks Area (km^2)	Parks and Gardens Count	Parks and Gardens Area (km^2)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Option 1 20 Arrivals											
RWY20 IAP Arrival from South East (1)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from South (1)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from North (1)	0	0	0	0	0	0	0	0	0	0	0
RWY20 IAP Arrival from North (2)	0	0	0	0	0.08	0	0	0	0	0	0
Option 1 02 Arrivals											
RWY02 IAP RF Arrival from South East (1)	0	0	0	0	0	0	0	0	0	0	0
RWY02 IAP RF Arrival from North (1)	0	0	0	0	0	0	0	0	0	0	0
RWY02 IAP Arrival from South (1)	0	0	0	0	0	0	0	0	0	0	0
Option 1 20 Departures											
RWY20 SID South West (1)	19982	0	0	0	4	1	-0.51	15	2	18	52
RWY20 SID South (1)	18909	0	0	0	5.72	1	-0.51	16	2	16	50
RWY20 SID South East (1)	24906	0	0	-1	-13.8	3	0.74	15	2	21	50
RWY20 SID North (1)	-1319	0	0	0	0	0	0	-6	0	6	3
Option 1 02 Departures											
RWY02 SID South West (3)	-4991	0	0	0	-0.29	-1	-0.86	-3	0	-2	-2
RWY02 SID North (1)	-229	0	0	0	-0.21	0	0	0	0	0	0
RWY02 SID South East (1)	-8	0	0	0	0.11	0	0	-1	0	1	1
RWY02 SID South (1)	-4991	0	0	0	-0.29	-1	-0.86	-3	0	-2	-2

When reviewing the L_{AMax} 65dB data it's important to note that the baseline is based on the average centreline and does not take into account the vectoring that takes place today. The option data also assumes that no vectoring occurs. It's therefore important to read the qualitative assessment below as well as the data table.

The L_{AMax} 65dB suggests that both the 20 and 02 arrivals will be very similar to the baseline. It is expected that in certain traffic scenarios, vectoring may still occur and within this option this is expected to remain similar to the baseline and therefore not materially impact the data outcomes.

The 02 departures improve in terms of population overflown and this is mainly due to the avoidance of Chandlers Ford compared to the baseline. The runway 20 departures data suggest a significant increase in population within the 65dB contour however the baseline does not take into account the vectoring that occurs today. It is expected that the population within the 65dB contour area would reduce if this was modelled. The data does however suggest that the area of highest concentration would change compared to the baseline; when reviewing the contour maps shown in appendix B, this appears to be because the contour extends slightly further to the west than in the baseline over the densely populated areas of Southampton as well as some variation in the contours further out. There may be opportunities for the option to be refined as part of the IFP development in Stage 3 to reduce this so that the initial routes more closely reflect what happens today however this will have to be developed within PBN and CAA design criteria.

Noise Summary
Overall, in terms of L_{Aeq}, this option is expected to remain relatively similar to today. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the Runway 20 arrivals and departures, and the Runway 02 arrivals offer small changes to population overflown. The runway 02 departures however offer a significant decrease in population overflown and therefore cumulatively there is expected to be an overall decrease in population overflown. When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 departures could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this.
Potential positive benefits and negative impacts to noise will be investigated in further detail as part of the full quantified noise analysis undertaken at Stage 3 should this option progress.

Tranquillity

- **Runway 20 Arrivals:** Option will continue to overfly the South Downs National Park. The data suggests arrivals from the north would reduce the area of South Downs National Park overflown however South and South East arrivals would lead to increases. The data does not take into account the vectoring that occurs today and overall the introduction of PBN compared to vectoring is expected to result in a reduction in the area of national park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 20 Departures:** Option will continue to overfly the New Forest National Park however will avoid the Isle of Wight AONB. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 02 Arrivals:** Option will continue to overfly the Isle of Wight AONB and New Forest National Park. Comparison against the average baseline centreline data suggests a small increase in national park overflown however, when considering the vectoring swathe of today and VOR approaches will no longer be available, adopting concentrated PBN paths is expected to reduce the overall area of AONB and National Park overflown. The areas under the PBN routes will however experience an increase in overflight compared to the baseline.
- **Runway 02 Departures:** Option will continue to overfly the South Downs National Park. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.

Biodiversity

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1640ft and therefore there is no anticipated change to biodiversity.
- **Runway 20 Departures:** Although this option aims to replicate how aircraft depart today due to a CAA IFP waypoint requirement there will be a slight change to how aircraft will fly laterally below 1640ft. This could lead to changes with the L_{Aeq} contour to the River Itchen SSSI/SPA/SAC and Solent and Southampton Water SPA. Compared to the vectoring baseline, there may be reduced overflight of the Southampton Common SSSI. Slow climbing aircraft may continue to overfly the New Forest National Park however this would be at altitudes close to 1640ft and less likely with the future fleet mix.
- **Runway 02 Arrivals:** Aircraft would continue to fly an RNP approach and therefore there is no expected change compared to the majority of the baseline however aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. This could lead to small benefits for the Dibden Bay SSSI although the overflight contours suggest that this would continue to be overflown as part of the RNP approach. The redistribution of traffic onto the RNP approach may also lead to a change in frequency of overflight over the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA, which could be within the L_{Aeq} contour areas.
- **Runway 02 Departures:** Option will continue to overfly the South Downs National Park and the River Itchen SSSI/SAC. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.

Communities	Air Quality	Qualitative

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality.
- **Runway 20 Departures:** Although this option aims to replicate how aircraft depart today due to a CAA IFP waypoint requirement there will be a slight change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. However, it should be noted that these changes are likely to be very small, particularly compared to the contribution of road traffic (M27/A27) to local air quality.
- **Runway 02 Arrivals:** Aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality including within the Southampton Council AQMAs. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
- **Runway 02 Departures:** This option is not expected to change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality.

Wider Society	Greenhouse Gas Impact	Qualitative
The fuel burn assessment has indicated that this option is expected to offer similar track mileage to the baseline. As track mileage is linked to Fuel Burn and associated CO_2 emissions, we therefore expect this option to have a neutral impact on Greenhouse Gas emissions compared to the baseline.		
Wider Society	Capacity/Resilience	Qualitative
This ACP does not seek to increase capacity for Southampton Airport and therefore we do not expect any change from today as a result of this option. The introduction of an PBN arrival onto runway 20 will improve resilience in the event of an ILS outage on Runway 20. The introduction of PBN SIDs and arrival transitions may lead to a decrease in resilience for Southampton Airport; today aircraft are tactically controlled by ATC and this creates a lot of flexibility within the airspace. For example, when departing from runway 20 and routing north, aircraft can be turned left or right depending on traffic conditions, whereas the introduction of fixed PBN routes will remove this flexibility.		
General Aviation	Access	Qualitative

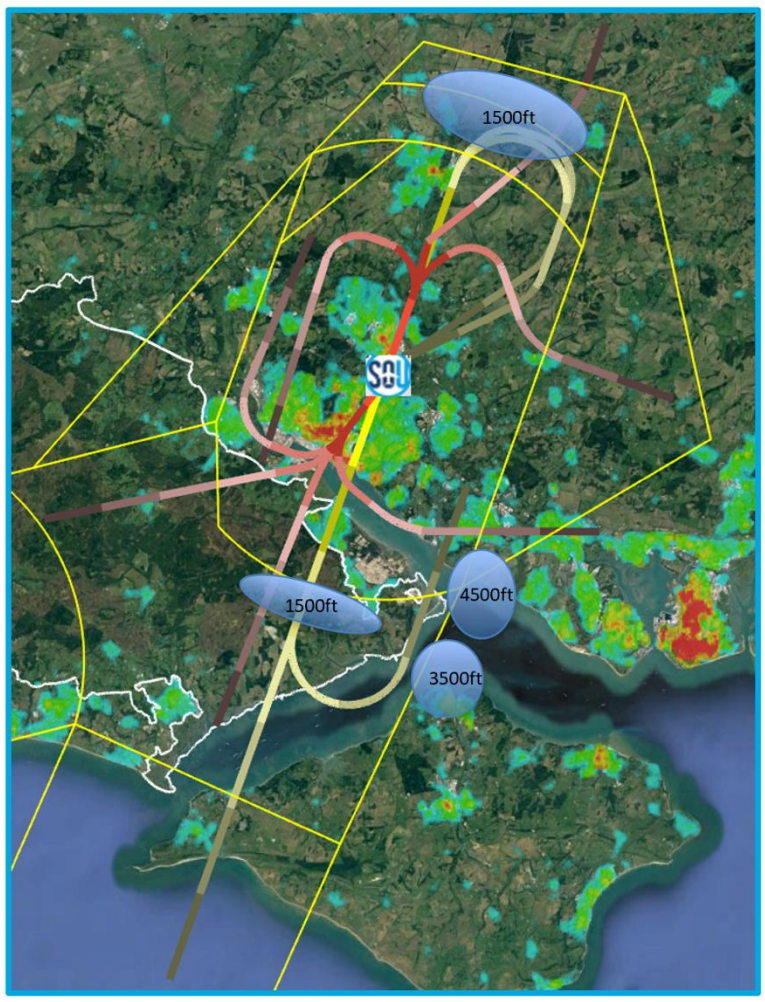


Figure 7 Indicative broad potential areas where more CAS would be required

CAS: This option would require additional CAS compared to the baseline in order to meet CAS containment requirements. This would be for both the runway 20 arrival and 02 arrival routes. Amendments and lowering the base of CAS in some areas would be required to Solent CTA 3 and possibly CTA 5 to the north, and CTA 2 to the south. Note, the figure opposite only aims to highlight the broad potential areas where more CAS may be required.

Overall, the volume of airspace required is expected to increase compared to the baseline. These volume increases would occur over areas that are used by General Aviation traffic and will therefore have an impact on GA although there may be some benefits to GA owing to reduced ATC workload (see access section below). Any additional volume of airspace around CTA 2 would potentially create increased bottlenecks outside of CAS that would require further investigation and safety mitigations should this option progress. GA have raised very strong concerns about any lowering of CTA2/extension to the CTR to wholly contain the existing RNP APCH to RWY 02. Very careful consideration would need to be given to the benefit of pursuing a lowering of CTA2/Extension to the CTR to contain the existing RNP APCH versus the impact to GA.

In addition to this, the runway 02 northbound SID would require c.12% climb gradient to remain contained within the existing baseline volume of airspace; this could be quite optimistic based on current and future fleet forecasts climb performance.

There may be scope to reduce the volume of the existing CTR by decreasing its width either side of the extended centreline, stepping up to a 1500ft base then progressively higher which may offer opportunities to raise parts of CTA 2, CTA 4, CTA 6 and CTA 8.

CTR/CTA dimensions depend very much on the Instrument Flight Procedures and/or Radar Vectoring patterns to and from the aerodrome. Therefore, until very detailed IFP design takes place and locations of the waypoints, fixes, PBN specifications and associated protection areas are available we can only provide some indications as to the general areas where changes are likely to be required to accommodate the options.

Due to the proximity and interdependency between the airports, the shape and structure of CAS to the SW will be dependent on Southampton's and Bournemouth's options and to the NE will be dependent on Southampton's and Farnborough's options; this will be explored in further detail as part of the Stage 3 FOA should this option progress.

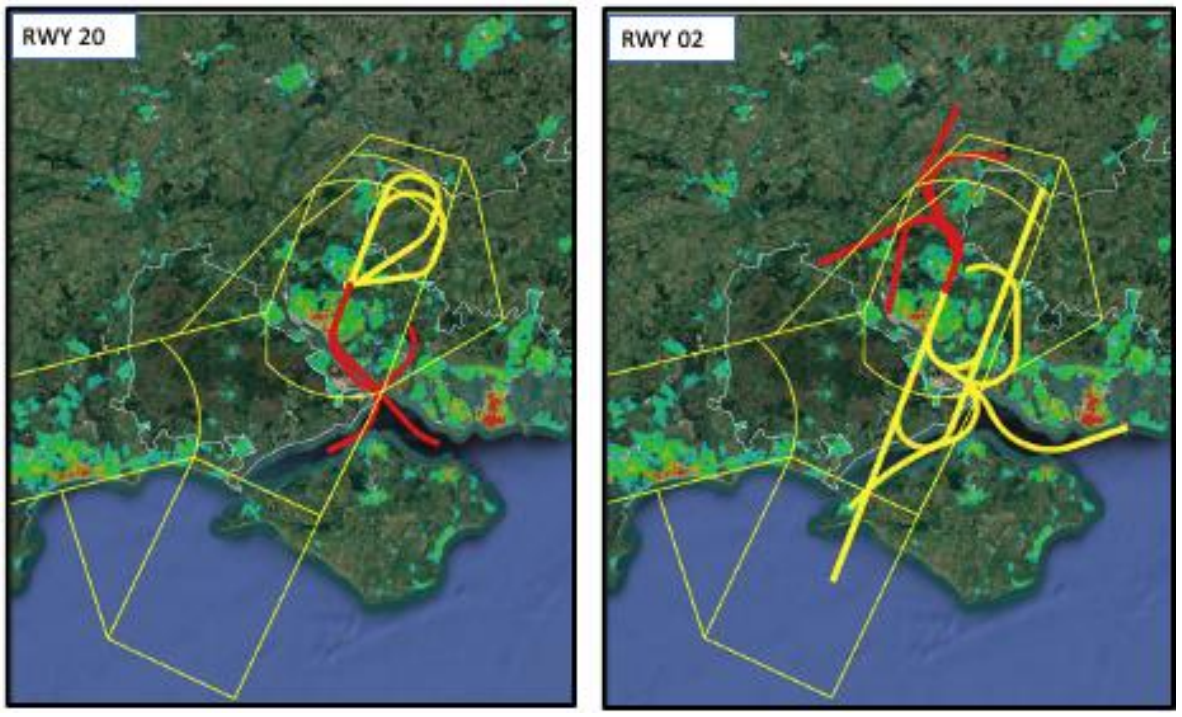
Access: The reduction in vectoring owing to the introduction of PBN arrival transitions and departure SIDs will significantly reduce ATC workload and as such, this offers an opportunity for improved access to CAS.

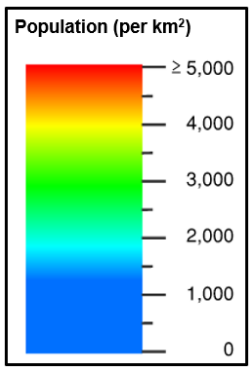
The shape/size/structure of CAS will be further explored as part of Stage 3 should this option progress.

General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
This ACP does not seek to increase capacity for Southampton Airport.		
General Aviation/ commercial airlines	Fuel Burn	Qualitative
We estimate that Option 1 will maintain similar track distances to the baseline or may potentially slightly increase track distance. The initial data (see appendix B) suggests some small variation in track length between most of the routes; when we look at this cumulatively taking into account the usage of each route, there is an increase in track mileage however for the purposes of this Initial Options Assessment the track distances have been rounded, and there may also be opportunities to refine the IFP designs as part of Stage 3 should this option progress. This option offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn (however the track length assessment is considered the main indicator of potential impacts compared to the baseline). In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.		
Commercial airlines	Training costs	Qualitative
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 option is not anticipated to require any additional training costs for airlines.		

Commercial airlines	Other costs	Qualitative
No other airline costs are foreseen		
Airport/ANSP	Infrastructure costs	Qualitative
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/ANSP	Operational costs	Qualitative
This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The option removes Southampton's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation.		
Airport/ANSP	Deployment costs	Qualitative
This option is expected to require air traffic controller training for the controllers and assistants located at NATS Swanwick and Southampton 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 also neighbouring airport options are known.		
All	Safety	Qualitative
The General Aviation assessment (see above) has highlighted concerns over the additional CAS required for the runway 20 and 02 arrival transitions and potentially the runway 02 northbound SID. If this option progresses, additional work would be required to ensure the volume of additional CAS was safe for CAT and GAT. The introduction of systemised approaches onto runway 20 would greatly reduce ATC and pilot workload, providing ATC with capacity to monitor and take action against any CAS infringements. The significantly lower workload would also enhance service provision to other airspace users, enabling improved integration. 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 or near 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.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
This option would modernise Southampton's airspace by introducing PBN arrival and departure routes. In terms of noise, this option's L_{Aeq} contour is expected to remain relatively similar to today. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the Runway 20 arrivals and departures, and the Runway 02 arrivals offer small changes to population overflown. The runway 02 departures however offer a significant decrease in population overflown and therefore cumulatively there is expected to be an overall decrease in population overflown. When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 departures could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this. The option is expected to maintain similar track distances to the baseline or may potentially slightly increase track distance. This option offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn (however the track length assessment is considered the main indicator of potential impacts compared to the baseline). The option will require additional new CAS compared to the baseline, but it does offer opportunities for potential reductions in other areas of CAS and improved access owing to the reduced ATC workload.		
All	Interdependencies, conflicts and trade-offs	Qualitative
Using the map provided in ACOG's Airspace Change Masterplan Iteration 2, the left turn departure route from runway 02 and large parts of the 20 departures and 02 approaches fall within the overlapping area between Bournemouth and Southampton. Parts of the runway 20 arrivals, and the runway 02 north departure, fall within the overlapping area between Farnborough and Southampton. Interactions below 7000ft are expected to maintain at a similar level to today although this will be explored in further detail at Stage 3 once shortlists of options from airports are known. Above 7000ft, there may be interdependencies and trade-offs that will be explored as part of Stage 3 along with Bournemouth, Farnborough and NATS NERL. Farnborough's designs will share interdependencies with Gatwick and Heathrow.		

Option 3





This option would see a suite of SIDs (red), PBN arrival transitions to each runway end, an RNP APCH to RWY 20 as well as an RNP-AR curved arrivals to RWY 02 (yellow). This option maximises use of the Solent, seeks to avoid the New Forest and also has RWY 02 departure routes positioned to the west of Winchester.

The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white, as well as areas of population density. (Note, actual centrelines are likely to change throughout the process).

Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative

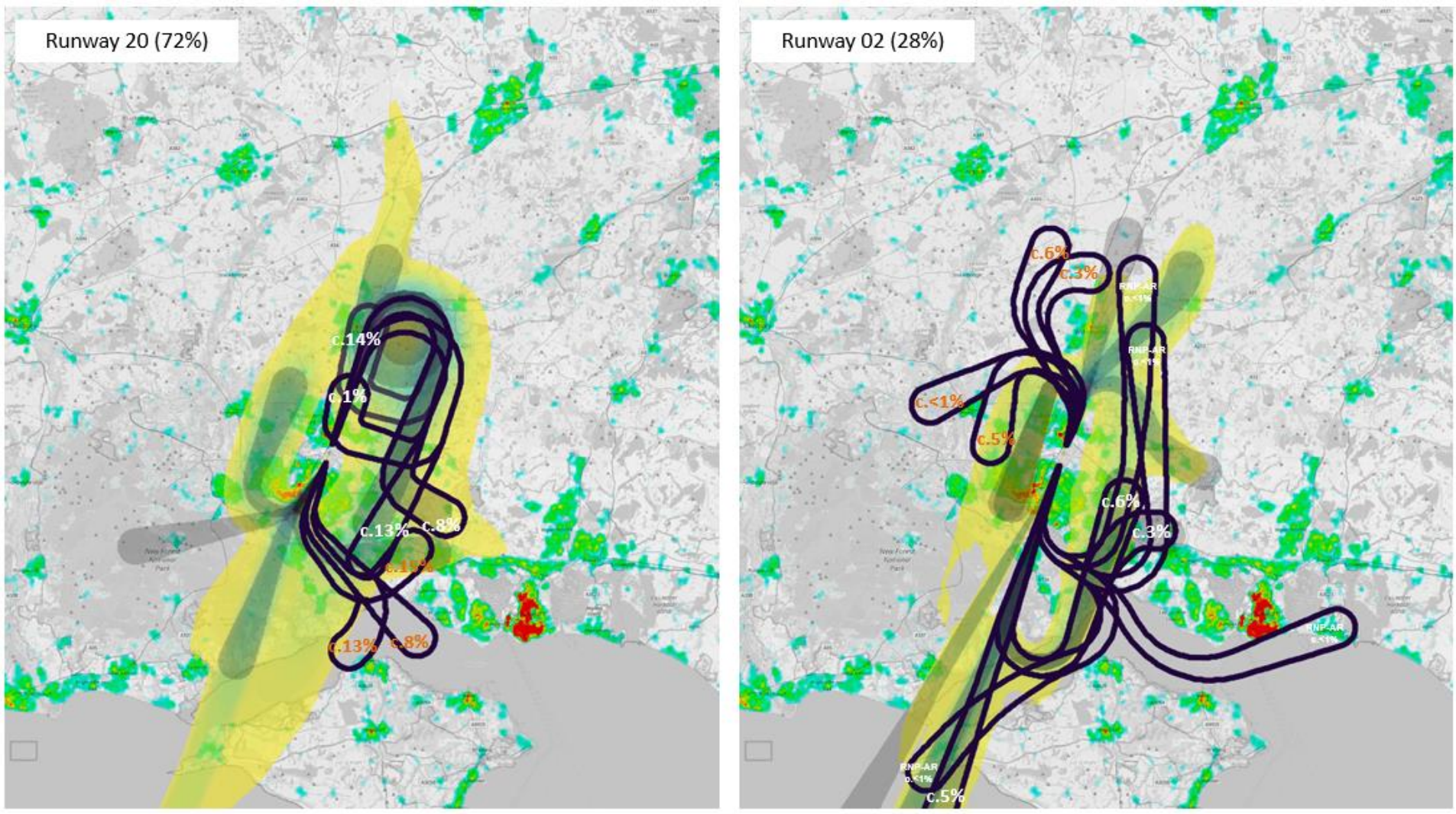


Figure 8 Runway 20 and Runway 02 Option 3. Baseline Heatmap (0-7000ft), Baseline overflight contour: Grey (0-7000ft), Option overflight contour: Black outline (0-7000ft)

Table 11 Option 3 comparison between option and baseline centreline overflight data 0-7000ft (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area (km^2)	National Parks Count	National Parks Area (km^2)	Parks and Gardens Count	Parks and Gardens Area (km^2)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Option 3 20 Arrivals											
RWY20 IAP Arrival from South East (1)	-342	0	0	0	-1.3	0	0.7	-2	0	1	-3
RWY20 IAP Arrival from North (2) (RNP)	2774	0	0	0	10.2	0	0.7	4	0	4	-1
RWY20 IAP RF Arrival from North (4) (RNP with RF)	8693	0	0	0	-8.6	2	-1.3	7	0	7	-13
RWY20 IAP RF Arrival from South (2)	4235	0	0	0	-6.3	1	-1.3	-4	1	2	-5
Option 3 02 Arrivals											
RWY02 IAP RF Arrival from South East (1)	-2880	0	0	0	-1.2	0	0	-3	0	-7	-2
RWY02 IAP RF Arrival from North (1)	289	0	0	0	-1.3	0	0	-4	0	-4	2
RWY02 IAP Arrival from South (1)	105	0	0	0	0.1	0	0	0	0	0	0
RWY02 IAP RNP AR Arrival from North (3)	-13188	0	0	0	15.68	1	2.41	-7	-2	-15	-6
RWY02 IAP RNP AR Arrival from South (2)	-1088	0	4.2	0	-15.0	0	0	-2	-1	7	-1
RWY02 IAP RNP AR Arrival from South East (2)	-15417	1	3.8	-1	-23.0	0	0	-13	-3	-11	-10
RWY02 IAP RNP AR Arrival from North (5)	-12902	0	0	0	14.8	0	0	-12	-2	-16	-7
Option 3 20 Departures											
RWY20 SID North (2)	-9109	0	0	1	1.67	0	-0.17	-13	0	11	-29
RWY20 SID South (2)	-4591	1	0	0	-36.5	0	-1.3	-10	-1	7	-37
RWY20 SID South East (2)	-33346	0	0	1	0.5	0	-0.2	-36	-3	-36	-46
Option 3 02 Departures											
RWY02 SID North (3)	-685	0	0	0	-27.4	-2	-2.9	1	0	0	-3
RWY02 SID South (2)	-37762	0	0	0	-0.5	-2	-0.9	-29	-5	-39	-43
RWY02 SID South West (1)	-41552	0	0	0	-1.3	2	1.2	-31	-5	-33	-36
RWY02 SID South East (2)	-3546	0	0	-1	-32.6	3	0.2	-1	0	-1	-4

LAeq

- **Runway 20 Arrivals:** Within the scope of the L_{Aeq} contours, the runway 20 arrivals are expected to remain very similar to today and therefore they are not expected to materially alter the L_{Aeq} contours.
- **Runway 20 Departures:** Runway 20 departures would climb straight ahead rather than turn to right to join the 217 radial as they do in the baseline, and therefore we would expect this option to result in a change to the shape of the L_{Aeq} contours. We expect that the existing lobe to the south west would be reduced and instead there would be an increase in the straight ahead direction towards the south. As the straight ahead would overfly the areas under the 02 final approach, we would expect there to be an increase to adverse impacts for those communities living under the straight ahead.
  Owing to the concentration of PBN the L_{Aeq} contours may extend far enough that they turn towards the south-east. The reduction in size of the south west contour lobe would reduce over some of the most densely populated areas of Southampton (shown in red on the population density underlay) and the straight ahead lobe may offer the potential to extend over the River Itchen and slightly less densely populated areas; these areas would see a significant increase in frequency of overflight compared to today.
- **Runway 02 Arrivals:** Within the scope of the L_{Aeq} contours, the majority of runway 02 arrivals will fly the same extended runway centreline as within the baseline, however in this scenario, the VOR approach flown in the baseline will not be available and therefore there will be more aircraft flying a straight in RNP approach. As 02 is only used 28% of the time, this is likely to have a very small influence on the contours – most likely extending the southern lobe slightly south but in turn, reducing the southwest lobe slightly. The south west lobe extends over the most densely populated areas in Southampton therefore this may lead to a very small reduction in population but this would require confirmation via a quantitative noise model in Stage 3 should this option progress.
- **Runway 02 Departures:** Compared to the baseline, runway 02 departures would turn earlier than today and all departures would turn to the left (west). Owing to runway 02 being in operation for around 28% of the year, these departure routes have a smaller influence on the shape of the contours compared to the runway 20 arrivals. It's anticipated that a lobe to the west could extend to reflect the turns in the departure routes. This may benefit the populated areas of Twyford and Colden Common, but may result in parts of Otterbourne falling within some of the outermost contours.

  The extent of these contour changes would require further investigation as part of a quantified noise model in Stage 3 should this option progress.

Overflight

- **Runway 20 Arrivals:** In the baseline, aircraft arriving onto runway 20 are tactically controlled (vectored) via a series of turns to descend to land. From the north, this creates what's sometimes referred to as the 'Winchester Orbit' which results in some communities being overflown twice below 7000ft. At this stage, the data presented does not look at frequency of overflight and therefore the data in the table does not account for this cumulative effect. Option 3 includes two 'orbit' routes from the north (2) (14%) and (4) (1%). It is expected that the majority of aircraft would fly the orbit that descends below 7000ft above Winchester (2) as it offers shorter track mileage (see assessment below). This option begins broadly aligned with the concentrated areas of baseline, but then turns to the east later than in the baseline; although these areas are overflown today, this will result in increased frequency of overflight. When turning towards the north, the tracks then become more aligned with the baseline where the final turns then join the extended centreline of final approach. The second route from the north (4) brings aircraft over Winchester above 7000ft but this does result in increased overflight of Colden Common, Fair Oak, Horton Heath and Bishop's Waltham compared to the baseline. Owing to the concentration of PBN, reduced overflight of New Alresford and Cheriton is expected.
  The arrival route from the south descends below 7000ft further south than in the baseline, which creates overflight of Locks Heath, Hamble-le-rice and Bishops Waltham. It then joins the final approach later than the baseline avoiding Winchester. The route from the south-east broadly follows the baseline. It is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.

- **Runway 20 Departures:** In the baseline, there is dispersion across the airspace owing to the vectoring of departures. The PBN SIDs that form part of Option 3 will lead to concentration of flight paths which will reduce the overall population overflown, however those who are overflown would now likely experience an increase in overflight compared to the baseline. Compared to the baseline, aircraft will fly straight ahead which will result in a change in overflight patterns and will result in communities under the final approach seeing an increase in overflight. The overflight contours do however show that the change to straight ahead reduces overflight of some of the most densely populated areas of Southampton with aircraft routing instead along parts of the river Itchen. The routes then turn south east, aiming to follow the water but these do overfly the southern parts of Woolston and Netley and Hamble-le-rice. The route to the north, overflies Titchfield and would increase frequency compared to today. The routes to the south and south east mainly overfly the water with the south east route slightly overflying parts of Cowes - there may be opportunities to refine this as part of IFP development at Stage 3 should the option progress.

- **Runway 02 Arrivals:** In the baseline, aircraft arriving onto runway 02 are tactically controlled (vectored) before joining one of Southampton's approach procedures. This creates broad dispersion across the airspace. The introduction of PBN transitions to join the approach procedures will lead to concentration and thus reduced population overflown however those who are overflown would now likely experience an increase in overflight compared to the baseline.
  Option 3 has three RNP arrival routes from the north, south and south east that we anticipate the majority of aircraft arriving at Southampton would use.

These routes are identical to the routes assessed in Option 1. In addition, Option 3 offers four RNP-AR arrival routes. We estimate at 10-15% of Southampton's fleet could be equipped to fly RNP-AR approaches in the future. The RNP-AR route from the south increases track mileage and therefore we would expect operators to fly the straight in RNP APCH which largely reflects the baseline scenario. Any aircraft that did elect to fly the RNP-AR arrival would utilise the Solent rather than flying over land, although Yarmouth will continue to be overflown at c7000-6000ft. Beyond this, the overflight contour follows the water, and avoids populated areas, before joining the straight in approach.
From the south east, the RNP-AR approach routes where possible over the water although it does introduce new overflight of Hayling Island and the southern parts of Portsmouth at c.7000-6000ft. There may be opportunities to refine the procedures at Stage 3 should this option progress.
The option offers two routes from the north, the northern most route (Labelled in the data table with (3)) broadly avoids densely populated areas until reaching the eastern areas of Hedge End, and then routes to the west of Locks Heath before turning over the water and joining final approach; although these areas are overflown today, aircraft flying this route would be lower than in the baseline. The alternative route from the north (Labelled in the table with (5)) overflies Bishops Waltham which is overflown in the baseline, before routing over new areas between Locks Heath and Fareham. Once beyond Titchfield, the route overflies sparsely populated areas before turning over the water and following the water before joining final approach.
When reviewed against the noise data the RNP-AR arrivals would offer a substantial decrease to population overflown however it's important to note that, as not all airlines are approved to fly RNP-AR approaches, the majority of aircraft in this option would continue to fly the PBN arrival routes which aim to replicate what happens today. For these three routes, there are only small differences between the baseline centreline contours and the option overflight contours which mainly occur over the sea. The overflight data suggests a decrease in population overflown for arrivals from the South East and marginal increases compared to the average baseline centrelines for aircraft arriving from the north and south. It's important to note that the baseline contour data does not reflect the vectoring that takes place today although it is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.
The removal of the VOR approach would benefit the areas around Lymington, Didben, however would lead to an increase in aircraft flying an RNP approach and thus more frequent overflight of Yarmouth and Hythe.

- **Runway 02 departures:** In the baseline, the majority of aircraft departing runway 02 fly straight ahead for 2.5nm until turning and typically aircraft routing south turn left, slow climbing aircraft routing north turn slightly right towards the north-east, better climbing aircraft routing north fly straight ahead, and aircraft routeing south east turn right. In option 3, all departures turn to the left earlier than today and, compared to the baseline, they avoid some of the most densely populated areas of Chandlers Ford, Southampton and Winchester. Owing to the concentration of PBN, there would be a significant change in traffic patterns compared to the vectoring swathes today, and that the frequency of overflight would increase for those living under the routes.

- **Components combined (Cumulative Overflight).** When considering each mode of operation (20/02) the PBN arrivals/departure overflight contours largely do not overlap, however if arrivals are vectored then there may be the potential for cumulative overflight between arrivals and departures. The straight ahead departure off runway 20 results in cumulative overflight with the runway 02 final approach although it does then turn to the south east. Both the runway 20 departures and runway 02 arrivals route around areas to the south east of the airport creating cumulative overflight over areas which would be far more frequently overflown than in the baseline. The 02 departures turn away from the 20 final approach relatively soon after departure and then route to the west away from the areas overflown by the 20 arrivals which helps reduce cumulative impacts.

L_{Amax} 65dB

Table 12 Option 3 comparison between option and baseline centreline LAMax 65dB data (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area (km²)	National Parks Count	National Parks Area (km²)	Parks and Gardens Count	Parks and Gardens Area (km²)	Schools Count	Hospitals Count	Carehomes Count	Places of worship Count
Option 3 20 Arrivals											
RWY20 IAP Arrival from South East (1)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from North (2)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP RF Arrival from North (4)	-1130	0	0	0	0.98	1	0.01	0	0	0	0
RWY20 IAP RF Arrival from South (2)	-1130	0	0	0	0.98	1	0.01	0	0	0	0
Option 3 02 Arrivals											
RWY02 IAP RF Arrival from South East (1)	0	0	0	0	0	0	0	0	0	0	0
RWY02 IAP RF Arrival from North (1)	0	0	0	0	0	0	0	0	0	0	0
RWY02 IAP Arrival from South (1)	0	0	0	0	0	0	0	0	0	0	0
RWY02 IAP RNP AR Arrival from North (3)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
RWY02 IAP RNP AR Arrival from South (2)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
RWY02 IAP RNP AR Arrival from South East (2)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
RWY02 IAP RNP AR Arrival from North (5)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
Option 3 20 Departures											
RWY20 SID North (2)	-9639	0	0	1	0.06	0	-0.15	-11	-1	-1	-19
RWY20 SID South (2)	14145	0	0	-1	-2.14	2	-0.4	12	1	14	33
RWY20 SID South East (2)	19554	0	0	-1	-13.8	3	0.46	14	1	19	33
Option 3 02 Departures											
RWY02 SID North (3)	-1533	0	0	0	-13.37	1	0.58	-1	0	1	-2
RWY02 SID South (2)	-5408	0	0	0	-0.37	0	-0.86	-4	0	-2	-3
RWY02 SID South West (1)	-5873	0	0	0	-1.15	0	-0.53	-3	0	-2	-1
RWY02 SID South East (2)	-1008	0	0	0	-13.29	1	0.94	-3	1	3	-2

When reviewing the L_{AMax} 65dB data it's important to note that the baseline is based on the average centreline and does not take into account the vectoring that takes place today. The option data also assumes that no vectoring occurs. It's therefore important to read the qualitative assessment below as well as the data table.

The data suggests that the population within the 65dB L_{AMax} contour would improve for the 02 Departures and 20 and 02 arrivals; when also considering the vectoring that occurs today, this would suggest that the improvements would be even greater if the vectoring was modelled (although some vectoring may still occur within the option). The runway 20 departures data suggest a significant increase in population within the 65dB contour however the baseline does not take into account the vectoring that occurs today. It is expected that the population within the 65dB contour area would reduce if this was modelled.

Whilst the data and qualitative assessment suggest cumulatively there could be an improvement, this option sees a significant change in lateral location for the departures compared to the baseline contours and therefore it is expected to significantly alter the population and noise sensitive areas within the 65dB L_{AMax} contour areas; this offers benefits for those currently in the contour areas but disbenefits to these new areas that may not currently experience high levels of noise. This will be investigated in further detail as part of the fully quantified noise analysis undertaken at Stage 3 should this option progress.

Noise Summary
Overall, in terms of L_{Aeq}, the changes to the runway 20 and runway 02 departures and 02 arrivals are expected to result in a change in shape of the L_{Aeq} contours. Against population data mapping, this is expected to decrease the number of population within these contours however owing to the population density of these areas potentially affected, the scale of any changes cannot be predicted without quantitative modelling.
When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency

of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the Runway 20 arrivals would be expected to increase population counts whereas the Runway 20 departure and Runway 02 departures and arrivals data suggest there would be a reduction in overflight of populated areas. Cumulatively there is expected to be an overall decrease in population overflown.
When considering L_{AMax} 65dB, this option is expected to result in a reduction of population however large areas will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline.
Potential positive benefits and negative impacts will be investigated in further detail as part of the full quantified noise analysis undertaken at Stage 3 should this option progress.

Tranquillity:

- **Runway 20 Arrivals:** Option will continue to overfly the South Downs National Park. The data suggests the main arrival from the north (2) would increase the area of national park overflown and all other routes would see decreases. The data does not take into account the vectoring that occurs today and overall the introduction of PBN compared to vectoring is expected to result in a reduction in the area of national park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 20 Departures:** This option would avoid overflight of the Isle of Wight AONB and the vast majority of the New Forest; considerably reducing overall overflight compared to the vectored baseline. There is a very small amount of overflight of the New Forest National Park over Calshot, however there may be opportunities to refine this as part of Stage 3 should this option progress.
- **Runway 02 Arrivals:** Option will continue to overfly the Isle of Wight AONB and New Forest National Park. Comparison against the average baseline centreline data suggests a small increase in national park overflown however, when considering the vectoring swathe of today and VOR approaches will no longer be available, adopting concentrated PBN paths is expected to reduce the overall area of AONB and National Park overflown. The areas under the PBN routes will however experience an increase in overflight compared to the baseline. The RNP-AR arrivals, which could be used by 10-15% of traffic, offer opportunities to avoid large parts of the New Forest National Park and the Isle of Wight AONB.
- **Runway 02 Departures:** This option avoids large areas of the South Downs National Park compared to the baseline with the departure routes overflying the park for a very small area before turning left away from the boundary. This option would therefore present a significant improvement in overflight compared to the baseline.

Biodiversity:

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1640ft and therefore there is no anticipated change to biodiversity.
- **Runway 20 Departures:** This option sees departures fly straight ahead and is therefore expected to lead to changes with the L_{Aeq} contour to the River Itchen SSSI/SPA/SAC and Solent and Southampton Water SPA. The departure routes will avoid the Southampton Common SSSI and the New Forest National Park. There will be changes to the distribution of traffic and frequency of overflight over the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA, which could be within the L_{Aeq} contour areas.
- **Runway 02 Arrivals:** Aircraft would continue to fly an RNP approach and therefore there is no expected change compared to the majority of the baseline however aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. This could lead to small benefits for the Dibden Bay SSSI although the overflight contours suggest that this would continue to be overflown as part of the RNP approach. The redistribution of traffic onto the RNP approach may also lead to a change in frequency of overflight over the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA, which could be within the L_{Aeq} contour areas. The approaches that follow the Solent result in changes to distribution of overflight over the Hythe and Calshot Marshes, Lee on Solent to Itchen Estuary SSSI, and Solent and Southampton Water SPA.
- **Runway 02 Departures:** This option avoids large areas of the South Downs National Park compared to the baseline with the departure routes overflying the park for a very small area before turning left away from the boundary. The option would continue to overfly the River Itchen SSSI/SAC; in these areas aircraft will be turning rather than flying straight ahead as they do in the baseline, and therefore there will be a redistribution of traffic which could be within the L_{Aeq} contour areas.

Communities	Air Quality	Qualitative

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality.
- **Runway 20 Departures:** There will be a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. However, it should be noted that these changes are likely to be small, particularly compared to the contribution of road traffic (M27/A27) to local air quality. All SIDs overfly the Southampton Council Bitterne Road West, Town Quay and Victoria Road AQMA.
- **Runway 02 Arrivals:** Aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality including within the Southampton Council AQMAs. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
- **Runway 02 Departures:** There will be a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. 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	Qualitative

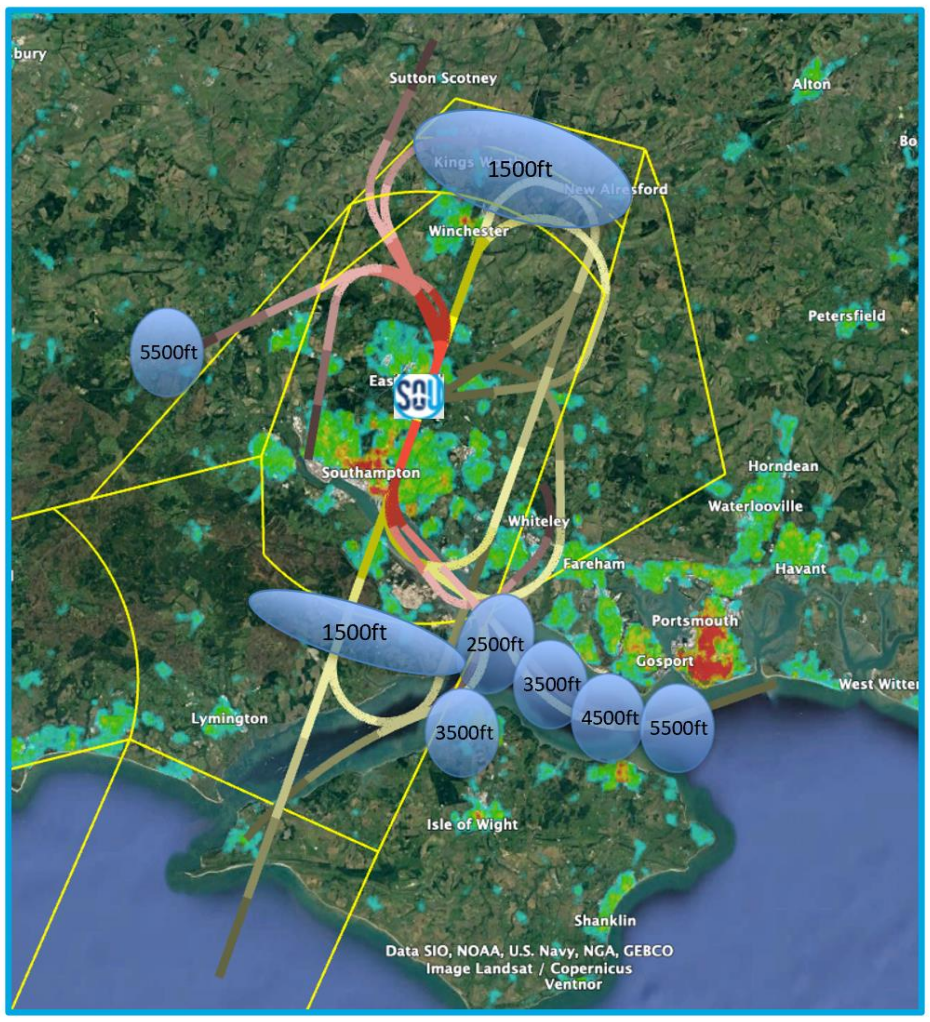
The fuel burn assessment has indicated that this option is expected to increase track mileage compared to the baseline. As track mileage is linked to Fuel Burn and associated CO2 emissions, we therefore expect this option to increase Greenhouse Gas impacts compared to the baseline.

Wider Society	Capacity/Resilience	Qualitative

This ACP does not seek to increase capacity for Southampton Airport and therefore we do not expect any change from today as a result of this option. The introduction of an PBN arrival onto runway 20 will improve resilience in the event of an ILS outage on Runway 20.

The introduction of PBN SIDs and arrival transitions may lead to a decrease in resilience for Southampton Airport; today aircraft are tactically controlled by ATC and this creates a lot of flexibility within the airspace. For example, when departing from runway 20 and routing north, aircraft can be turned left or right depending on traffic conditions, whereas the introduction of fixed PBN routes will remove this flexibility.

General Aviation	Access	Qualitative



CAS: With regards to CAS, this option would require additional CAS compared to the baseline in order to meet CAS containment requirements. Note, the figure opposite only aims to highlight the broad potential areas where more CAS would be required.

To the NW, CTA 3 would require amendment in order to accommodate the runway 02 departures to the west of Winchester. Amendments and lowering the base of CAS in some areas would be required to Solent CTA 3 and possibly CTA 5 to the north for 20 arrivals. CTA 2 to the south would require significant additional areas of CAS to accommodate the RNP-AR arrival routes.

Overall, the volume of airspace required is expected to increase compared to the baseline. These volume increases would occur over areas that are used by General Aviation traffic and will therefore have an impact on GA. Any additional volume of airspace around CTA 3 or CTA 2 would potentially create increased bottlenecks outside of CAS that would require further investigation and safety mitigations should this option progress. Feedback from GA and MoD stakeholders has raised significant concerns that more CAS in the north west of the existing CTR boundaries could generate bottle necks in Class G to the south west of Middle Wallop. GA stakeholders raised concerns that airspace to the south east to accommodate SOU flight paths over the Solent would create a bottle neck between Isle of Wight and UK mainland as well as risk to single engine aircraft crossing the Channel at considerably lower altitude. GA have also raised very strong concerns about any lowering of CTA2/extension to the CTR to wholly contain the existing RNP APCH to RWY 02. Very careful consideration would need to be given to the benefit of pursuing a lowering of CTA2/Extension to the CTR to contain the existing RNP APCH versus the impact to GA.

There may be scope to reduce the volume of the existing CTR by decreasing its width either side of the extended centreline, stepping up to a 1500ft base then progressively higher which may offer opportunities to raise of parts of CTA 2, CTA 4, CTA 6 and CTA 8 however overall a net increase in CAS is anticipated.

CTR/CTA dimensions depend very much on the Instrument Flight Procedures and/or Radar Vectoring patterns to and from the aerodrome. Therefore, until very detailed IFP design takes place and locations of the waypoints, fixes, PBN specifications and associated protection areas are available we can only provide some indications as to the general areas where changes are likely to be required to accommodate the options.

Due to the proximity and interdependency between the airports, the shape and structure of CAS to the SW will be dependent on Southampton's and Bournemouth's options and to the NE will be dependent on Southampton's and Farnborough's options; this will be explored in further detail as part of the Stage 3 FOA should this option progress.

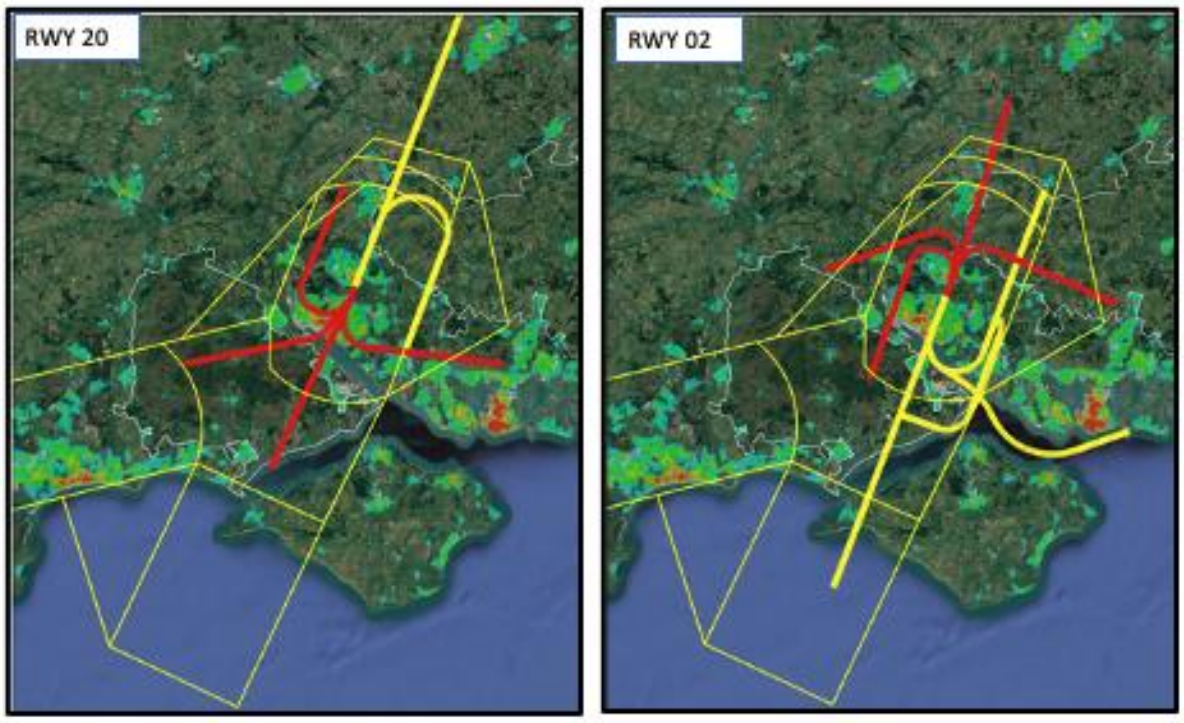
Access: The reduction in vectoring owing to the introduction of PBN arrival transitions and departure SIDs will significantly reduce ATC workload and as such, this offers an opportunity for improved access to CAS. However we would not expect the amount of access improvement to be able to accommodate the number of GA operations currently taking place in the areas where more CAS would be required (even if all those operations wanted to/could talk to ATC).

The shape/size/structure of CAS will be further explored as part of Stage 3 should this option progress.

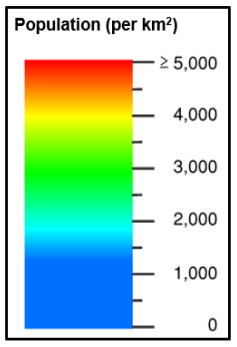
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
This ACP does not seek to increase capacity for Southampton Airport.		
General Aviation/ commercial airlines	Fuel Burn	Qualitative
We estimate that Option 3 will increase track distance compared to the baseline. The initial data (see appendix B) suggests some variations in track length between most of the routes; when we look at this cumulatively taking into account the usage of each route, there is an increase in track mileage overall although the 02 arrival element does have the potential to cumulatively decrease track mileage. There is an aspiration for all aircraft to climb and descend continuously to/from at least 7000ft (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn however the track length assessment is considered the main indicator of potential impacts compared to the baseline. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.		
Commercial airlines	Training costs	Qualitative
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 option is not anticipated to require any additional training costs for airlines. There will be a cost to airlines to train crews in order to operate the RNP-AR routes if they are not already approved, however this route would not be mandatory and airlines could choose whether the benefits of the route balance with any costs before choosing to operate it.		
Commercial airlines	Other costs	Qualitative
No other airline costs are foreseen. The introduction of an RNP-AR route could result in additional costs for airlines not already approved. It is understood that aircraft manufacturer approvals/certification can be as much as $60,000 per aircraft frame. However, these routes would not be mandatory and airlines could consider the benefits against any costs associated with the route before choosing to operate them.		
Airport/ANSP	Infrastructure costs	Qualitative
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/ANSP	Operational costs	Qualitative
This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The option removes Southampton's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation.		
Airport/ANSP	Deployment costs	Qualitative

This option is expected to require air traffic controller training for the controllers and assistants located at NATS Swanwick and Southampton 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 also neighbouring airport options are known.		
All	Safety	Qualitative
The General Aviation assessment (see above) has highlighted significant concerns over the safety of increasing the volume of CAS to the NW which may result in bottle necks in Class G to the south west of Middle Wallop. We received similar feedback from MoD Boscombe Down. In addition to this, there are safety concerns from GA around the approaches over the Solent. If this option progresses, considerable additional work would be required to ensure the considerable volume of additional CAS was safe for CAT and GAT. The introduction of systemised approaches onto runway 20 would greatly reduce ATC and pilot workload, providing ATC with capacity to monitor and take action against any CAS infringements. The significantly lower workload would also enhance service provision to other airspace users, enabling improved integration.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
This option would modernise Southampton's airspace by introducing PBN arrival and departure routes. In terms of L_{Aeq} noise, the changes to the runway 20 and runway 02 departures and 02 arrivals are expected to result in a change in shape of the L_{Aeq} contours. Against population data mapping, this is expected to decrease the number of population within these contours however owing to the population density of these areas potentially affected, this requires further quantified investigation. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the Runway 20 arrivals could be expected to increase population counts whereas the Runway 20 departure and Runway 02 departures and arrivals data suggest there would be a reduction in overflight of populated areas. Cumulatively there is expected to be an overall decrease in population overflown. When considering L_{AMax} 65dB, this option could result in a reduction of population however large areas will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline. We estimate that Option 3 will increase track distance compared to the baseline. There is an aspiration for all aircraft to climb and descend continuously to/from at least 7000ft (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn however the track length assessment is considered the main indicator of potential impacts compared to the baseline. This option will require considerably more new CAS compared to the baseline.		
All	Interdependencies, conflicts and trade-offs	Qualitative
Using the map provided in ACOG's Airspace Change Masterplan Iteration 2, although initial parts of the routes to the south of the airport are located within the overlapping area between Bournemouth and Southampton, this is unavoidable due to the location of the two airports. The routes then turn towards the south east, and route away from the main area where interdependencies are likely to occur. We therefore expect reduced interactions with Bournemouth traffic below 7000ft. When considering Farnborough Airport, the 20 arrivals are located within the overlapping area between Farnborough and Southampton, alongside the later parts of the runway 20 departure. The runway 02 north and south-east departures also route within this overlapping area. This will be explored in further detail at Stage 3 once shortlists of options from all airports are known. Above 7000ft, there may be interdependencies and trade-offs that will be explored as part of Stage 3 along with Bournemouth, Farnborough and NATS NERL. Farnborough's designs will share interdependencies with Gatwick and Heathrow.		

Option 4



This option would see a suite of SIDs (red), PBN arrival transitions to each runway end, an RNP APCH to RWY 20 as well as an RNP-AR curved arrival to RWY 02 (yellow). This option also sees a straight in approach to RWY 20 to reduce CO_2 emissions and the use of the 'Winchester Orbit'. SIDs from both runway ends turn to NORRY, GOODWOOD, THRED and GIBSO as soon as possible to reduce CO_2 emissions.



The option images show the illustrative route centrelines up to 7000ft. The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white as well as areas of population density. Actual centrelines are likely to change throughout the process.

Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative

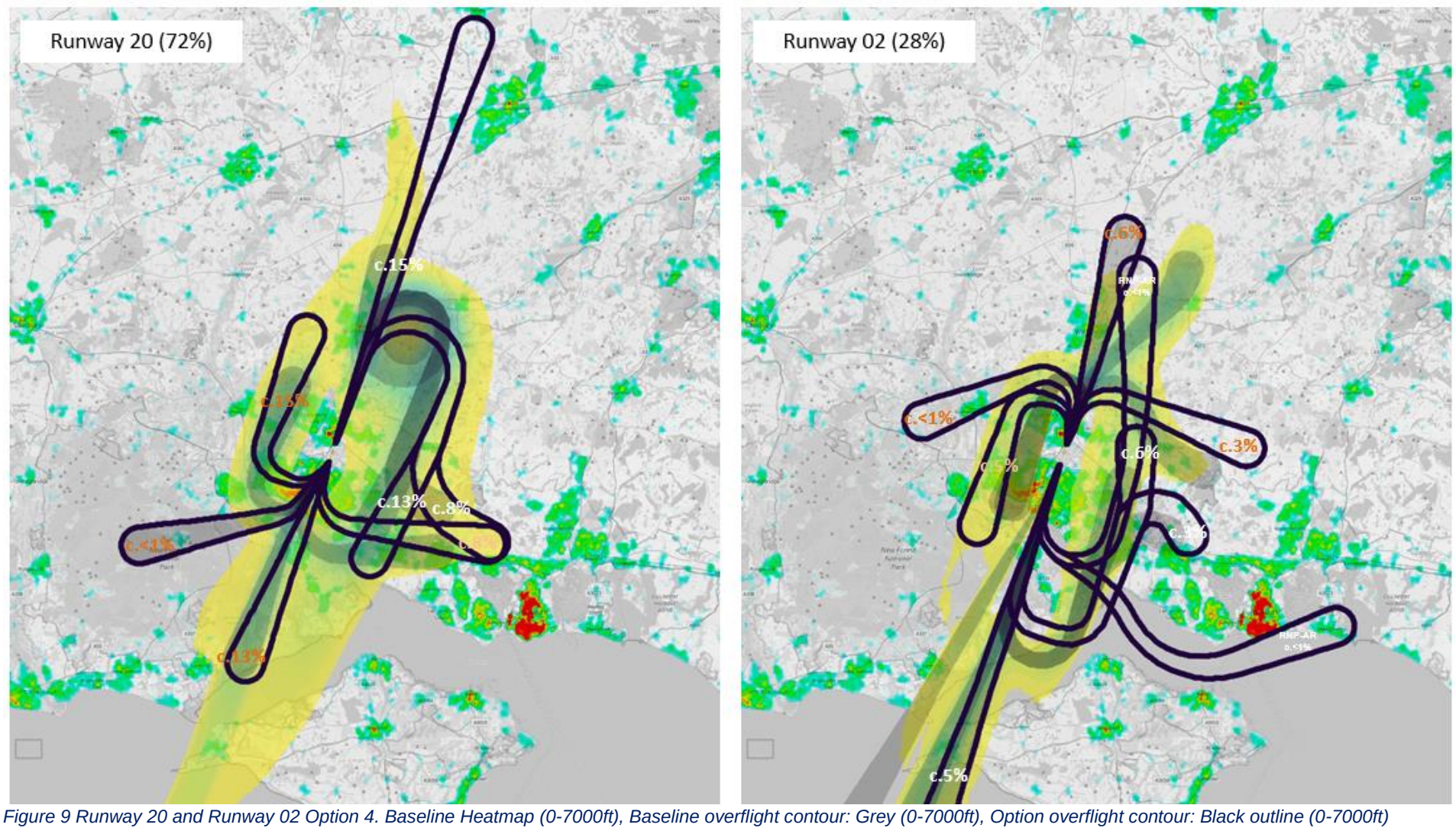


Figure 9 Runway 20 and Runway 02 Option 4. Baseline Heatmap (0-7000ft), Baseline overflight contour: Grey (0-7000ft), Option overflight contour: Black outline (0-7000ft)

Table 13 Option 4 comparison between option and baseline centreline overflight data 0-7000ft (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area	National Parks Count	National Parks Area	Parks and Gardens	Parks and Gardens Area	Schools	Hospitals	Carehomes	Places of worship
Option 4 20 Arrivals											
RWY20 IAP RF Arrival from South East (2)	278.0	0	0	0	-5.3	1	-1.3	-3	0	0	-4
RWY20 IAP RF Arrival from South (2)	4235.0	0	0	0	-6.3	1	-1.3	-4	1	2	-5
RWY20 IAP Arrival from North (5)	-5698.0	1.0	11.6	0	-38.6	0	-0.6	-3	0	-9	-17
Option 4 02 Arrivals											
RWY02 IAP RF Arrival from South East (3)	-1121	0	0	1	-6.39	0	0.82	-1	0	4	4
RWY02 IAP RF Arrival from North (6)	2104.0	0	0	1	-5.3	0	0.8	1	0	-1	1
RWY02 IAP RNP AR Arrival from South East (2)	-15417.0	1.0	3.8	-1	-23.0	0	0	-13	-3	-11	-10

RWY02 IAP RNP AR Arrival from North (3)	-13188.0	0	0	0	15.7	1.0	2.4	-7	-2	-15	-6
RWY02 IAP Arrival from South (1)	105	0	0.03	0	0.06	0	0	0	0	0	0
Option 4 20 Departures											
RWY20 SID South (3)	-86.0	0	0	0	-4.1	0	-0.3	-2	-1	7	-28
RWY20 SID North (3)	-4753.0	0	0	0	0.0	0	-0.1	-5	3	10	-18
RWY20 SID South West (1)	-118.0	0	0	0	0.1	0	0	-1	0	-2	-4
RWY20 SID South East (3)	-14861	0	0	0	0	-1	-0.48	-14	0	-7	-29
Option 4 02 Departures											
RWY02 SID South (3)	-19639.0	0	0	0	8.3	-2	-1.0	-8	-3	-35	-22
RWY02 SID South East (3)	-4050.0	0	0	0	10.9	0	0	-3	0	-4	-9
RWY02 SID North (4)	7452.0	0	0	0	-14.0	-3	-2.9	9	0	6	20.0
RWY02 SID South West (2)	-33786.0	0	0	-1	-1.4	2	1.6	-22	-4	-24	-25

LAeq

- **Runway 20 Arrivals:** Within the scope of the L_{Aeq} contours, the runway 20 arrivals are expected to remain very similar to today and therefore they are not expected to materially alter the L_{Aeq} contours.
- **Runway 20 Departures:** In the baseline, the vast majority of aircraft climb to 500ft before turning to follow the 217 VOR radial. Aircraft then follow this radial until reaching 2000ft. In this option, aircraft heading north (c.30% of departures) would turn right earlier than the baseline, aircraft heading south-west (c.1% of departures) would initially follow a similar path to the baseline, aircraft heading south (c.26% of departures) would fly straight ahead, and finally aircraft heading south east (c.16% of departures) would turn left earlier than in the baseline. These changes are expected to impact the L_{Aeq} contours with the baseline south-west lobe reducing in size, and the contour extending slightly to reflect the early turns to the north and south east, and the straight ahead. The reduction in size of the south west contour would reduce over some of the most densely populated areas of Southampton (shown in red on the population density underlay) however the right turn north departure lobe would likely extend over areas also densely populated. The straight ahead and south east departures may offer the potential to extend over the River Itchen and slightly less densely populated areas.
- **Runway 02 Arrivals:** Within the scope of the L_{Aeq} contours, the majority of runway 02 arrivals will fly the same extended runway centreline as within the baseline, however in this scenario, the VOR approach flown in the baseline will not be available and therefore there will be more aircraft flying a straight in RNP approach. As 02 is only used 28% of the time, this is likely to have a very small influence on the contours – most likely extending the southern lobe slightly south but in turn, reducing the southwest lobe slightly. The south west lobe extends over the most densely populated areas in Southampton therefore this may lead to a very small reduction in population but this would require confirmation via a quantitative noise model in Stage 3 should this option progress.
- **Runway 02 Departures:** Compared to the baseline, runway 02 departures would turn earlier than today. Owing to runway 02 being in operation for around 28% of the year, these departure routes have a smaller influence on the shape of the contours compared to the runway 20 arrivals and this is further reduced as this option splits the turns to serve the various outbound directions (compared to option 3 where all departures initially turn to the left over the same area). It's therefore anticipated that this option would have a very small influence on the shape of the L_{Aeq} contour, however it is expected that a small lobe to west may extend over parts of Eastleigh, Boyatt Wood and Allbrook which could increase the population within the outermost contour bands. The right turn has the potential to impact Colden Common however as it will be flown by c3% of overall flights, this is expected to have very little influence on the shape of the contour. The extent of these contour changes would require further investigation as part of a quantified noise model in Stage 3 should this option progress.

Overflight

- **Runway 20 Arrivals:** In the baseline, aircraft arriving onto runway 20 are tactically controlled (vectored) via a series of turns to descend to land. From the north, this creates what's sometimes referred to as the 'Winchester Orbit' which results in some communities being overflown twice below 7000ft. Option 4 offers a direct route from the north, thus reducing this cumulative overflight and, owing to the concentration of PBN, significantly reducing the number of people overflown (however increasing the frequency of overflight for those living under the route). It would overly the area of East Oakley, which is not overflown below 7000ft in the baseline. The route then continues to overfly the eastern parts of Winchester but does avoid overflight of wider areas of the city at higher altitudes as happens in the baseline. The areas of New Alresford, Owlesbury Compton, and Colden Common would also experience significantly reduced overflight compared to the baseline. From the South East, the wider turn would result in increased overflight over Bishops Waltham. From the South, the wider turn and slightly later final approach join result in overflight of Locks Heath and Bishops Waltham, however compared to the baseline the route does avoid the areas of Hedge End. It's important to note that in certain traffic conditions, there may be a requirement for some aircraft to still fly a tactical orbit. For the purposes of this IOA, we estimate this to be around 30% of arrivals from the north however we will explore this in further detail in Stage 3 should this option progress.
  It is anticipated that despite PBN transitions being available, arrivals from the other directions may also continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.
- **Runway 20 Departures:** In the baseline, there is dispersion across the airspace owing to the vectoring of departures. The PBN SIDs that form part of Option 4 will lead to concentration of flight paths which will reduce the overall population overflown, however those who are overflown would now likely experience an increase in overflight compared to the baseline. Compared to the baseline, aircraft routing north will turn earlier than today; this laterally alters overflight and still occurs over densely populated areas in Southampton and these areas are not frequently overflown, or in some cases overflown at all, within the baseline. As aircraft turn to the north, they will be lower over the areas of Lordshill and North Baddesley, before routing over sparsely populated areas and avoiding Chandlers Ford. Aircraft routing south east will largely remain the same as today. Aircraft routing to the south will fly straight ahead which will change overflight patterns and will result in communities under the final approach seeing an increase in overflight. The overflight contours do however show that the change to straight ahead reduces overflight of some of the most densely populated areas of Southampton with aircraft routing instead along parts of the river Itchen. The contours do overfly Hythe more so than the baseline does today before routing over more sparsely populated areas.
  Aircraft routing to the south west turn left earlier than today and, compared to the baseline, this will create overflight at lower altitudes over the areas of Bitterne and New Town before routing over the outskirts of Swanwick and Locks Heath. The population data suggests that although different areas would be overflown, the number of people overflown would be similar to the baseline average centrelines.
- **Runway 02 Arrivals:** In the baseline, aircraft arriving onto runway 02 are tactically controlled (vectored) before joining one of Southampton's approach procedures. This creates broad dispersion across the airspace. The introduction of PBN transitions to join the approach procedures will lead to concentration and thus reduced population overflown however those who are overflown would now likely experience an increase in overflight compared to the baseline. Option 4 has three RNP approaches serving the north, south and south east, and two RNP-AR arrivals serving the north and south-east. From the south east, the RNP-AR arrival routes where possible over the water although it does introduce new overflight of Hayling Island and the southern parts of Portsmouth at c.7000-6000ft. There may be opportunities to refine the procedures at Stage 3 should this option progress. The RNP-AR arrival from the north (Labelled in the data table with (3)) broadly avoids densely populated areas until reaching the eastern areas of Hedge End, and then routes to the west of Locks Heath before turning over the water and joining final approach; although these areas are overflown today, aircraft flying this route would be lower than in the baseline.
  When reviewed against the noise data the RNP-AR arrivals would offer a substantial decrease to population overflown however it's important to note that, as not all airlines are approved to fly RNP-AR approaches, the majority of aircraft in this option (85-90%) would fly the RNP arrival routes.

  The RNP route from the north initially routes just west of Bishops Waltham before descending over Locks Heath; this is east of the main areas of concentration in the baseline and the overflight of Locks Heath contributes to the increased population numbers seen in the data table. Beyond Locks Heath, the route avoids dense areas of population however it does route outside of areas overflown today before turning to join the straight in final approach.

  The RNP route from south east is initially slightly north of the baseline contour before routing over Locks Heath, it then follows the same route as the RNP

route from the north, avoiding dense areas of population however it does route outside of areas overflown today before turning to join the straight in final approach. Finally the RNP route from the south broadly replicates what happens today. It's important to note that the baseline contour data does not reflect the vectoring that takes place today although it is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.
The removal of the VOR approach would benefit the areas around Lymington, Didben, however would lead to an increase in aircraft flying an RNP approach and thus more frequent overflight of Yarmouth and Hythe.

- **Runway 02 Departures:** In the baseline, the majority of aircraft departing runway 02 fly straight ahead for 2.5nm until turning and typically aircraft routing south turn left, slow climbing aircraft routing north turn slightly right towards the north-east, better climbing aircraft routing north fly straight ahead, aircraft routing south east turn right and finally aircraft routing to the south west turn left. In option 4, the south departure turns left earlier than today and overflies the northern parts of Chandlers Ford. It then routes further west and so avoids the most densely populated parts of Southampton city centre however it does still overfly population that is currently overflown today. The data suggests that this will result in a significant decrease in population overflown. The route to the south west overflies Romsey, outside of areas overflown in the baseline, however this is expected to be very infrequently operated. The north routes straight ahead and therefore overflies the eastern parts of Winchester which results in the increase in population seen in the data table. Finally to the south east, aircraft turn earlier than today, overflying Colden Common, before taking a more direct route over areas which are not frequently overflown in the baseline and avoiding Bishops Waltham.
  Owing to the concentration of PBN, there would be a significant change in traffic patterns compared to the vectoring swathes today, and that the frequency of overflight would increase for those living under the routes.

- **Components combined (Cumulative Overflight).** When considering each mode of operation (20/02) the PBN arrivals/departure overflight contours have overlapping areas where cumulative overflight between arrivals and departures will occur. The straight ahead departure off runway 20 results in cumulative overflight with the runway 02 final approach although compared to option 3, the departure traffic is split across various straight ahead and turning routes which helps to reduce cumulative impacts. The runway 02 departure also has a straight ahead route which overflies the same population as the 20 approach although traffic to the south, south west and south east turn away from areas overflown by 20 arrivals. The removal of the Winchester orbit results in significant cumulative overflight reductions for communities living under the orbit and those located under final approach. The left turn 02 departure and the right turn 20 departure overfly similar areas.

L_{Amax} 65dB:

Table 14 Option 4 comparison between option and baseline centreline L_{AMax} 65dB data (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area	National Parks Count	National Parks Area	Parks and Gardens	Parks and Gardens Area	Schools	Hospitals	Carehomes	Places of worship
Option 4 20 Arrivals											
RWY20 IAP RF Arrival from South East (2)	-1130	0	0	0	0.98	1	0.01	0	0	0	0
RWY20 IAP RF Arrival from South (2)	-1130	0	0	0	0.98	1	0.01	0	0	0	0
RWY20 IAP Arrival from North (5)	0	0	0	0	-0.04	0	0	0	0	0	0
Option 4 02 Arrivals											
RWY02 IAP RF Arrival from South East (3)	42	0	0	0	0.2	0	0	0	0	0	0
RWY02 IAP RF Arrival from North (6)	42	0	0	0	0.2	0	0	0	0	0	0
RWY02 IAP RNP AR Arrival from South East (2)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
RWY02 IAP RNP AR Arrival from North (3)	-4953	0	0	-1	-1.53	0	0	-6	-1	-4	-4
RWY02 IAP Arrival from South (1)	0	0	0	0	0	0	0	0	0	0	0
Option 4 20 Departures											
RWY20 SID South (3)	19844	0	0	0	2.65	1	-0.56	21	3	10	44
RWY20 SID North (3)	5770	0	0	0	0	0	-0.12	9	4	20	-8
RWY20 SID South West (1)	19982	0	0	0	4	1	-0.51	15	2	18	52
RWY20 SID South East (3)	21895	0	0	-1	-13.8	1	0.12	21	1	22	30
Option 4 02 Departures											
RWY02 SID South (3)	21	0	0	-1	-2.14	0	0.13	3	1	1	3
RWY02 SID South East (3)	-293	0	0	0	0.13	0	0	-3	0	0	-1
RWY02 SID North (4)	3720	0	0	0	-4.03	0	0	4	0	5	14
RWY02 SID South West (2)	-5506	0	0	0	-1.44	0	-0.37	-3	1	-2	0

When reviewing the L_{AMax} 65dB data it's important to note that the baseline is based on the average centreline and does not take into account the vectoring that takes place today. The option data also assumes that no vectoring occurs. It's therefore important to read the qualitative assessment below as well as the data table.

The data suggests that the population within the 65dB LAMax contour would cumulatively improve for the 20 and 02 arrivals; when also considering the vectoring that occurs today, this would suggest that the improvements would be even greater if the vectoring was modelled although some vectoring may still occur within the option.

The runway 20 departures data suggest a significant increase in population within the 65dB contour however the baseline does not take into account the vectoring that occurs today. Even taking into account the vectoring within the baseline, the runway 20 departures are expected to increase population within the contour areas due to the earlier turns.

The runway 02 departures suggest a mix of increases and decreases with the main decrease to the South West which is used by a very low percentage of traffic. Therefore population within the L_{AMax} 65dB according to the data may increase, but when taking into account the vectoring that occurs today, would likely decrease if modelled.

This option sees a significant change in lateral location for the departures compared to the baseline contours and therefore it is expected to significantly alter the population and noise sensitive areas within the 65dB L_{AMax} contour areas; this offers benefits for those currently in the contour areas but disbenefits to these new areas that may not currently experience high levels of noise.

Noise Summary:
Overall, in terms of L_{Aeq}, the changes to the runway 20 and runway 02 departures and 02 arrivals are expected to result in a change in shape of the L_{Aeq} contours. Against population data mapping, this is expected to slightly decrease the population within the contours to the south of the airport (runway 20 departures and 02 arrivals) and possible slightly increase population to the north (02 departures). Owing to the population density of these areas potentially affected, the scale of any changes cannot be predicted without quantitative modelling.

When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the data suggests this option would significantly reduce the number of people overflown however it would introduce large areas of overflight over areas either infrequently, or not at all overflown today. Particularly below 4000ft, the early turns will result in populated areas being overflown at lower altitudes and at a higher frequency than seen in

the baseline. When considering L_{AMax} 65dB, this option is expected to result in a reduction of population for the arrivals and an increase for the 20 departures. Large areas of departures will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline. Potential positive benefits and negative impacts will be investigated in further detail as part of the full quantified noise analysis undertaken at Stage 3 should this option progress.

Tranquillity:

- **Runway 20 Arrivals:** Option will continue to overfly the South Downs National Park. The direct route from the north will significantly decrease the area of National Park overflown due to the removal of the Winchester orbit. The routes from the south and south east also reduce overflight as they join final approach later than today, and therefore do not fly as far north into the South Downs National Park. Overall the introduction of PBN compared to vectoring is expected to result in a reduction in the area of national park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 20 Departures:** Option will continue to overfly the New Forest National Park however will avoid the Isle of Wight AONB. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 02 Arrivals:** Option will continue to overfly the Isle of Wight AONB and New Forest National Park. When considering the vectoring swathe of today and VOR approaches will no longer be available, adopting concentrated PBN paths is expected to reduce the overall area of AONB and National Park overflown. The areas under the PBN routes will however experience an increase in overflight compared to the baseline. The RNP-AR arrivals, which could be used by 10-15% of traffic, offer opportunities to avoid large parts of the New Forest National Park and the Isle of Wight AONB.
- **Runway 02 Departures:** Option will continue to overfly the South Downs National Park and the earlier left turns to the south and south east will introduce overflight of the New Forest National Park. The routes to the north and south west are expected to reduce overflight; adopting concentrated PBN paths is expected to reduce the overall area of South Downs National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.

Biodiversity:

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1640ft and therefore there is no anticipated change to biodiversity.
- **Runway 20 Departures:** This option sees some departures flying straight ahead and some turning earlier than today and is therefore expected to lead to changes to the River Itchen SSSI/SPA/SAC and the Solent and Southampton Water SPA within the L_{Aeq} contours. The route to the north will overfly the Southampton Common SSSI more frequently than today. The route to the south east turns earlier than today; this will reduce overflight of the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA. The straight ahead route to the south will overfly these areas, as well as the River Itchen SSSI/SPA/SAC, the Solent and Southampton Water SPA and the New Forest National Park.
- **Runway 02 Arrivals:** Aircraft would continue to fly an RNP approach and therefore there is no expected change compared to the majority of the baseline however aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. This could lead to small benefits for the Dibden Bay SSSI although the overflight contours suggest that this would continue to be overflown as part of the RNP approach. The redistribution of traffic onto the RNP approach may also lead to a change in frequency of overflight over the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA, which could be within the L_{Aeq} contour areas. The approaches that follow the Solent result in changes to distribution of overflight over the Hythe and Calshot Marshes, Lee on Solent to Itchen Estuary SSSI, and Solent and Southampton Water SPA.
- **Runway 02 Departures:** This option sees the south and south east departures turn earlier than in the baseline which results in reduced overflight of the River Itchen SSSI/SAC and the routes also avoid the South Downs National Park. The straight ahead route to the north will continue to overfly as per the baseline. The earlier right turn to the south east results in reduced overflight of the River Itchen SSSI/SAC areas and the South Downs National Park. Overall the earlier turns and straight ahead route will lead to a redistribution of traffic which could be within the L_{Aeq} contour areas.

Communities	Air Quality	Qualitative

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality.
- **Runway 20 Departures:** There will be a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. However, it should be noted that these changes are likely to be small, particularly compared to the contribution of road traffic to local air quality. The South East SID overflies Southampton Councils Commercial Road, Bitterne Road West, Bevois Valley, New Road and Town Quay AQMA. The South SID overflies the Southampton Council Bitterne Road West, Town Quay and Victoria Road AQMA and the South West SID overflies the Bevois Valley, and Eastleigh Borough Council Hamble Lane AQMA.
- **Runway 02 Arrivals:** Aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality including within the Southampton Council AQMAs. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
- **Runway 02 Departures:** There will be a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality. The left turn SID overflies the Eastleigh Borough Council M3 AQMA.

Wider Society	Greenhouse Gas Impact	Qualitative

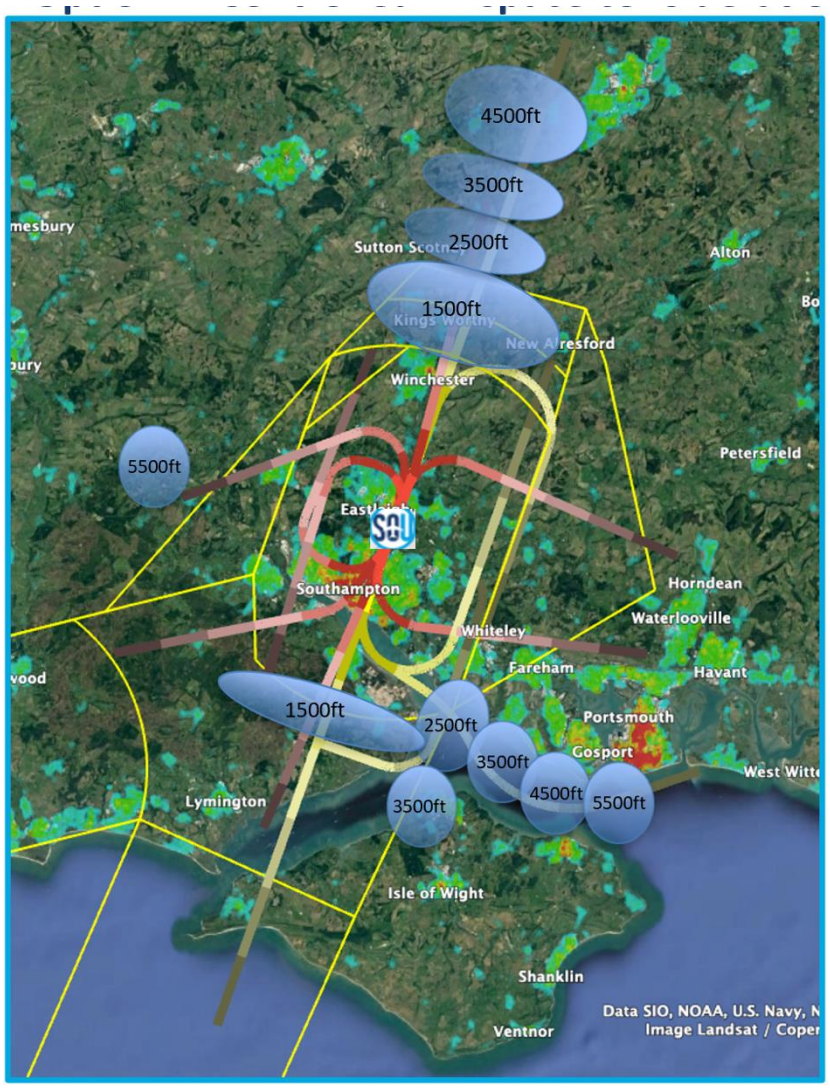
The fuel burn assessment has indicated that this option is expected to decrease track mileage compared to the baseline. As track mileage is linked to Fuel Burn and associated CO2 emissions, we therefore expect this option to decrease Greenhouse Gas impacts compared to the baseline.

Wider Society	Capacity/Resilience	Qualitative

This ACP does not seek to increase capacity for Southampton Airport and therefore we do not expect any change from today as a result of this option. The introduction of a PBN arrival onto runway 20 will improve resilience in the event of an ILS outage on Runway 20.

The introduction of PBN SIDs and arrival transitions may lead to a decrease in resilience for Southampton Airport; today aircraft are tactically controlled by ATC and this creates a lot of flexibility within the airspace. For example, when departing from runway 20 and routing north, aircraft can be turned left or right depending on traffic conditions, whereas the introduction of fixed PBN routes will remove this flexibility.

General Aviation	Access	Qualitative



CAS: With regards to CAS, this option would require significant additional CAS compared to the baseline in order to meet CAS containment requirements. Note, the figure opposite only aims to highlight the broad potential areas where more CAS would be required.

Amendments and lowering the base of CAS in some areas would be required to Solent CTA 3 and possibly CTA 5 to the north for 20 arrivals. CTA 2 to the south would require significant additional areas of CAS to accommodate the RNP-AR arrival routes and finally the straight in arrival from the north would require significantly more airspace under and adjacent to CTA 3.

Overall, the volume of airspace required is expected to increase compared to the baseline. These volume increases would occur over areas that are used by General Aviation traffic and will therefore have an impact on GA. Any additional volume of airspace around CTA 2 (Lee-on-Solent area), and additional volume and lowering of the base of CTA 3 to the north would potentially create increased bottlenecks outside of CAS that would require further investigation and safety mitigations should this option progress. Initial feedback from GA stakeholders has raised significant concerns that airspace to the North to accommodate a straight in approach would create bottlenecks and Lasham Gliding Club said this would result in their closure. GA stakeholders raised concerns that airspace to the SE to accommodate SOU flight paths over the Solent would create a bottle neck between IOW and UK mainland as well as risk to single engine aircraft crossing the Channel at considerably lower altitude. GA have also raised very strong concerns about any lowering of CTA2/extension to the CTR to wholly contain the existing RNP APCH to RWY 02. Very careful consideration would need to be given to the benefit of pursuing a lowering of CTA2/Extension to the CTR to contain the existing RNP APCH versus the impact to GA.

There may be scope to reduce the volume of the existing CTR by decreasing its width either side of the extended centreline, stepping up to a 1500ft base then progressively higher which may offer opportunities to raise of parts of CTA 2, CTA 4, CTA 6 and CTA 8 however overall a net increase in CAS is anticipated.

CTR/CTA dimensions depend very much on the Instrument Flight Procedures and/or Radar Vectoring patterns to and from the aerodrome. Therefore, until very detailed IFP design takes place and locations of the waypoints, fixes, PBN specifications and associated protection areas are available we can only provide some indications as to the general areas where changes are likely to be required to accommodate the options.

Due to the proximity and interdependency between the airports, the shape and structure of CAS to the SW will be dependent on Southampton's and Bournemouth's options and to the NE will be dependent on Southampton's and Farnborough's options; this will be explored in further detail as part of the Stage 3 FOA should this option progress.

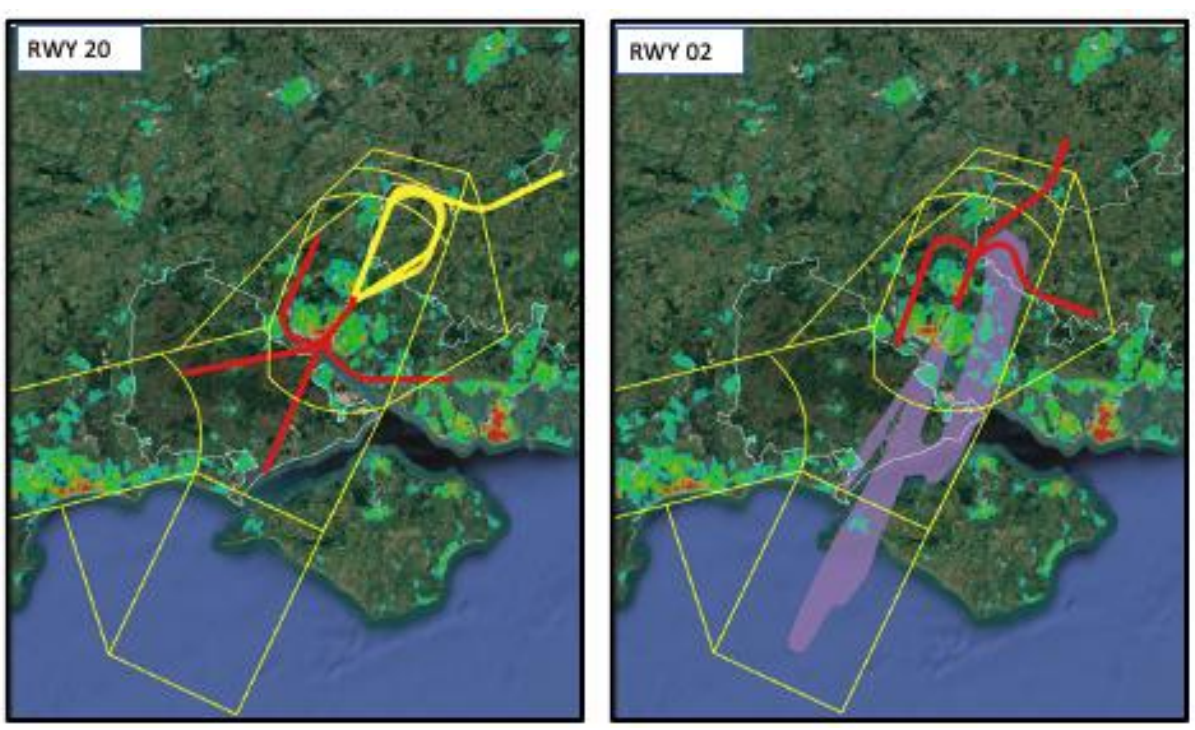
Access: The reduction in vectoring owing to the introduction of PBN arrival transitions and departure SIDs will significantly reduce ATC workload and as such, this offers an opportunity for improved access to CAS. However we would not expect the amount of access improvement to be able to accommodate the number of GA operations currently taking place in the areas where more CAS would be required (even if all those operations wanted to/could talk to ATC)

The shape/size/structure of CAS will be further explored as part of Stage 3 should this option progress.

General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
This ACP does not seek to increase capacity for Southampton Airport.		
General Aviation/ commercial airlines	Fuel Burn	Qualitative
We estimate that Option 4 will decrease track distance compared to the baseline. The initial data (see appendix B) suggests that the routes would decrease in track mileage and therefore when we look at this option cumulatively, taking into account the usage of each route, there is a decrease in track mileage overall. This option offers the opportunity for improved CCO/CDO performance for the routes compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft), however the runway 02 RNP-AR arrival and south-eastbound SID, and the runway 20 south-eastbound SID and runway 20 arrival will require integration. This options therefore offers some benefits and impacts to CCO/CDO which may affect fuel burn however the track length assessment is considered the main indicator of potential impacts compared to the baseline. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.		
Commercial airlines	Training costs	Qualitative
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 option is not anticipated to require any additional training costs for airlines. There will be a cost to airlines to train crews in order to operate the RNP-AR routes if they are not already approved, however this route would not be mandatory and airlines could choose whether the benefits of the route balance with any costs before choosing to operate it.		
Commercial airlines	Other costs	Qualitative
No other airline costs are foreseen.		
Airport/ANSP	Infrastructure costs	Qualitative
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/ANSP	Operational costs	Qualitative
This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The option removes Southampton's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation.		
Airport/ANSP	Deployment costs	Qualitative
This option is expected to require air traffic controller training for the controllers and assistants located at NATS Swanwick and Southampton 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 also neighbouring airport options are known.		

All	Safety	Qualitative
The General Aviation assessment (see above) has highlighted significant concerns over the safety of a straight in approach to runway 20 and the runway 02 approaches over the Solent. If this option progresses, considerable additional work would be required to ensure the considerable volume of additional CAS was safe for CAT and GAT. In addition to this, the Ministry of Defence (MOD) noted concerns that this option could generate bottle necks in Class G to the south west of Middle Wallop. The introduction of systemised approaches onto runway 20 would greatly reduce ATC and pilot workload, providing ATC with capacity to monitor and take action against any CAS infringements. The significantly lower workload would also enhance service provision to other airspace users, enabling improved integration. The interactions within the runway 02 RNP-AR arrival and south-eastbound SID, and the runway 20 south-eastbound SID and runway 20 arrival will require resolution however these are expected to be safely mitigated.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
This option would modernise Southampton's airspace by introducing PBN arrival and departure routes. Overall, in terms of L_{Aeq}, the changes to the runway 20 and runway 02 departures and 02 arrivals are expected to result in a change in shape of the L_{Aeq} contours. Against population data mapping, this is expected to slightly decrease the population within the contours to the south of the airport (runway 20 departures and 02 arrivals) and possible slightly increase population to the north (02 departures). Owing to the population density of these areas potentially affected, the scale of any changes cannot be predicted without quantitative modelling. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, the data suggests this option would significantly reduce the number of people overflown. When considering L_{AMax} 65dB, this option is expected to result in a reduction of population for the arrivals and an increase for the 20 departures. Large areas of departures will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline. We estimate that Option 4 will decrease (improve) track distance compared to the baseline. This option offers the opportunity for improved CCO/CDO performance for the routes compared to the baseline. This options therefore offers some benefits and impacts to CCO/CDO which may affect fuel burn however the track length assessment is considered the main indicator of potential impacts compared to the baseline. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail. This option will require considerably more new CAS compared to the baseline.		
All	Interdependencies, conflicts and trade-offs	Qualitative
Using the map provided in ACOG's Airspace Change Masterplan Iteration 2, the left turn departures from runway 02, and large parts of the 20 departures and 02 approaches fall within the overlapping area between Bournemouth and Southampton. When considering Farnborough Airport, the 02 arrivals from the north and the 20 arrivals are located within the overlapping area between Farnborough and Southampton and are likely to share interdependencies with the Farnborough ACP. The runway 02 and 20 north departures also route within this overlapping area. This will be explored in further detail at Stage 3 once shortlists of options from all airports are known. Above 7000ft, there may be interdependencies and trade-offs that will be explored as part of Stage 3 along with Bournemouth, Farnborough and NATS NERL. Farnborough's designs will share interdependencies with Gatwick and Heathrow.		

Option 5



This option was generated to address Stage 2A engagement feedback to try and mitigate the volume of additional CAS required with some other options. This option is similar to option 2 (which was discontinued as part of the DPE) but excludes a PBN arrival transition to RWY 02 to reduce the requirement for CAS but whilst keeping overflight of the New Forest to a minimum. The existing swathe is shown in figure below however it's important to note that the existing RNP APCH to runway 02 will remain alongside the existing NDB approach. The existing VOR approach will be withdrawn as the SAM VOR is being removed as part of the NATS VOR rationalisation programme.

The RWY 02 Northbound SID follows a path more similar to today to avoid increasing numbers within the LOAEL but would still avoid Winchester by tracking to the East of RWY 20 final approach.

The figure above shows the illustrative route centrelines/swathes up to 7000ft (SIDs (Red), Arrival Transitions and RNP Approach for runway 20 (Yellow)). The existing Solent and Bournemouth CTRs/CTAs are shown in thin yellow lines, National Park outlines in white as well as areas of population density. Actual centrelines are likely to change throughout the process.

Group	Impact	Level of Analysis
Communities	Noise impact on health and quality of life	Qualitative and partly quantitative

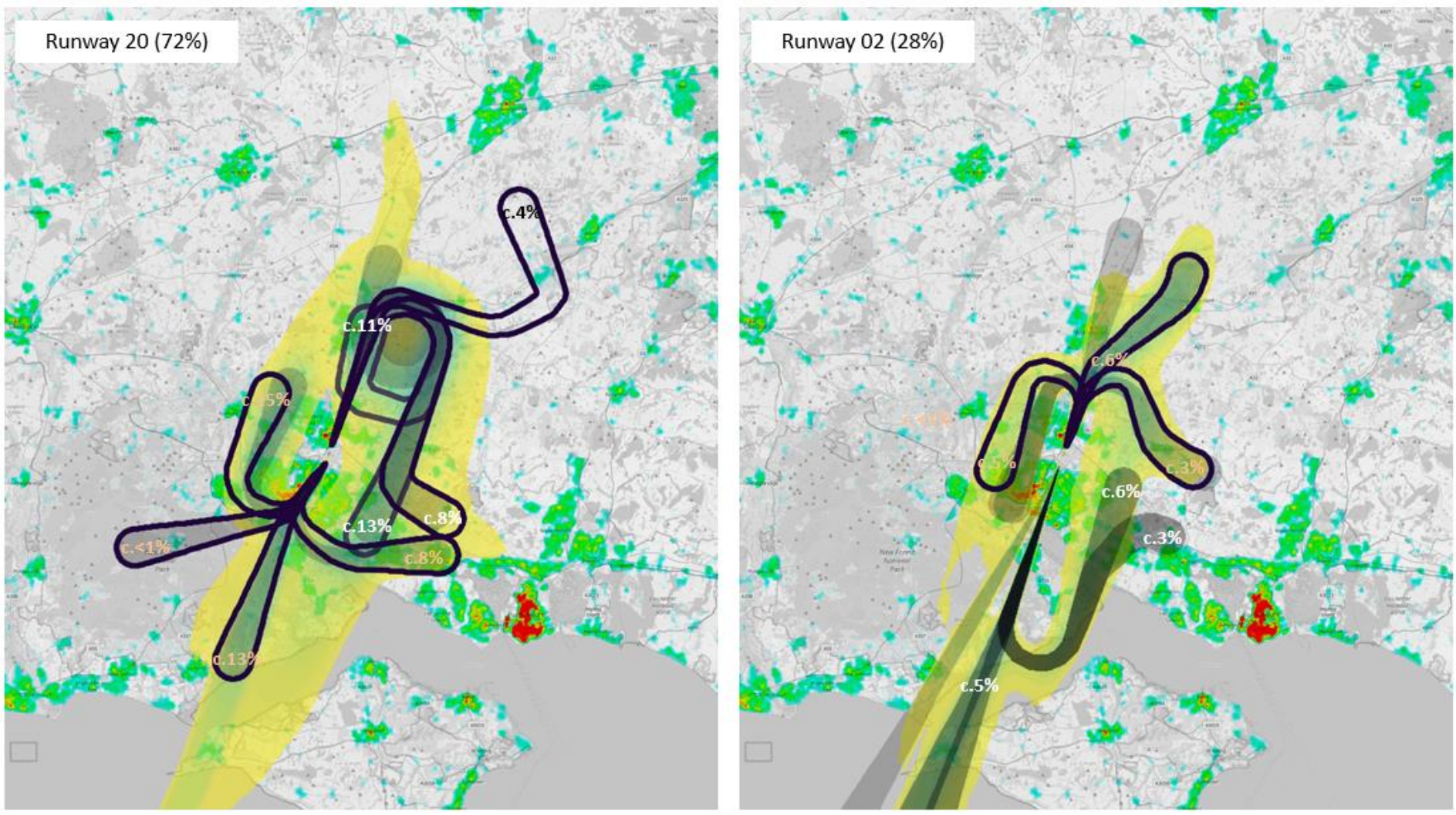


Figure 10 Runway 20 and Runway 02 Option 5. Baseline Heatmap (0-7000ft), Baseline overflight contour: Grey (0-7000ft), Option overflight contour: Black outline (0-7000ft)

Table 15 Option 5 comparison between option and baseline centreline overflight data 0-7000ft (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area	National Parks Count	National Parks Area	Parks and Gardens	Parks and Gardens Area	Schools	Hospitals	Care homes	Places of worship
Option 5 20 Arrivals											
RWY20 IAP Arrival from South East (1)	-342	0	0	0	-1.3	0	0.7	-2	0	-1	3
RWY20 IAP Arrival from South (1)	322	0	0	0	-2.3	1	0.7	-1	0	0	6

RWY20 IAP Arrival from North (2)	2774	0	0	0.0	10.2	0	0.7	4	0	4	1
RWY20 IAP Arrival from North (3)	-4547	0	0	0.0	-20.9	1	0.1	-4	0	-7	11
Option 5 02 Arrivals											
Runway 02 average baseline arrival from North	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline RNP arrival from South	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline NDB/DME arrival from South	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline arrival from South East	0	0	0	0	0	0	0	0	0	0	0
Option 5 20 Departures											
RWY20 SID South West (1)	-118	0	0	0	0.1	0	0.0	-1	0	-2	4
RWY20 SID South (1)	-2029	0	0	0	1.3	0	0.1	-3	0	-2	10
RWY20 SID South East (1)	2952	0	0	0	0	0	0.3	1	-1	1	-7
RWY20 SID North (1)	-6900	0	0	0	0	2	0.37	-10	0	-1	6
Option 5 02 Departures											
RWY02 SID South West (3)	-22017	0	0	0	-0.4	-2	-1.0	-7	0	-30	21
RWY02 SID North (1)	661	0	0	0	0.6	1	-0.8	1	0	0	-1
RWY02 SID South East (1)	-120	0	0	0	0.7	0	0	0	0	0	1
RWY02 SID South (1)	-23196	0	0	0	-0.4	-3	-1.1	-12	0	-36	28

LAeq

- **Runway 20 Arrivals:** Within the scope of the L_{Aeq} contours, the runway 20 arrivals are expected to remain very similar to today and therefore they are not expected to materially alter the L_{Aeq} contours.
- **Runway 20 Departures:** Although the runway 20 departures aim to replicate, due to CAA IFP requirements, a waypoint will be required at the Departure End of Runway (DER). This waypoint prevents departures from turning to join the 217 VOR radial before the DER whereas in the baseline, some departures turn before the DER today. Subsequently it is expected that there would be a change to traffic patterns around the 500ft point which is likely to narrowly influence the shape of the L_{Aeq} contours. Beyond this, the initial parts of the routes overfly the densely populated areas of the city of Southampton and owing to the change in waypoint configuration, there is likely to be changes to the population within the L_{Aeq} contours which cannot be predicted without quantitative modelling. The concentration due to PBN is expected to change the shape of the contours. Given runway 20 is operated 72% of the year, lobes may extend along the PBN paths although with the exception of the left turn, the overflight contours suggest this will occur over less densely populated areas.
- **Runway 02 Arrivals:** Within the scope of the L_{Aeq} contours, the majority of runway 02 arrivals will fly the same extended runway centreline as within the baseline, however in this scenario, the VOR approach flown in the baseline will not be available and therefore there will be more aircraft flying a straight in RNP approach. As 02 is only used 28% of the time, this is likely to have a very small influence on the contours – most likely extending the southern lobe slightly south but in turn, reducing the southwest lobe slightly. The south west lobe extends over the most densely populated areas in Southampton therefore this may lead to a very small reduction in population but this would require confirmation via a quantitative noise model in Stage 3 should this option progress.
- **Runway 02 Departures:** Runway 02 departures will fly a very similar straight ahead route to today before turning. Owing to runway 02 being in operation for around 28% of the year, these departure routes have a smaller influence on the shape of the contours compared to the runway 20 arrivals. Due to the concentration of PBN there may be slight lobes to the west and east to the outermost contours however these are not expected to be significant. This may impact the areas north of Otterbourne and Colden Common. The 51dB contour may also extend towards Twyford. The extent of these contour changes would require further investigation as part of a quantified noise model in Stage 3 should this option progress.

Overflight

- **Runway 20 Arrivals:** In the baseline, aircraft arriving onto runway 20 are tactically controlled (vectored) via a series of turns to descend to land. This creates what's sometimes referred to as the 'Winchester Orbit' which results in some communities being overflown twice below 7000ft. At this stage, the data presented does not look at frequency of overflight and therefore the data in the table does not account for this cumulative effect. The orbit option from the north begins broadly aligned with the concentrated areas of baseline but then turns to the east later than in the baseline; although these areas are overflown today, this will result in increased overflight of Colden Common, and Shawford. When turning towards the north, the tracks then become broadly aligned with the baseline where the final turns then join the extended centreline of final approach. Owing to the concentration of PBN, reduced overflight of New Alresford and Cheriton is expected compared to aircraft flying the orbit today. Option 5 offers an alternative tactical arrival from the north east which will overfly areas not frequently overflown today including the populated area of Four Marks before routing west and joining the main area of concentration; the data suggests this route may reduce population overflown however it's important to note that this route would only be available on a tactical basis and the majority of arrivals would likely fly the orbit approach. Arrivals from the south and south east are broadly aligned with the existing areas of overflight. It is anticipated that despite PBN transitions being available, arrivals may continue to require some vectoring in future; this will be explored as part of the Full Options Appraisal at Stage 3 should this option progress.

- **Runway 20 Departures:** In the baseline, there is broad dispersion across the airspace owing to the vectoring of departures. The PBN SIDs that form part of Option 5 will lead to concentration of flight paths which will reduce the overall population overflown, however those who are overflown would now likely experience an increase in overflight compared to the baseline. Initially, aircraft will continue to overfly the densely populated areas of Southampton City. Compared to the baseline, the left turn departure to the south east turns sightly earlier that today, this avoids Hythe however results in slightly more of Fareham being overflown at c.7000ft which the data suggests increases the population overflown. The straight ahead and south-west departures are broadly the same as within the baseline with the population data showing slightly reduced population overflown. The right turn to the north cannot be replicated to PBN standards and the Option 5 route avoids some of the densely populated areas of Southampton city and the western parts of Chandlers Ford, but does overfly the area of Totton and the eastern parts of Romsey. Totton and Romsey are overflown within the baseline but both are likely to see an increase in frequency of overflight.
- **Runway 02 Arrivals:** Within option 5, runway 02 arrivals would continue to be vectored as they are today and therefore they are not expected to materially alter overflight. Compared to the baseline, the VOR approach would not be flown (due to the NATS VOR Rationalisation program) and this would benefit the areas around Lymington, Didben, however would lead to an increase in aircraft flying an RNP approach and thus more frequent overflight of Yarmouth and Hythe. There may be some small changes to traffic patterns in order to accommodate the PBN SIDs and any changes to the network above 7000ft. This will be explored further as part of real time simulations in Stage 3 should this option progress and information from this would be used to inform the noise modelling within the Full Options Appraisal (FOA).

- **Runway 02 Departures:** In the baseline, the majority of aircraft departing runway 02 fly straight ahead for 2.5nm until turning and typically aircraft routing south turn left, slow climbing aircraft routing north turn slightly right towards the north-east, better climbing aircraft routing north fly straight ahead, aircraft routeing south east turn right and finally aircraft routing to the south west turn left. In option 5, the south departure turns left earlier than today and overflies the northern parts of Chandlers Ford. It then routes further west and so avoids the most densely populated parts of Southampton city centre however it does still overfly population that is currently overflown today. The data suggests that this will result in a significant decrease in population overflown. The route to the north reflects the route used by the majority of aircraft routing north in the baseline. It slightly increases overflight of New Alresford, which is reflected in the overflight data, however this could be refined in detailed IFP design at Stage 3 should this option progress. The route to the south east broadly reflects the baseline within the constraints of PBN design criteria.

Owing to the concentration of PBN, there would be a significant change in traffic patterns compared to the vectoring swathes today, and that the frequency of overflight would increase for those living under the routes.

- **Components combined (Cumulative Overflight).** When considering each mode of operation (20/02) the PBN arrivals/departure overflight contours largely do not overlap, however the vectoring of 02 arrivals and any potential vectoring of 20 arrivals creates the potential for cumulative overflight between arrivals and departures. The offset departure from runway 20 helps avoid cumulative overflight of the runway 02 final approach. The 02 departures turn away from final approach, although not as soon as possible, which does help reduce cumulative overflight of the 20 final approach.

L_{AMax}:

Table 16 Option 5 comparison between option and baseline centreline L_{AMax} 65dB data (Data in the table should be read in conjunction with qualitative assessment).

Difference between the Baseline and the Option (Full Data in Technical Appendix B)	Population	AONB Count	AONB Area	National Parks Count	National Parks Area	Parks and Gardens	Parks and Gardens Area	Schools	Hospitals	Care homes	Places of worship
RWY20 IAP Arrival from South East (1)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from South (1)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from North (2)	0	0	0	0	0.08	0	0	0	0	0	0
RWY20 IAP Arrival from North (3)	0	0	0	0	-0.04	0	0	0	0	0	0
Option 5 02 Arrivals											
Runway 02 average baseline arrival from North	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline RNP arrival from South	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline NDB/DME arrival from South	0	0	0	0	0	0	0	0	0	0	0
Runway 02 average baseline arrival from South East	0	0	0	0	0	0	0	0	0	0	0
Option 5 20 Departures											
RWY20 SID South West (1)	19982	0	0	0	4	1	-0.51	15	2	18	52
RWY20 SID South (1)	18909	0	0	0	5.72	1	-0.51	16	2	16	50
RWY20 SID South East (1)	24906	0	0	-1	-13.8	3	0.74	15	2	21	50
RWY20 SID North (1)	-1319	0	0	0	0	0	0	-6	0	6	3
Option 5 02 Departures											
RWY02 SID South West (3)	-4991	0	0	0	-0.29	-1	-0.86	-3	0	-2	-2
RWY02 SID North (1)	-229	0	0	0	-0.21	0	0	0	0	0	0
RWY02 SID South East (1)	-8	0	0	0	0.11	0	0	-1	0	1	1
RWY02 SID South (1)	-4991	0	0	0	-0.29	-1	-0.86	-3	0	-2	-2

When reviewing the L_{AMax} 65dB data it's important to note that the baseline is based on the average centreline and does not take into account the vectoring that takes place today. The option data also assumes that no vectoring occurs. It's therefore important to read the qualitative assessment below as well as the data table.

The L_{AMax} 65dB suggests the runway 20 arrivals will be very similar to the baseline. It is expected that in certain traffic scenarios, vectoring may still occur and within this option this is expected to remain similar to the baseline and therefore not materially impact the data outcomes. The 02 arrivals will remain the same as the baseline as there is no change with this option other than the withdrawal of the VOR approach.

The 02 departures improve in terms of population overflown and this is mainly due to the avoidance of Chandlers Ford compared to the baseline. The runway 20 departures data suggest a significant increase in population within the 65dB contour however the baseline does not take into account the vectoring that occurs today. It is expected that the population within the 65dB contour area would reduce if this was modelled. The data does however suggest that the area of highest concentration would change compared to the baseline; when reviewing the contour maps shown in appendix B, this appears to be because the contour extends slightly further to the west than in the baseline over the densely populated areas of Southampton as well as some variation in the contours further out. There may be opportunities for the option to be refined as part of the IFP development in Stage 3 to reduce this so that the initial routes more closely reflect what happens today however this will have to be developed within PBN and CAA design criteria.

Noise Overall: Overall, in terms of L_{Aeq}, this option is expected to remain relatively similar to today although there may be the potential for a small decrease in population within the contours due to the changes to the 02 arrivals. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, cumulatively there is expected to be an overall decrease in population overflown.

The introduction of PBN approaches to 20 compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, cumulatively there is expected to be an overall decrease in population overflown. When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this.
Potential positive benefits and negative impacts will be investigated in further detail as part of the full quantified noise analysis undertaken at Stage 3 should this option progress.

Tranquillity:

- **Runway 20 Arrivals:** Option will continue to overfly the South Downs National Park. The data suggests the main arrival from the north (2) would increase the area of national park overflown and all other routes would see decreases. The data does not take into account the vectoring that occurs today and overall the introduction of PBN compared to vectoring is expected to result in a reduction in the area of national park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 20 Departures:** Option will continue to overfly the New Forest National Park however will avoid the Isle of Wight AONB. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.
- **Runway 02 Arrivals:** Within option 5, runway 02 arrivals would continue to be vectored as they are today and therefore they are not expected to materially alter overflight. Compared to the baseline, the VOR approach would not be flown (due to the NATS VOR Rationalisation program) and this would benefit overflight of the New Forest National Park.
- **Runway 02 Departures:** Option will continue to overfly the South Downs National Park. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.

Biodiversity:

- **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1640ft and therefore there is no anticipated change to biodiversity.
- **Runway 20 Departures:** Although this option aims to replicate how aircraft depart today due to a CAA IFP waypoint requirement there will be a slight change to how aircraft will fly laterally below 1000ft. This could lead to changes with the L_{Aeq} contour to the River Itchen SSSI/SPA/SAC and Solent and

Southampton Water SPA. Compared to the vectoring baseline, there may be reduced overflight of the Southampton Common SSSI. Slow climbing aircraft may continue to overfly the New Forest National Park however this would be at altitudes close to 1640ft. • **Runway 02 Arrivals:** Aircraft would continue to fly an RNP approach and therefore there is no expected change compared to the majority of the baseline however aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. This could lead to small benefits for the Dibden Bay SSSI although the overflight contours suggest that this would continue to be overflown as part of the RNP approach. The redistribution of traffic onto the RNP approach may also lead to a change in frequency of overflight over the Lee-on-Solent to Itchen Estuary SSSI and the Solent and Southampton Water SPA, which could be within the L_{Aeq} contour areas. • **Runway 02 Departures:** Option will continue to overfly the South Downs National Park and the River Itchen SSSI/SAC. Adopting concentrated PBN paths is expected to reduce the overall area of National Park overflown however the areas under the PBN routes will experience an increase in overflight compared to the baseline.		
Communities	Air Quality	Qualitative
• **Runway 20 Arrivals:** This option does not change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality. • **Runway 20 Departures:** Although this option aims to replicate how aircraft depart today due to a CAA IFP waypoint requirement there will be a slight change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality. However, it should be noted that these changes are likely to be very small, particularly compared to the contribution of road traffic (M27/A27) to local air quality. • **Runway 02 Arrivals:** Aircraft would no longer fly the offset VOR approach and instead would likely make use of the RNP approach. Whilst there are likely to be no increase in emissions in their totality, there could be a change in the location of emissions below 1000ft which could affect local air quality including within the Southampton Council AQMAs. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality. • **Runway 02 Departures:** This option is not expected to change lateral flight paths of arrivals below 1000ft and therefore there is no anticipated change or impact to air quality.		
Wider Society	Greenhouse Gas Impact	Qualitative
The fuel burn assessment has indicated that this option is expected to offer similar track mileage to the baseline. As track mileage is linked to Fuel Burn and associated CO2 emissions, we therefore expect this option to have a neutral impact on Greenhouse Gas emissions compared to the baseline.		
Wider Society	Capacity/Resilience	Qualitative
This ACP does not seek to increase capacity for Southampton Airport and therefore we do not expect any change from today as a result of this option. The introduction of an PBN arrival onto runway 20 will improve resilience in the event of an ILS outage on Runway 20. The introduction of PBN SIDs and arrival transitions may lead to a decrease in resilience for Southampton Airport; today aircraft are tactically controlled by ATC and this creates a lot of flexibility within the airspace. For example, when departing from runway 20 and routing north, aircraft can be turned left or right depending on traffic conditions, whereas the introduction of fixed PBN routes will remove this flexibility.		
General Aviation	Access	Qualitative
CAS: With regards to CAS, this option would require additional CAS compared to the baseline in order to meet CAS containment requirements however would require smaller changes to the boundaries than Options 1, 3 and 4. The main change to CAS would be to accommodate the runway 20 arrival with potential amendments and lowering the base of CAS required to Solent CTA 3 and possibly CTA 5 to the north. These volume increases would occur over areas that are used by General Aviation traffic and will therefore have an impact on GA although there may be some benefits to GA owing to reduced ATC workload (see access section below). Any additional volume of airspace could potentially create increased bottlenecks outside of CAS that would require further investigation and safety mitigations should this option progress. In addition to this the runway 02 northbound SID would require c.12% climb gradient to remain contained within the existing baseline volume of airspace; this could be quite optimistic based on current and future fleet forecast climb performance. There may be scope to reduce the volume of the existing CTR by decreasing its width either side of the extended centreline, stepping up to a 1500ft base then progressively higher which may offer opportunities to raise of parts of CTA 2, CTA 4, CTA 6 and CTA 8. CTR/CTA dimensions depend very much on the Instrument Flight Procedures and/or Radar Vectoring patterns to and from the aerodrome. Therefore, until very detailed IFP design takes place and locations of the waypoints, fixes, PBN specifications and associated protection areas are available we can only provide some indications as to the general areas where changes are likely to be required to accommodate the options. Due to the proximity and interdependency between the airports, the shape and structure of CAS to the SW will be dependent on Southampton's and Bournemouth's options and to the NE will be dependent on Southampton's and Farnborough's options; this will be explored in further detail as part of the Stage 3 FOA should this option progress. **Access:** The reduction in vectoring owing to the introduction of PBN arrival transitions and departure SIDs will significantly reduce ATC workload and as such, this offers an opportunity for improved access to CAS. The shape/size/structure of CAS will be further explored as part of Stage 3 should this option progress.		
General Aviation/ commercial airlines	Economic impact from increased effective capacity	Qualitative
This ACP does not seek to increase capacity for Southampton Airport.		
General Aviation/ commercial airlines	Fuel Burn	Qualitative
We estimate that Option 5 will maintain similar track distances to the baseline or may potentially slightly increase track distance. The initial data (see appendix B) suggests that the 02 arrivals and departures are very similar to the baseline with the 02 arrivals being identical. The 20 departures show a very small increase in track mileage and the 20 arrivals have a small increase from the north. When we look at this cumulatively taking into account the usage of each route, there is an increase in track mileage however for the purposes of this Initial Options Assessment the track distances have been rounded, and there may also be opportunities to refine the IFP designs as part of Stage 3 should this option progress and therefore we expect this option to remain similar to the baseline. This option offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn (however the track length assessment is considered the main indicator of potential impacts compared to the baseline). In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail.		
Commercial airlines	Training costs	Qualitative
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 option is not anticipated to require any additional training costs for airlines.		
Commercial airlines	Other costs	Qualitative

No other airline costs are foreseen.		
Airport/ANSP	Infrastructure costs	Qualitative
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/ANSP	Operational costs	Qualitative
This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The option removes Southampton's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation.		
Airport/ANSP	Deployment costs	Qualitative
This option is expected to require air traffic controller training for the controllers and assistants located at NATS Swanwick and Southampton 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 also neighbouring airport options are known.		
All	Safety	Qualitative
Additional work would be required to ensure the additional CAS required for the runway 02 and 20 arrivals, and potentially for the RWY 02 Northbound SID was safe for CAT and GAT (See GA Assessment above). This option offers the opportunity for improved access to CAS, with smaller amendments to CAS compared to other options, which may help mitigate some safety concerns however this would require further investigation in Stage 3 should this option progress. The introduction of systemised approaches onto runway 20 would greatly reduce ATC and pilot workload, providing ATC with capacity to monitor and take action against any CAS infringements. The significantly lower workload would also enhance service provision to other airspace users, enabling improved integration. 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.		
All	Performance against the vision and parameters/strategic objectives of the AMS	Qualitative
This option would modernise Southampton's airspace by introducing PBN arrival and departure routes however would have an element of vectoring to final approach for runway 02. Overall, in terms of L_{Aeq}, this option is expected to remain relatively similar to today although there may be the potential for a small decrease in population within the contours due to the changes to the 02 arrivals. When considering overflight, the concentration of PBN compared to the baseline vectoring will result in a reduction in population overflown however the frequency of overflight would increase for those living under the routes. When considering the baseline centreline data against the overflight contours, cumulatively there is expected to be an overall decrease in population overflown. When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this. We estimate that Option 5 will maintain similar track distances to the baseline or may potentially slightly increase track distance. This option offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn (however the track length assessment is considered the main indicator of potential impacts compared to the baseline). The option will require additional new CAS compared to the baseline, but it does offer opportunities for potential reductions in other areas of CAS and improved access owing to the reduced ATC workload.		
All	Interdependencies, conflicts and trade-offs	Qualitative
Using the map provided in ACOG's Airspace Change Masterplan Iteration 2, the left turn departure route from runway 02, and large parts of the 20 departures and 02 approaches fall within the overlapping area between Bournemouth and Southampton. When considering Farnborough Airport, the 20 arrivals route within this overlapping area and the tactical arrival route from the north east has significant interdependencies with Farnborough and will be dependent on their ACP; this will be explored in further detail once the shortlist of options are known. The 02 departure also roues within the Farnborough/Southampton area. Interactions are expected to maintain at a similar level to today below 7000ft, with the exception of the tactical arrival route, and this will be explored in further detail at Stage 3 once shortlists of options from both airports are known. Above 7000ft, there may be interdependencies and trade-offs that will be explored as part of Stage 3 along with Bournemouth, Farnborough and NATS NERL. Farnborough's designs will share interdependencies with Gatwick and Heathrow.		

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.

Discounting Methodology

We have used the IOA assessments as the basis for determining whether to continue or discontinue an option although noise or overflight metrics have not been used to inform those decisions. In some cases, there may be multiple options that perform well against the baseline and in these cases we have also looked at the comparative performance of each option; details of this are included in the conclusion tables below. As part of the conclusion table below we have summarised the main categories that differentiate the options such as noise, CO_2 and Controlled Airspace access impacts. Please refer to the full IOA tables for assessments against all the IOA categories as required by CAP1616.

Alongside this, when considering whether to continue or discontinue an option, 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. The following table therefore provides the rationale for discounting or progressing an option and explains these qualitative elements. It's also important to note that our final option may be developed in Stage 3 from a combination of different aspects from each of the remaining options.

Option Name	Conclusion	Progress to Stage 3
Option 1	The IOA has established that this option is expected to: • Modernise Southampton's airspace by introducing PBN arrival and departure routes, • Maintain L_{Aeq} noise impacts similar to the baseline, • Offer an overall decrease in population overflown compared to today, however the frequency of overflight would increase for those living under the routes. The routes broadly aim to follow the areas most frequently overflown today, with the exception of the 02 north departure where PBN design criteria means that the route cannot be replicate the average baseline centreline, and subsequently it avoids a highly populated area. • When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 departures could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this to more closely reflect what happens today. • Maintain similar track distances (and associated Fuel Burn and Greenhouse Gas emission impacts) to the baseline or may potentially slightly increase track distance. This option also offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn. • Require additional new CAS compared to the baseline in order to accommodate the runway 20 arrival and 02 arrival routes. Compared to Options 3 and 4, Option 1 would require less controlled airspace. The option does however offer opportunities for potential reductions in other volumes of CAS and improved access owing to the reduced ATC workload. We have therefore chosen to continue this option into Stage 3 of this ACP in order to understand the positive benefits and negative impacts in further quantitative detail.	Yes
Option 3	The IOA has established that this option is expected to: • Modernise Southampton's airspace by introducing PBN arrival and departure routes, • Change the shape of the L_{Aeq} contours compared to the baseline. Against population data mapping, this is expected to decrease the number of population within these contours however owing to the population density of these areas potentially affected, this requires further quantified investigation. As the straight ahead runway 20 departures would overfly the areas under the 02 final approach, we would expect there to could be an increase in adverse impacts for those communities living under the straight ahead sections/final approach. • Offer an overall decrease in population overflown compared to today, however the frequency of overflight would increase for those living under the routes. When considering the average baseline centreline data against the overflight contours, the Runway 20 arrivals would be expected to increase population counts whereas the Runway 20 departure and Runway 02 departures and arrivals data suggest there would be a reduction in overflight of populated areas. • Increase the frequency of overflight and introduce overflight at lower altitudes over areas not currently overflown in the baseline, or areas that are relatively infrequently overflown in the baseline. • When considering L_{AMax} 65dB, this option is expected to result in a reduction of population however large areas will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline. • Significantly reduce overflight of the South Downs and New Forest National Parks. • Result in an increase in track distance (and associated Fuel Burn and Greenhouse Gas emission impacts) compared to the baseline. There is an aspiration for all aircraft to climb and descend	Some routes discounted, some continued. Please see conclusion detail for further information.

continuously to/from at least 6000ft (subject to the NATS NERL ACP for the airspace above 7000ft) which may offer some benefits to fuel burn however the track length assessment is considered the main indicator of potential impacts compared to the baseline.

- Require a considerable amount of CAS compared to the baseline. The MoD and General Aviation airspace users have highlighted significant concerns around increased CAS in some areas which may lead to bottle necks.

Review of the IOA of option 3 concluded that on balance, when reviewing the option as a whole this option had more impacts (costs) and disbenefits than benefits. There is the potential for an improvement to population within the L_{Aeq} to the south of the airport and overflight of population numbers on some routes, However, the option offers other disbenefits in terms of concentrating noise over new areas, also resulting in a potential increase in L_{Aeq} to the north due to concentration of multiple departure routes. This would also significantly increases track mileage on some routes and require a considerable increase in the amount of new CAS to the north-west which MoD Boscombe Down and general aviation cited as likely to generate bottle necks in Class G to the south west of Middle Wallop. The BGA have raised this region as very important to them in enabling cross-country flights from between Lasham and the south-west.

Although Option 3 is discontinued as a whole, some routes within the option are already included in other options which are being progressed into Stage 3 and there are some other aspects of this option that could perform well alongside other components of the other remaining options. The final option for the ACP may be developed in Stage 3 from a combination of different aspects from each of the remaining option. The following section breaks down the conclusion on option 3 on a component-by-component basis:

Option 3 Runway 02 Departures (Part discontinued, part continued):
When we look at the overflight data on a route by route basis, the runway 02 departure routes decrease population overflown compared to the baseline, however unlike the other 02 departure options and the baseline, this configuration turns all aircraft to the west after departure. This means that all departing aircraft for c.7nm would overfly the same populations of Otterbourne, Shawford, Compton and Silkstead. Whilst on average runway 02 is only used for 28% of the year, during periods of 02 operations the concentration of traffic is expected to significantly increase compared to today, and this has the potential to increase adverse impacts over those areas. As well as not meeting Air Navigation Guidance 2017, this also does not meet DP8 which aims to ensure a predictable, fair and equitable share of traffic across all routes, through multiple route options and respite routes.

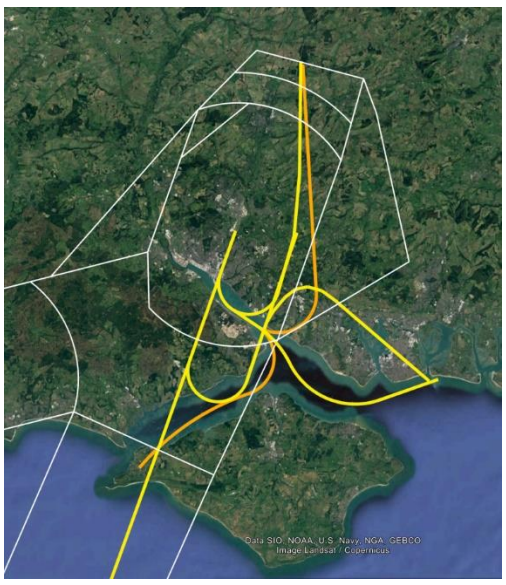
When considering track distance, fuel burn, and CO_2 impacts, the runway 02 departures cumulatively would increase track mileage compared to the baseline. The south west departure offers a marginal improvement however this only accounts for c.2% of movements. The south east departure has the most significant impact compared to today with a 11nm increase in track mileage for c. 21% of traffic.

Finally, when considering Controlled Airspace, the runway 02 northbound (incl south east) departures would require considerably more CAS and amendment to CTA-3. The General Aviation and Safety assessment noted significant concerns from GA and the MoD over the safety of increasing the volume of CAS to the NW which may result in bottle necks in Class G to the south west of Middle Wallop. The route to the south west would also require a change in volume of CAS which when balanced against the amount of traffic expected to use the route (<1%) is considered disproportionate.

We have therefore chosen to discontinue the Option 3 runway 02 departure routes to the south west, south east and north. The Option 3 route to the south performs well in terms of noise when compared against the baseline and other options, however it does have some CO_2 and CAS impacts (to a lesser extent than the other 02 departure routes within option 3). This route to the south will be progressed to Stage 3 so that the costs/benefits of the route can be explored in more quantitative detail.

Option 3 Runway 20 Departures (Continued):
The runway 20 departure routes are not included in any other option. The IOA has shown that these routes offer opportunities to reduce the population overflown between 0-7000ft. When considering the primary LAeq metrics, there are some potential benefits in terms of avoiding some of the most densely populated parts of Southampton, however the departures would newly overfly communities already under final approach, and therefore there could be an increase in adverse effects for communities living under the straight ahead but this is not clear without quantitative modelling. The routes all increase track mileage compared to the baseline and would result in increases in CAS.

Further quantified analysis would be required to understand the extent of the noise contour changes and the potential cost/benefit of changing the initial section of departures compared to today. We have therefore progressed the runway 20 departure routes to Stage 3 in order to investigate this in further quantified detail and compare this against the costs of the increase in track mileage.

	Option 3 Runway 02 Arrivals (Part discontinued, part continued in other options): The majority of Option 3 runway 02 arrival routes are contained within Option 1 and Option 4; these are shown in yellow on the figure opposite. Two routes are not contained within any other options, these are RNP-AR route from south (V2) and the RNP-AR route from the north (V5) (shown in orange on the image opposite).  The RNP-AR route from the south (V2) has an increase in track mileage, would require a considerable increase in CAS with associated safety concerns, and offers only marginal improvements in population overflown compared to the baseline. In addition to this, V2 could not be a sole PBN arrival option, because not all aircraft operators are approved to fly the RNP-AR specification. It is anticipated that owing to the track mileage increases and the RNP-AR specification, airlines would not elect to use this route but instead would use an alternative non RNP-AR PBN arrival such as a the straight in approach shown. The RNP-AR route from the north (V5) offers a reduction in track mileage of 2.5nm compared to the baseline, but the alternative RNP-AR arrival route from the north (north V2) offers a 11.5nm improvement. When comparing noise assessments, V5 offers a small improvement in terms of population overflown (-1088 compared to the baseline) whereas north V2 overflies -13,188 fewer population than the baseline. The two routes share the same turn onto final approach and therefore are expected to have the same expected LAeq impacts. We therefore concluded that the majority of the routes contained within Option 3 Runway 02 arrivals would continue into the IOA as part of other options, and the two RNP-AR routes detailed above would be discontinued at this stage. **Option 3 Runway 20 Arrivals (Continued in other options):** The Option 3 runway 20 arrival routes are contained within Option 1, 4 and 5 which are being progressed to the Initial Options Appraisal. We expect the upper parts of these routes to evolved as we integrate them with the airspace above 7000ft and connect to the STAR end points.	
Option 4	The IOA has established that this option is expected to: • Modernise Southampton's airspace by introducing PBN arrival and departure routes, • Change the shape of the L_{Aeq} contours compared to the baseline. Against population data mapping, this is expected to slightly decrease the population within the contours to the south of the airport (runway 20 departures and 02 arrivals) and possible slightly increase population to the north (02 departures). Owing to the population density of these areas potentially affected, the scale of any changes cannot be predicted without quantitative modelling. • Offer an overall decrease in population overflown compared to today, however the frequency of overflight would increase for those living under the routes. When considering the average baseline centreline data against the overflight contours, the data suggests this option would significantly reduce the number of people overflown. • Increase the frequency of overflight and introduce overflight at lower altitudes over areas not currently overflown in the baseline, or areas that are relatively infrequently overflown in the baseline. This is mainly because of the early turns in the departures. • Remove the cumulative overflight impacts of the Winchester Orbit which also significantly reduces overflight of the South Downs National Park. • When considering L_{AMax} 65dB, this option is expected to result in a reduction of population for the arrivals and an increase for the 20 departures. Large areas of departures will newly fall into the contour area and therefore this could result in a significant change in noise environment compared to the baseline. • Decrease (improve) track distance (and associated Fuel Burn and Greenhouse Gas emission impacts) and improve CCO/CDO compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft and integration of some arrival/departure routes within the option). • Require a considerable amount of CAS compared to the baseline. General Aviation airspace users have highlighted significant concerns around increased CAS in some areas which may lead to bottle necks and safety concerns. In particular, the RWY02 departure to the south west would require considerably more CAS in an area of concern highlighted to us by MoD Boscombe and general aviation. As this route is anticipated to be used by only <1% of departures, it has been discontinued.	Yes apart from the RWY 02 SID to the SW

	We have therefore chosen to continue this option, with the exception of the runway 02 departure to the south west noted above, into Stage 3 of this ACP in order to understand the positive benefits and negative impacts in further quantitative detail.	
Option 5	The IOA has established that this option is expected to: • Modernise Southampton's airspace by introducing PBN arrival and departure routes however would have an element of vectoring to final approach for runway 02. • Maintain L_{Aeq} noise impacts similar to the baseline, • Offer an overall decrease in population overflown compared to today, however the frequency of overflight would increase for those living under the routes. The routes broadly aim to follow the areas most frequently overflown today, with the exception of the 02 north departure where PBN design criteria means that the route cannot be replicate the average baseline centreline, and subsequently it avoids a very populated area. The other exception is the 20 arrival from the north east. When considering the average baseline centreline data against the overflight contours, the data suggests this option would cumulatively reduce the number of people overflown. • Partially remove the cumulative overflight impacts of the Winchester Orbit • When considering L_{AMax}, the runway 20 and 02 arrivals are expected to remain very similar to the baseline. The runway 02 departures could improve population within the 65dB contour, and the runway 20 departures could increase population within the contour, although there may be some opportunities as part of Stage 3 to refine this to more closely reflect what happens today. • Maintain similar track distances (and associated Fuel Burn and Greenhouse Gas emission impacts) to the baseline or may potentially slightly increase track distance. This option offers the opportunity for improved CCO/CDO performance compared to the baseline (subject to the NATS NERL ACP for the airspace above 7000ft). • Require additional new CAS compared to the baseline in order to accommodate the runway 20 arrival route however compared to all other options, this option requires the smallest amount of new CAS. The option does however offer opportunities for potential reductions in other volumes of CAS and improved access owing to the reduced ATC workload. We have therefore chosen to continue this option into Stage 3 of this ACP in order to understand the positive benefits and negative impacts in further quantitative detail.	Yes

Preferred Option & Information to collect as part of Full Options Appraisal at Stage 3

We have outlined which options we plan to take forward to Stage 3 as part of our IOA Summary and conclusion section above.

Our final option may be developed in Stage 3 from a combination of different aspects from each of the remaining options. It's important to note that we will need to refine options ahead of the Full Options Appraisal (FOA) to ensure they can integrate with the network, our neighbouring airports, and to ensure they are in accordance with regulations and that the routes are all flyable. All refinements that lead to the final solution(s) taken to FOA and subsequent consultation will be documented as part of the design evolution. As such, given how we anticipate the options will evolve following the activities within Stage 3, we do not feel it is appropriate to select one of the existing options as our preferred at this stage.

Our preference is to have PBN arrival transitions to both runway ends, an RNP Approach to Runway 20 and SIDs from each runway. For RWY 20 arrivals we aspire to have a final solution which avoids all arrivals from the North overflying the same population twice, ideally with a reduction in track miles flown as a result. As noted in the IOA, this is likely to have a dependency on Farnborough's design solutions which in turn has dependencies on Heathrow and Gatwick. We acknowledge the concerns from General Aviation stakeholders about the amount of CAS that could be required to address those preferences and we are committed to exploring the impacts and benefits in further detail as part of Stage 3. With this is mind, there is no preferred final route positioning at this stage from the remaining options as we will seek to evolve a solution that best balances the strong and competing requirements as the wider FASI designs mature.

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 and alongside this, we also plan to collect further information. Table 17 sets out the information we plan to collect and how we intend to collect this:

Table 17 Further information to be collected at Stage 3

Information for Stage 3 Full Options Appraisal	How we will collect the information
A quantified baseline year (pre-implementation and 10 years post implementation, including 10 year traffic forecast)	Southampton Airport will generate a forecast for the year of implementation and 10 years beyond (expected to be 2027 out to 2036). This will require alignment with the NATS NERL forecast. NATS are responsible for the airspace above 7000ft and alignment is required in order to generate CO_2 and fuel burn assessments. We will look to the Airspace Change Organising Group (ACOG) for guidance on how the forecasts are aligned in order to facilitate the assessments outlined below.
Primary noise metric data (LAeq contours)	At Stage 3 we will fully quantify the L_{Aeq} contours associated with each option to CAP2091 standards. To do this, we will use the movement forecast (see above) alongside the forecast future fleet mix to model expected noise impacts. The noise model will also account for the expected dispersion around the route centrelines. The expected level of dispersion will be partly informed by development simulations run by NERL. This noise model will output the LAeq contours for the baseline 'pre-implementation scenario' and the options, with associated population data and contour size information. This quantifies significant noise impacts. LAeq data will be input into the government's WebTAG assessment spreadsheet, in order to provide a monetised cost/benefit for these significant noise impacts.

Secondary noise metric data: Quantitative Nx contours, population counts and size (km2) that take into account the frequency of overflight	At Stage 3 we will fully quantify the secondary metrics up to 7000ft. To do this, we will use the movement forecast (see above) alongside the forecast future fleet mix to model expected noise impacts. The noise model will also account for the expected dispersion around the route centrelines. This noise model will output the Nx and overflight contours, population and size, which will convey noise affects between 0-7000ft.
Secondary noise metric data: Quantitative overflight contours, population counts and size (km2) that take into account the frequency of overflight	
Quantified information about the shape and size of the CAS structure that would be required in order to accommodate the options.	Following IFP development of the options proposed to be taken to FOA/Consultation, a representative CAS structure will be developed in collaboration with neighbouring airports and NERL. We expect ACOG to co-ordinate this work. The representative CAS will then allow us to quantify the volume of CAS required for the options and compare this against the existing airspace structure.
Further analysis of Air Quality	A further qualitative assessment on air quality impacts to determine if there is a real risk of significant, negative air quality impacts from any airspace change at Southampton. The results of these qualitative assessments will be used to determine if there is a need for a full, quantitative assessment of any change proposals. If detailed assessments are required, they will be carried out to determine quantitative impacts.
Track length/Fuel Burn and CO2 emissions data	Along with NERL who are responsible for the airspace above 7000ft, we will generate detailed Fuel Burn and CO_2 analysis. This will be informed by the design of the airspace above 7000ft, the movement forecast, and the expected future fleet mix. Data from this analysis will be input into the Government's webTAG spreadsheet and used to generate a monetised output.
Further information around any interdependencies with Bournemouth, Farnborough and the NATS NERL network	Southampton will continue to work with neighbouring airport's as part of ACOG interdependency workshops.
Further details of ATC deployment / training costs	Once the options for consultation have been finalised, we will quantify any ATC deployment or training costs associated with the options.
WebTAG and a Net Present Value Table	Any monetised outputs following the assessments outlined above will be input into a Net Present Value (NPV) table.

Our Stage 3 Full Options Appraisal (FOA) will contain full details of the methodology used when generating data within the FOA.

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 figure shows our options on one map image, displayed using 7000ft 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 considered when identifying the audience such as other noise metrics, changes to controlled airspace etc and we will ensure these are also factored in.

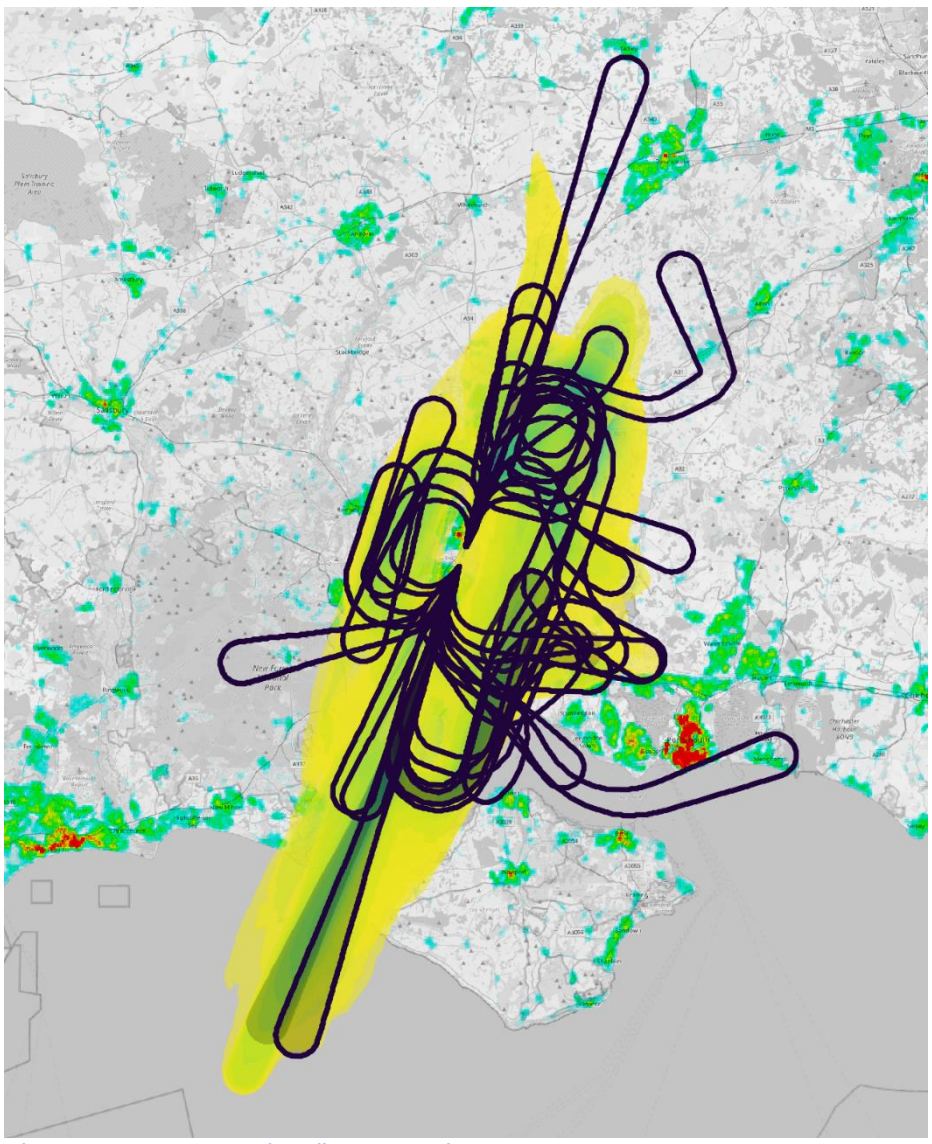


Figure 11 SOU Impacted Audience Mapping

6. Appendix A L_{Aeq} Contours

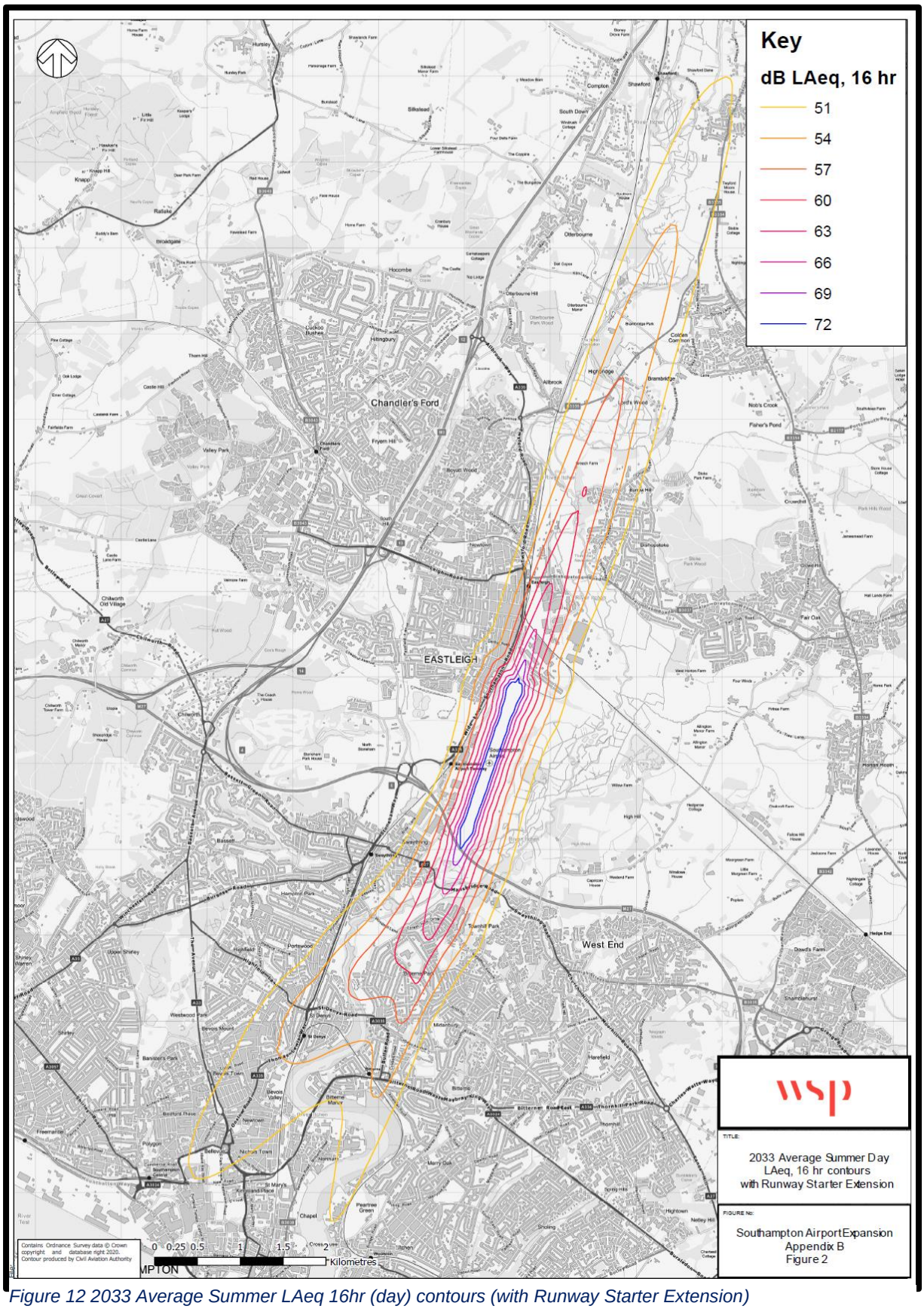


Figure 12 2033 Average Summer LAeq 16hr (day) contours (with Runway Starter Extension)

7. Appendix B Technical

Due to file size, this is published separately on the CAA's Airspace Change Portal