ACP-2021-006

ENABLING BVLOS RPAS OPERATIONS FROM KEEVIL AIRFIELD, WILTSHIRE

STAGE 4 – OPTIONS APPRAISAL
(PHASE 3 – FINAL)

Version 1.1

Ministry of Defence

Responsible Authors of this Document

The Sponsor for this Airspace Change Proposal is the Ministry of Defence and will be managed under Project LOVERIDGE. The project team is drawn from Joint Helicopter Command, specifically the Watchkeeper Force and 47th Regiment Royal Artillery.

Only responsible authors may implement amendments via the Project LOVERIDGE lead. All revisions will be listed and detailed in the table below.

Revision Number	Affected Part	Revised By	Notes
Initial Issue v1		Project LOVERIDGE lead	2 Nov 22
v1.1	Option 2 – Training Costs Option 3 – Training Costs	Project LOVERIDGE lead on request of the CAA	24 Jan 23

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References

A. Stage 3 Consultation Document

B. Stage 3 Consultation Strategy

C. CAA Feedback on use of Navigation Warnings

D. Stage 3 Environmental Impact Assessment

E. Stage 2 Initial Safety Assessment

F. Stage 3 Electronic Conspicuity Flight Data

G. Stage 3A Full Options Appraisal.

Introduction

Scope

0.1 This document forms part of Stage 4 of the Airspace Change Proposal ACP-2021-006, which aims to facilitate Beyond Visual Line of Sight (BVLOS) take-off and landing of Remotely Piloted Air System (RPAS) from Keevil Airfield, Wiltshire in order to operate within the Danger Areas over Salisbury Plain Training Area.

0.2 The aim of this document is to provide evidence to the CAA that the Change Sponsor has adhered to the process laid out in CAP 1616 for Stage 4. It aims to build upon the work undertaken during the Full Options Appraisal in Stage 3 by applying considerations received during the Stage 3 Consultation and analyse the chosen airspace option to be taken forward for the final submission.

0.3 **Stage 3 Full Options Appraisal.** The Full Options Appraisal (Ref. G) evaluated two Danger Area designs (simple and multi-sectored) against the 'do nothing' baseline. As per CAP 1616 the Sponsor also provided a preferred design option and Option 2 (simple Danger Area) was chosen at that stage.

0.4 **Stage 4 Final Options Appraisal.** The Final Options Appraisal is an evolution of the Full Options Appraisal. Analysis of Option 2 will be refined with further quantitative and qualitative data used to support the key deductions. As a result of analysis of consultation feedback and an updated qualitative risk assessment the Sponsor will discount Option 3 and will not develop the Option further. Option 3 will still be appraised within this document in order to justify why the Sponsor has elected the simple shape over the multi-sectored design.

0.5 The Options Appraisals have evolved in the following way:

Stage 2B			Stage 3A	
Option 0 -	Do nothing	→	Option 0 -	Do nothing
Option 1 -	Use existing airspace structures	→	Option 1 -	**Discounted**
Option 2 -	Danger Area (simple shape)	→	Option 2 -	Danger Area (simple shape)
Option 3 -	Danger Area (multi-sectored complex)	→	Option 3 -	Danger Area (multi-sectored complex)

	Stage 4A	
→	Option 0 -	Do nothing
→	Option 1 -	**Discounted**
→	Option 2 -	Danger Area (simple shape)
→	Option 3 -	**Discounted**

Section 1

Context

Supplementary Evidence

1.1 After completing the Initial Options Appraisal the Sponsor identified additional data that would allow the options to be further developed at Stage 3. Noting the fact that the airspace sits wholly within Class G it was determined at Stage 2 that quantitative environmental, noise and air traffic assessments would not be possible to achieve. However, it was determined that the following data would be useful to inform the Full and subsequently Final Options Appraisal:

1.1.1 Monitor air traffic movements using electronic conspicuity data[1] over a set period in order to:

- Assess traffic patterns and the impact on the funnelling effect between Salisbury Plain and the Bristol CTR.
- Better determine the number of movements around Keevil in order to understand current aircraft behaviours.

1.1.2 Look to utilise the 'Airspace4All' VFR heatmap and BGA ladder data to further assess the current funnelling of aircraft in and around Keevil and understand current trends for how the airspace is utilised.

1.2 During consultation it was suggested that the electronic conspicuity data gathered in the Full Options Appraisal was insufficient as it (1) only utilised ADS-B and FLARM data and (2) the data gathering period was not long enough. The BMAA suggested contacting SkyDemon to obtain a heatmap showing the tracks of all their users in the region over a two-year period. SkyDemon was able to provide a heatmap showing traffic at all altitudes between 2018 and 2020. This data reaffirms the conclusion derived from the 2-week flight data collection in the Full Options Appraisal that pilot behaviour is generally to avoid the Keevil overhead, with most aircraft routing North of the airfield and a minority following the railway line to the South. The SkyDemon evidence is provided at Annex A and is available to the CAA only and not published in the public domain, at request of SkyDemon.

1.3 The following data was compiled during the Full Options Appraisal in order to inform the development of the environment assessment and the assessment of the 'do nothing' option in order to better determine the effects different airspace structures may have. These, in conjunction with the new data at Annex A, remain extant for the Final Options Appraisal.

[1] ADS-B, FLARM and MLAT

UK Airprox Board Airprox Locations

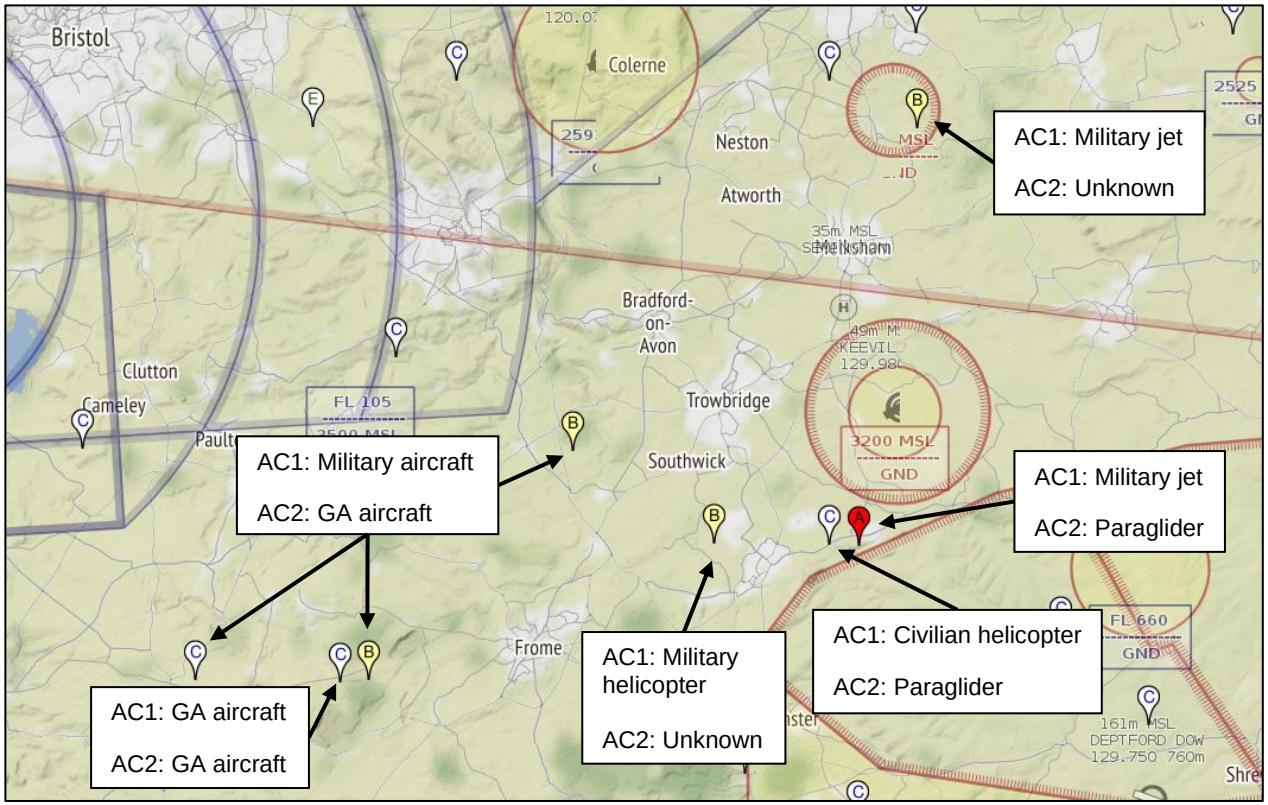

Image 1 – Airprox Board data. Source: Mr C Fox, Airprox Board

1.4 This graphic was obtained from the UK Airprox Board website[2] and depicts all filed airprox incidents between 1st January 2011 and 8th April 2022 to the UK Airprox Board. The aim of this analysis is to understand the extent of the funnelling effect of GA aircraft that currently exists between Bristol CTR and Salisbury Plain Danger Area in order to inform the 'Do Nothing' option and then compare how new airspace structures may affect this.

1.5 The data presented in the graphic is for all air traffic (military and civilian) operating VFR or IFR. Commercial air transport aircraft have been omitted.

1.6 Whilst the use of airprox data alone cannot conclude whether or not funnelling exists, it can be deduced that, based on the current volume of air traffic, this 'pinch-point' does not present an air safety risk.

[2] https://www.airproxboard.org.uk/reports-and-analysis/interactive-map/

Airspace 4 All Heatmap

1.7 The Future Airspace Strategy VFR Implementation Group (FASWIG) register of VFR Significant Areas[3] lists the Brize Norton/Boscombe Down/Bristol Gap as a 'busy VFR area with a wide range of local and transit traffic'.

1.8 It also states that the gap is only 'moderately constrained by Bristol Class D in the West but any increase of CAS would increase the density of traffic…and place a further major obstruction to non-CAS pilots as rerouting is not a practical option because of Bristol and Brize Norton CAS and Salisbury Plain ranges'[4].

1.9 From the VFR heatmaps it can be concluded that:

- The 'Bristol gap' is more congested towards Salisbury Plain than Bristol CTA.
- The gap between the Keevil and the boundary of Salisbury Plain DA is not as widely utilised compared to operating to the North of Keevil between Frome, Westbury and Trowbridge.

1.10 However, the data does not factor in the transit altitude that aircraft are operating around Keevil so this data must be used in conjunction with ADS-B and glider data taken for aircraft operating at lower altitudes as well as the SkyDemon user data at Annex A – both of which indicates pilot behaviour is to avoid the Keevil overhead.

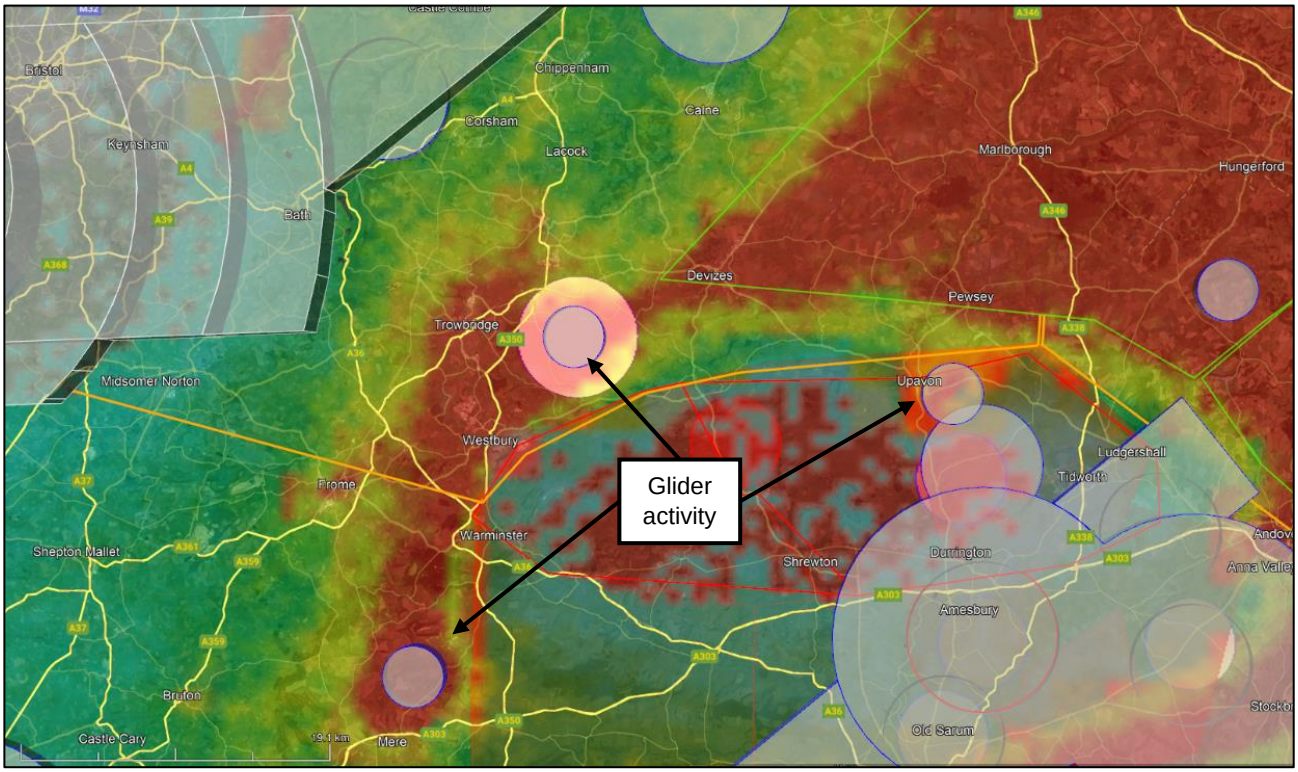

Image 2 – VFR Significant Areas in General. Source: FASVIG, Google Earth

1.11 It is assessed that any additional airspace around Keevil would not significantly alter the VFR heatmap for the following reasons:

[3] http://docs.fasvig.info/Projects/MAS01/20170930-MAS01-0002-FASVIG-VSA-V2.pdf
[4] Register of VFR Significant Areas v2, p39

- The majority of air traffic already chooses to route around the North of the airfield or above the overhead. Therefore additional airspace will not change current behaviour as long as the dimensions are minimised to the North and West and uses similar altitudes to that of the existing navigation warnings.

- Aircraft choosing to route through the airspace when active will be able to obtain a DACS, therefore will not contribute to any additional pinch-points.

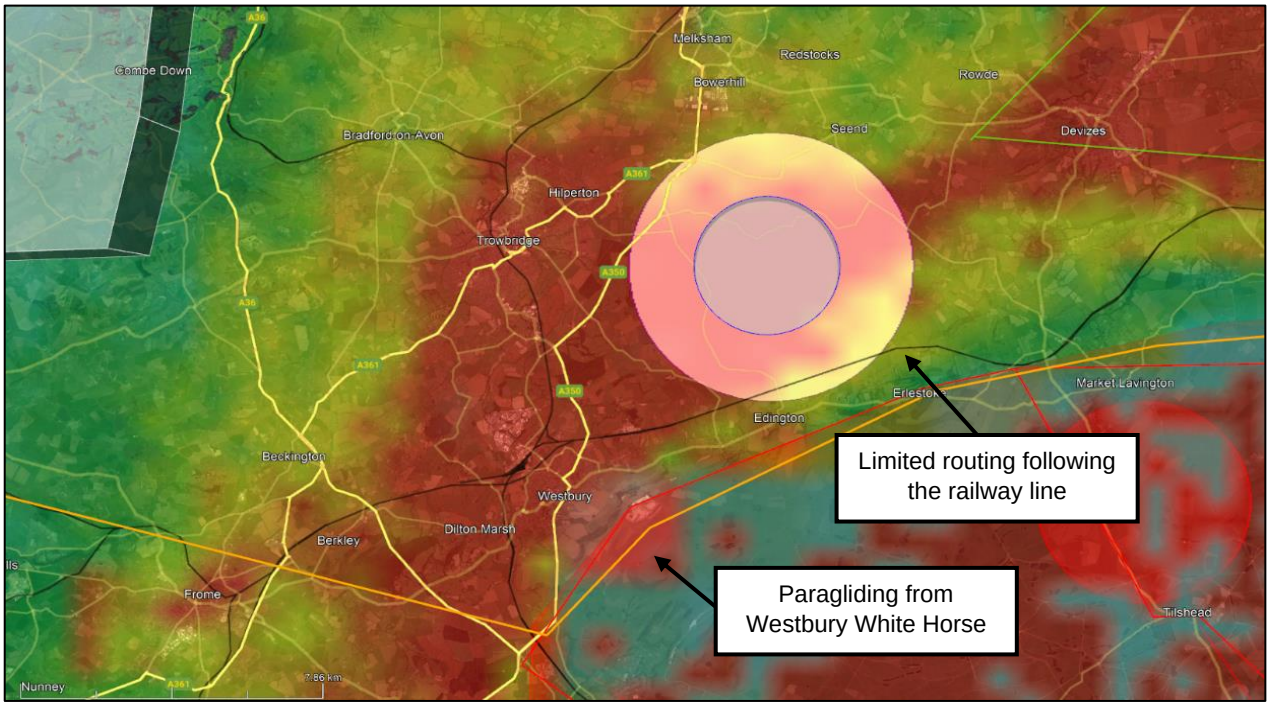

Image 3 – VFR Significant Area in Detail. Source: FASVIG, Google Earth

BGA Ladder

1.12 The dataset below was obtained from the BGA Ladder[5] and represents gliders who submitted a flight in which Keevil was a turning point between 11th May 2019 and 15th August 2021. All flights in which Keevil was the start point have been filtered.

Number	Date of Flight	Club	Site	Task	Date
1	15-Aug-21	Wyvern Gliding Club	Upavon	UPA - KEE - WEL - UPA	Weekend
2	13-Jun-21	Wyvern Gliding Club	Upavon	UPA - KEE - WEL - UPA	Weekend
3	05-Jun-21	Wyvern Gliding Club	Upavon	UPA - KEE - WEL - UPA	Weekend
4	05-Jun-21	Wyvern Gliding Club	Upavon	UPA - KEE - WEL - UPA	Weekend
5	02-May-21	Cotswold GC	Aston Down	AST - EYE - KEE - WAN - AST	Weekend
6	02-May-21	Cotswold GC	Aston Down	AST - EYE - KEE - WAN - AST	Weekend
7	02-May-21	Cotswold GC	Aston Down	AST - EYE - KEE - WAN - AST	Weekend
8	12-Sep-20	Wyvern Gliding Club	Upavon	UPA - KEE - WEL - UPA	Weekend
9	10-Sep-20	Cotswold GC	Aston Down	*TP0 - YAT - BOW - KEE - *TP0 - *TP0	Weekday
10	11-Aug-20	Edghill Gliding Center	Shenington	EDG - RAR - RIV - KEE - EVE - EDG	Weekday
11	29-Jul-20	Edghill Gliding Center	Shenington	EDG - SNI - KEE - RIV - NOS - EDG	Weekday
12	22-Jul-20	Edghill Gliding Center	Bicester	EDG - SNI - KEE - RIV - NOS - EDG	Weekday
13	21-Jul-20	Cambridge Gliding Centre	Gransden Lodge	GRL - WOB - DCT - KEE - WTB - GRL	Weekday
14	12-Jul-20	RAFGSA	RAF Halton	HAL - KEE - CHV - HUS - HAL	Weekend
15	11-Jul-20	Bristol & Gloucester GC	Nympsfield	NYM - PRK - KEE - GCB - NYM	Weekend
16	07-Jun-20	Windrushers GC	Bicester	OXF - LA3 - KEE - BC1	Weekend
17	02-Jun-20	Wyvern Gliding Club	Upavon	UPA - WEL - KEE - UPA	Weekday
18	31-May-20	Windrushers GC	Bicester	BIC - GRW - KEE - MYN - BC1	Weekend
19	31-May-20	Windrushers GC	Bicester	BC1 - GRW - KEE - MYN - BC1	Weekend
20	31-May-20	Windrushers GC	Bicester	BIC - GRW - KEE - MYN - BC1	Weekend
21	31-May-20	Bath, Wilts & N. Dorset GC	The Park	PRK - MEL - MLY - BAS - KEE - PRK	Weekend
22	09-Oct-19	Wyvern Gliding Club	Aboyne	Height Gain	Weekday
23	20-Aug-19	London GC	Dunstable	LBZ - MUR - KEE - BOZ - SIL - DUN	Weekday
24	04-Aug-19	Herefordshire GC	Shobdon	TRO - MAM - CLN - BLA - DEV - KEE	Weekend
25	22-Jun-19	Bath, Wilts & N. Dorset GC	The Park	PRK - TIS - GLA - KEE - PRK	Weekend
26	25-May-19	RAFGSA	RAF Halton	HAL - KEE - DID - ENS - HAL	Weekend
27	11-May-19	Bristol & Gloucester GC	Nympsfield	NYM - SHA - BCL - KEE - NYM	Weekend

Table 1 – BGA ladder of gliders overflying KVL. Source: bgaladder.net

1.13 The following deductions can be made:

- Out of a total of 27 flights, 19 occurred at the weekend and 8 during the weekday.
- Of the 8 aircraft that overflew Keevil as a turning feature during the working week the highest altitude recorded was 4,475ft and the lowest was 3,100ft.
- The average altitude overflown during the working week by a glider was 3,887ft.

1.14 It is acknowledged that there will be more unrecorded glider flights for which no file has been uploaded. These will include local training and leisure flights from Bannerdown, The Park, Aston Down, Nympsfield, Halesland, Upavon, Rivar Hill and

[5] Daily Scores (bgaladder.net)

other regional gliding airfields, as well as flights by pilots who choose to fly cross country but not participate in the BGA online competition.

1.15 However, whilst it is acknowledged that the BGA ladder does not represent all glider flights that will have occurred over this period it assessed to be indicative of the altitude that gliders operate when flying cross country.

1.16 It is therefore concluded that a Danger Area with a vertical dimension of around 3,200 AMSL will have a low impact on cross-country gliding, which can further be mitigated by a crossing service, provided the glider is radio-equipped (estimated to include 80% of gliders operating in the vicinity of Keevil[6]).

Electronic Conspicuity Data[7]

1.17 The image below is a summary of Electronic Conspicuity tracks identified between 4th and 8th April 2022. The aircraft displayed are a combination of civilian and military aircraft that were operating SFC-4000ft AMSL. Full analysis was conducted between 28th March and 8th April and can be found at Ref F.

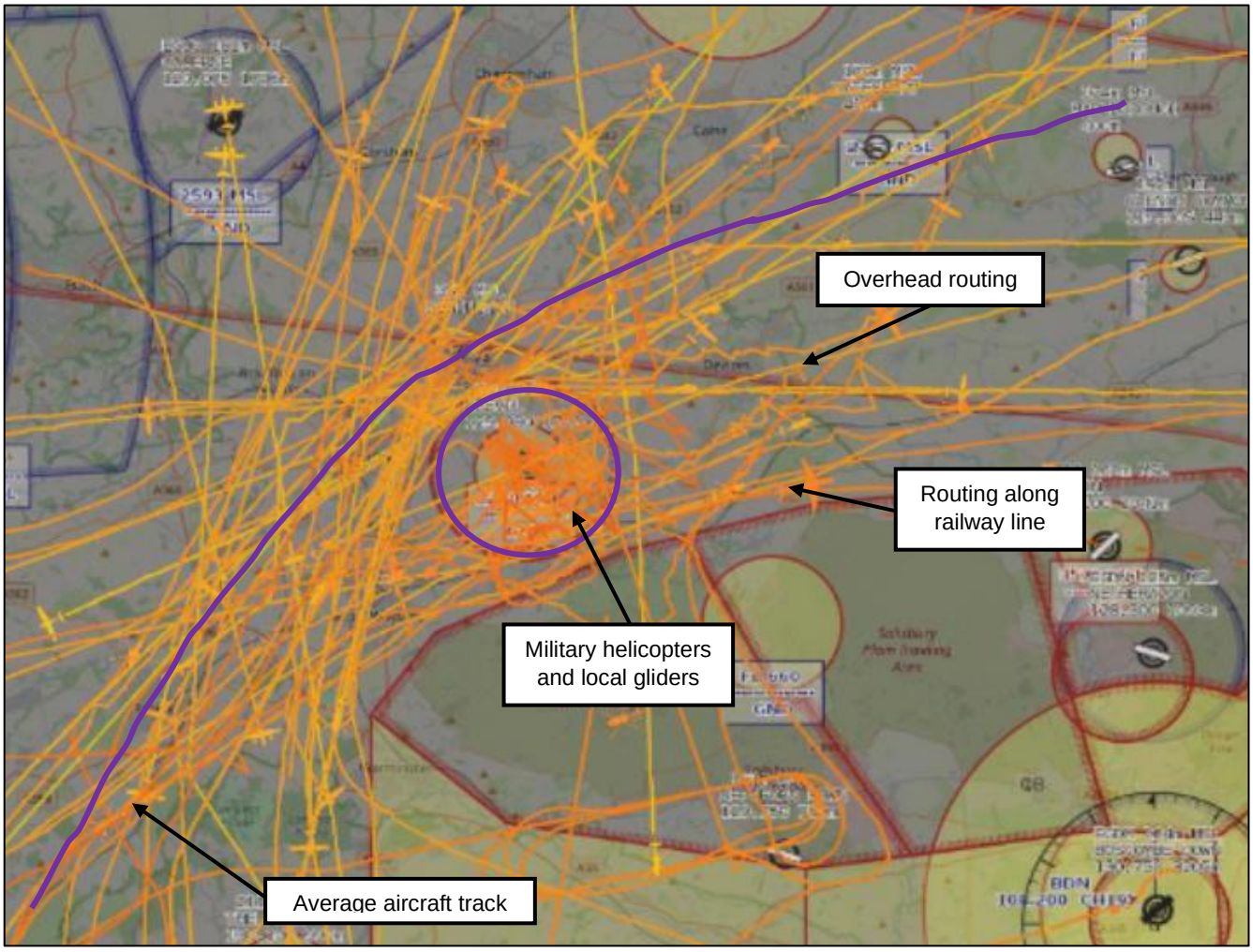

Image 4 – Electronic Conspicuity data Source: globe.adsbexchange.com

[6] As estimated by the BW&ND GC representative during previous engagements
[7] Electronic Conspicuity Data implies data retrieved from ADS-B, MLAT and FLARM traces over a set 2 week period. The term Aircraft Traces, Electronic Conspicuity, ADS-B, FLARM or MLAT all implies the document and data at Ref G

1.18 Whilst, due to the time of year and limited period of data collection, this may underrepresent the **volume** of aircraft tracks expected during the summer it is assessed that the **behaviour** of air users will not change[8]. In summary, the following key deductions have been made about the behaviour of aircraft in the 'do nothing' scenario:

- Over a two-week period (weekdays only) 164 aircraft operated in the vicinity of Keevil- 88 were civilian and 76 were military.

- The majority of air users currently elect to route around the Keevil area to the North (76% of air users).

- The majority of users routinely operating below 3,000ft and within 2NM of the airfield are military helicopters and local gliders (gliders launched from Keevil itself).

- Some air users (around 1 in 12) elect to use the railway line for VFR navigation.

- Very few (17 out of 164) air users elected to transit overhead below 3,000 ft AMSL during the 2 week period. The average operating altitude for those 17 aircraft were between 1000 - 2000 ft AMSL.

1.19 It is therefore concluded that a Danger Area with a vertical dimension of approximately 3,200ft AMSL will have a limited impact on air users when compared with the current situation.

[8] This conclusion was reaffirmed by the SkyDemon user data at Annex A

Environment and noise assessment

1.20 An Environmental Impact Assessment was conducted at Stage 2. This was further developed at Stage 3 and assessed to be valid during Stage 4. It provides a rationale for a qualitative assessment[9] to inform the options appraisal. The following was considered:

- noise impact
- fuel burn/ CO2 emissions[10]
- traffic forecast
- Biodiversity
- Tranquillity.

1.21 Despite the limited quantitative study undertaken, due to the class of airspace the Sponsor cannot accurately estimate the frequency or type of aircraft flying in the vicinity of Keevil or where and at what height they will overfly those on the ground. It is therefore not possible to model noise or other environmental impacts quantitively. As a result, the Sponsor was unable to conduct analysis as described in:

- CAP 1616a 'Environmental Technical Annex'
- Options Appraisal of costs and benefits set out in the Air Navigation Guidance
- The 'WebTAG' quantitative methodology[11].

1.22 The additional data gathered can be used to identify trends on aircraft behaviour but does not allow for greater quantitative assessment of the environmental impact of different airspace structures compared to the current situation.

Safety Assessment

1.23 A safety assessment (Ref. E) was conducted during Stage 2. This was reassessed during Stage 4 against the developments brought out from consultation and the removal of previously discounted Options. It is assessed that the information obtained during consultation supports the underlying assumptions made during Stage 2 and does not change the safety assessment outcomes on the use of a Danger Area.

1.24 Safety Assessment generic for both Option 2 and Option 3 Danger Area designs:

- A Danger Area (DA) may cause an increase in the risk of Mid Air Collision (MAC) if the airspace structure contributes to an increase in the funnelling effect of aircraft between SPTA and Bristol CTR. – *This risk is mitigated by reducing the airspace required for the DA to as small as possible and providing a DACS which will be available at all times when the airspace is activated.*

[9] Transport Act 2000 Sect 70
[10] In accordance with CAP1616 and CAP 2091 para.5.13
[11] WebTAG A3 did not provide useful data due to the majority of the metrics required being unknown.

- It is assessed that this risk of MAC will only increase in the event that **all** air traffic chooses to route around the DA to the North and if the gap between the DA and Bristol CTR is also reduced. – *The reduction in the size of the airspace required and the provision of a DACS will mitigate against aircraft being required to route North unless absolutely necessary.*

- The introduction of multiple methods to obtain information on the status of the DA may cause confusion and contribute to the risk of MAC due to aircraft around Keevil operating in close proximity to each other using different methods to obtain the same information. – *Publishing clear and recognised procedures for requesting a DAAIS and DACS will mitigate the risk of pilots conducting the same activity on different frequencies and loosing Situational Awareness.*

- Pilots currently routing through the Keevil overhead without using the Glider Common frequency or without being in receipt of an air traffic service may not be aware of any glider winch launching activity taking place (placing themselves and any gliders in danger of collision). – *The addition of a DA with a published DACS frequency will reduce the likelihood of MAC during DA activation periods only, due to ATC's awareness of traffic wishing to operate within the vicinity of the airfield and all participating traffic being on the same frequency. The level of risk when the DA is not active remains the same as currently experienced with the existing airspace use.*

1.25 Safety Assessment specific to Option 2 – Simple Design:

- It is assessed that with Option 2 – Design 1 (Simple Multi-Point DA) a risk of pilots plotting the multiple points incorrectly on their charts are increased compared to that of a more basic circular designed DA. – *With the introduction of electronic flight planning application and moving map software, that automatically ingests new airspace and NOTAMs, it is believed that the risk of incorrectly added airspace on paper charts is significantly reduced, noting this risk is only present before subsequent chart updates.*

- The airspace design is simpler to navigate around and does not present any new 'pinch-points'.

- It is assessed that Option 2 - Design 2 (Circular design) which includes airspace not required for RPAS operations will unnecessarily increase the funnelling effect to the North of Keevil. This will increase the risk of MAC to the north of Keevil. – *Reduction of the airspace not required will reduce the risk of MAC.*

1.26 As a result of the additional risks associated with Option 2 – Design 2, the Sponsor is discounting this option. The reasons will be further explained during the Options Appraisal in Section 2 below.

1.27 Safety Assessment specific to Option 3 Multi-Sectored Design:

- The creation of a multi-sectored Danger Area seeks to facilitate continued use of the gap between the Keevil DZ/ glider site and D123, allowing VFR traffic to navigate using the railway track.

- It is assessed that, compared with Option 2, there is an increased risk of Mid Air Collision as the corridor that the design creates will lead to a higher density of traffic choosing to route through the 'Keevil-D123 gap'. Whilst currently this routing is chosen by the minority of air users it is assessed that:

    - This would lead to an increased risk of Mid Air Collision, particularly as it is concluded that this option is more likely to be chosen by aircraft without radios or electronic conspicuity.

    - This is likely to lead to an increased risk of airspace infringement given the design of the 'hanging airspace'.

1.28 As a result of the additional risks associated with Option 3, the Sponsor is discounting this option. The reasons will be further explained during the Options Appraisal in Section 2 below.

1.29 Additionally, the risks associated with all military operations in the area are identified and reduced using the BowTie risk assessment model.

Current Situation: Option 0 – Do Nothing

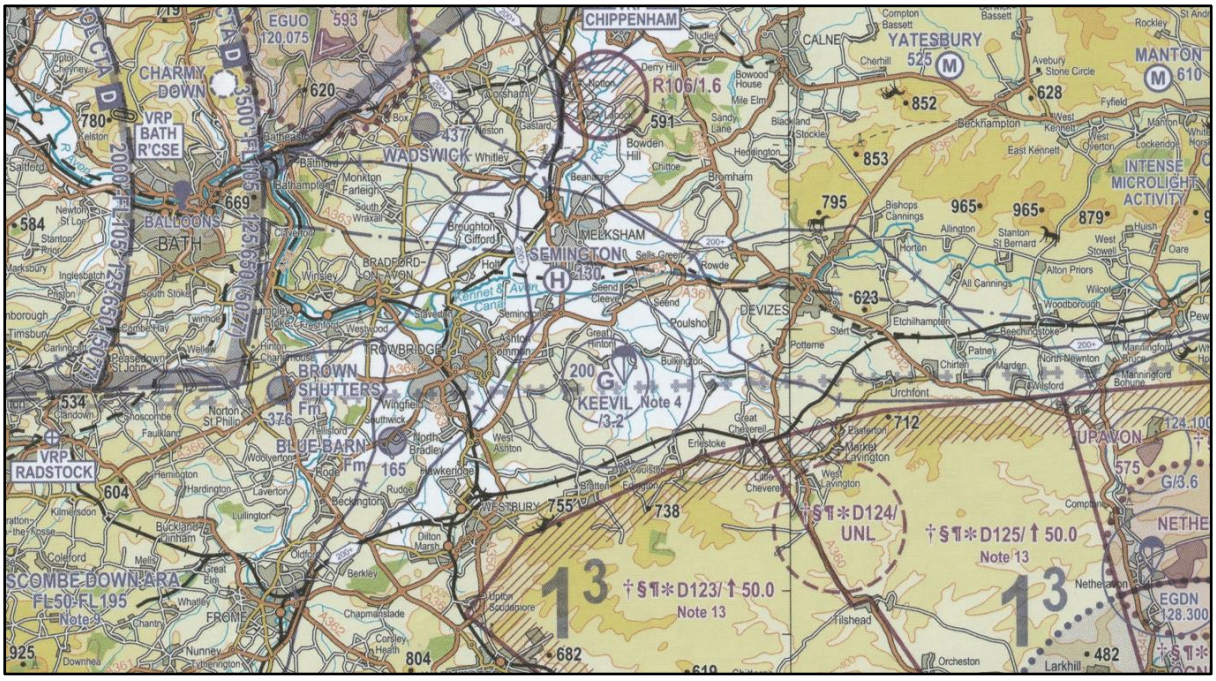

Image 5 – Do Nothing / Current Situation Source: CAA 1:250k Aeronautical Chart, Sheet 7

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

The types of aircraft that will be most affected are gliders (minimal noise impact), microlights, light aircraft and low flying helicopters (the majority being military). Gliders launching from Keevil predominantly operate during the weekends only (Friday afternoon – Sunday, sunrise to sunset). During periods of operation the area will see multiple glider launchers per hour. Currently military rotary wing helicopters from RNAS Yeovilton, Culdrose and Middle Wallop, RAF Benson and Odiham utilise Keevil several times per week for technical and tactical training. Military para-dropping occurs less frequently but is conducted periodically in support of large exercises (three to four times per year).

The limited quantitate ADS-B data that was gathered suggests that due to the existing airspace structures over Keevil, the majority of aircraft already choosing to avoid the glider site / DZ. Most aircraft are planning to track to the Northern edge of the DZ near the towns of Frome and Devizes (listed VRPs). A lesser amount route through the gap between the glider site and SPTA D123 following the railway line for navigation. It is assessed that, in the 'do nothing' scenario, should the current DZ be activated aircraft will either continue to route North of the glider site or elect to climb over the activated airspace (winch launching already occurs to 3,200ft AMSL) therefore limited to no change to general aviation behaviour will occur.

The highest number of aircraft flying in the vicinity of the local villages surrounding Keevil in a single day was 28- including 5 separate HEMS movements and low-flying military aircraft. It can be expected that during summer periods this number will increase however due to the assessed behaviour of these aircraft this will still have a limited noise impact on local communities.

Group	Impact	Level of Analysis
Communities	Air quality	Qualitative

Evidence

The Sponsor assesses that currently there is a negligible impact on local air quality as a result of aviation activities. As demonstrated by the VFR heatmap, SkyDemon user heatmap and ADS-B data the altitude that aircraft transit the area as well as the number and type of aircraft leads to an inconsequential impact on air quality.

Group	Impact	Level of Analysis
Wider society	Greenhouse gas impact	Qualitative

Evidence

It remains difficult to meaningfully quantify the amount of greenhouse gas emission in the 'do nothing' scenario for the following reasons:

- As the affected area is entirely within Class G airspace the operation of aircraft cannot be accurately predicted.
- The number of aircraft movements in the area cannot be accurately quantified.
- The area is primarily utilised by general aviation. The variety of GA aircraft makes a quantitative assessment on the efficiency of engines and the predicted greenhouse gas emissions impossible to accurately determine.

Group	Impact	Level of Analysis
Wider society	Capacity / resilience	Qualitative

Evidence

If the Glider site / DZ is active, there may be a slight increase in the amount of aircraft routing in between Melksham and the Keevil DZ and contribute to the funnelling effect between Bristol and Salisbury Plain. Air user data data shows that most aircraft already choose to route around Keevil and the funnelling can already be observed. However, as the airprox data highlights, this does not translate into a noticeable increase in the risk of airprox or mid-air collision.

Group	Impact	Level of Analysis

General Aviation	Access	Qualitative
Evidence		
The entire area sits within Class G airspace therefore GA have significant freedom and access. However, ADS-B traces and SkyDemon user data indicate that the majority of GA are already routing around the area due to the possibility of gliding activity and Note 4 in VFR charts (1:125k sheet 7 Ed 13) advising aircraft to avoid Keevil at all times with 2Nm and 2000ft AAL.		
Group	**Impact**	**Level of Analysis**
General Aviation / Commercial Airlines	Economic impact from increased effective capacity	Qualitative
Evidence		
There are currently no affects to air transport or passenger numbers brought on by the current airspace structures in the area.		
Group	**Impact**	**Level of Analysis**
General Aviation / Commercial Airlines	Fuel Burn	Qualitative
Evidence		
ADS-B, MLAT, FLARM and SkyDemon data indicates that GA are largely already routing around Keevil or climbing above it.		
Group	**Impact**	**Level of Analysis**
Commercial Airlines	Training Costs	N/A
Evidence		
It is assessed that there is currently no impact on commercial airline training costs as a result of the Drop Zone or Glider site.		
Group	**Impact**	**Level of Analysis**
Commercial Airlines	Other Costs	N/A
Evidence		
It is assessed that there are no additional costs to commercial airlines as a result of the current airspace structure.		
Group	**Impact**	**Level of Analysis**
Airport / Air Navigation Service Provider	Infrastructure Costs	N/A
Evidence		
There are no additional infrastructure costs for airports or ANSPs associated with Keevil airfield.		
Group	**Impact**	**Level of Analysis**
Airport / Air Navigation Service Provider	Operational Costs	N/A
Evidence		
There are no additional operational costs for airports or ANSPs associated with Keevil airfield.		
Group	**Impact**	**Level of Analysis**
Airport / Air Navigation Service Provider	Deployment Costs	N/A
Evidence		
There are currently no deployment costs for airports or ANSPs.		

Summary of Option 0 Full Appraisal

1.30 Option 0 does not satisfy the Design Principles set out in Stage 1 of the airspace change process. However, whilst this option in itself would not facilitate BVLOS operation of RPAS, it will provide the baseline to compare the Danger Area options against.

Section 2

Options Appraisal

Operating Principles

2.1 The following operating principles are common to both Option 2 and Option 3 airspace designs[12]:

a. The Danger Area would only be activated by NOTAM when required. During exercise periods activities on Friday will typically conclude by 1400hrs in order to offer greater access to local air users, in particular the local Gliding Club. Should operation at night or the weekend be required this will be published as much in advance as possible.

b. The Danger Area would be kept active for the duration of the RPAS sortie (in order to facilitate early recovery or emergency situations) but will be available for use by other air users as soon as RPAS have established in SPTA. The take-off and landing phases of a typical Watchkeeper sortie will last no longer than 15 minutes. On occasion, circuits may be required for pilot currency, and these will be kept to a minimum. A Danger Area Crossing Service from Boscombe ATC may be utilised by aircraft in order to efficiently utilise the airspace whilst RPAS are operating within SPTA.

c. Due to Keevil being an uncontrolled airfield, the Sponsor previously consulted on the use of the SAFETYCOM frequency (135.480) to provide additional information for transiting aircraft during activation periods as an alternative to requesting a DACS/ DAAIS. Due to the Glider Common frequency of 129.980 being used predominantly during periods of the DA not being active, the Sponsor has identified that the further introduction of an additional frequency in the form of SAFETYCOM will cause confusion between the frequencies to be used whilst the DA is active vs inactive. The Sponsor will therefore propose in the ENR 5.1 that during DA activation, aircraft call Boscombe Zone on 126.7 for a DACS or London Info 124.750 for a DAAIS. For all other periods, aircraft are able to apply their own discretion depending on the type of their operations, be that to use the Glider Common Frequency or SAFETYCOM depending on their operations.

d. Additionally, the Sponsor consulted on the use of an “ATIS” frequency as an additional means to notify aircraft that the DA is active or inactive. The Sponsor notes that the Stakeholders most likely effected by this decision will be those without a Flight Radio Telephony Operators License (FRTOL) in the instances where the DA was planned to be active during flight planning, but subsequently deactivated whilst that pilot is airborne. Should that pilot not have the ability to listen to the proposed “ATIS” frequency, to find out that the DA has been deactivated post their flight planning and subsequent departure, they will have to assume that the DA is active and fly around or over it as they are unable to request a DACS or DAAIS. The Sponsor assesses that a very small amount of aircraft will fall within this category as 80% of gliders are estimated to

[12] The establishment of Danger Areas and the provision of DACS/DAAIS can be found in the CAA Policy Statement on the Establishment of Danger Areas here (Jul 20).

be able to use radios[13]. Following discussion with the Defence Airspace and Air Traffic Management Cell and the CAA, the Sponsor has decided that the value brought by a separate source, providing the same information as what would be provided on a DAAIS, is disproportionate to the confusion that additional published frequencies for different purposes may cause. The Sponsor will therefore not create an ATIS frequency for the purpose of providing a separate source of information for pilots. Boscombe Down ATC will retain primacy over airspace access. Should air users struggle to obtain a service or be denied access unnecessarily from Boscombe Down pilot are encouraged to file a FCS1522 'UK Airspace Access or Refusal of ATS Report'[14].

e. There must be a guarantee of HEMS access at all times. A Letter of Agreement with emergency response aircraft in the region, especially Wiltshire Air Ambulance and Hampshire and Isle of Wight and Wiltshire Air Ambulances, must be drafted to ensure procedural deconfliction allows unimpeded access during emergency responses.

f. **Frequency of flights.** It is anticipated that RPAS will operate from Keevil predominantly between the months of May and September, usually for 3-6 weeks at a time. It is not currently the intent to operate on an enduring basis nor will routine weekend or evening activity be conducted. Normal operation will see one RPAS operated per day from Keevil.

g. **Hours of operation.** Routinely the MOD will utilise the airspace between the hours of 0830 – 1730 Monday- Thursday and 0830 – 1430 on a Friday. However, only a short time will actually be spent within the airspace itself with the majority of the sortie spent within Salisbury Plain.

Option 2 - Danger Area (simple design)

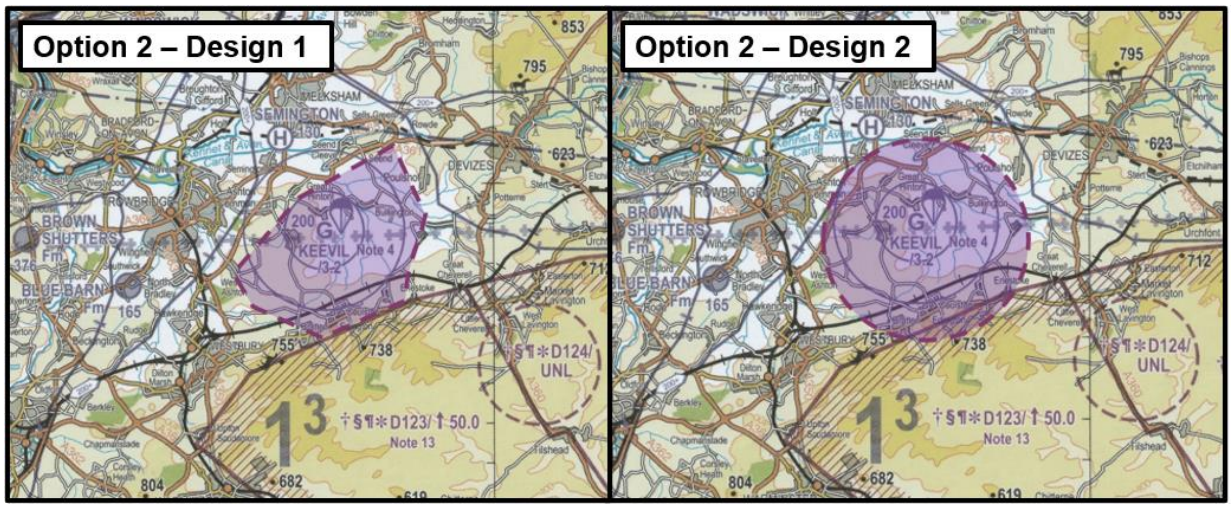

Image 6.A – Simple Designs (multi point) Image 6.B – Simple Designs (circular design)
Source: CAA 1:250k Aeronautical Chart, Sheet 7

Note: These images are for illustrative purposes only**.** The principle of a simple design consists of a single structure, SFC to a published altitude.

[13] As estimated by the BW&ND GC representative during previous engagements
[14] This form may be used to contact the CAA about being denied access to airspace, being refused an air traffic service, or being refused the type of air traffic service you requested.

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

Evidence

A Danger Area with a simple design allows the Sponsor to tailor the dimensions of the airspace to the minimum required size. Aircraft electing to climb over a Danger Area will create less noise impact that those currently routing at lower altitudes. The types of aircraft will not differ from those in the Option 0 'do nothing' scenario.

The area required to the North of Keevil may be reduced such as with Image 6.A above, allowing more space for transiting aircraft to pass through. This will allow better dissipation of aircraft reducing the effect of noise to the local communities.

ADS-B flight traces and SkyDemon user data and also demonstrates that due to the existing airspace structures over Keevil, the majority of aircraft already elect to avoid the glider site / DZ, with very few choosing to route directly overhead. A lesser amount route through the gap between the glider site and SPTA D123 following the railway line for navigation. It is assessed that should the DA be activated, aircraft will either continue to route North of the glider site or elect to climb above thereby causing no change to noise impact on communities compared with the 'do nothing' option.

It is therefore assessed that a Danger Area will lead to:

- No change in the level of noise compared with the 'do nothing' option. The same level of gliding and military activity will continue.
- A decrease in noise in some areas with fewer aircraft routing via the railway line between the DZ and D123 (or routing higher if they still elect that track).
- No change in noise patterns for aircraft on a direct track using a Crossing Service.
- A decrease in noise for aircraft climbing over the activated airspace higher than they currently may choose to.

Group	Impact	Level of Analysis
Communities	Air quality	Qualitative

Evidence

The Sponsor has concluded that a Danger Area around Keevil will not result in an increase of CO2 emissions. It is assessed that there is no additional impact on air quality compared to when the existing DZ or glider site is activated.

Due to more definitive flight planning possible compared to the current situation (due to certainty of the DA over a glider site or note on VFR charts), pilots should be better able to plan their routing either around or over the airspace. This will allow a gradual climb to altitude over a greater distance, displacing the emissions over a larger area compared to initiating an orbital climb once at the boundary of the DA. ADS-B/ SkyDemon data shows that aircraft approaching Keevil seeking to route overhead are already at the appropriate altitude for a transit therefore air quality will remain unchanged.

Aircraft expecting to navigate following the railway track may be required to route to the North resulting in additional flight time should they not be able or wish to climb over the active airspace or obtain a DACS.

Group	Impact	Level of Analysis
Wider society	Greenhouse gas impact	Qualitative

Evidence

No additional greenhouse gas emissions compared to the impact from the DZ/ glider site. There is no anticipated increase in air traffic in the area as a result of a Danger Area being activate compared with 'do nothing' option.

WebTAG could not provide any quantifiable data due to the varying amount, altitude and type of aircraft transiting the area daily.

Group	Impact	Level of Analysis
Wider society	Capacity / resilience	Qualitative

Evidence

The Sponsor assessed that there may be some reduction in traffic North of Keevil and a resultant increase to the current use of the Keevil airspace by those pilots who are currently avoiding the overhead due to Note 4 in the VFR chart (sheet 7 Ed 13) or glider activity. Since a crossing service can be afforded, pilots who are observed routing around Keevil may now choose to cross through the overhead using a crossing service, slightly reducing their route length, fuel consumption and aircraft congestion North of Keevil.

Additionally, if activated by NOTAM it is assessed that air users will be more certain of the activity status of the airfield whereas currently air users are advised to avoid the area at all times.

Group	Impact	Level of Analysis
General Aviation	Access	Qualitative

Evidence

The area is extensively used by GA to route around SPTA. The ADS-B data indicates that GA are largely already routing around the Keevil area due to the possibility of gliding activity and Note 4 in VFR charts (sheet 7 Ed 13) advising aircraft to avoid Keevil at all times. ADS-B traces also suggest a lesser number of pilots are routing via the railway line between the airfield and D123. Even fewer pilots are choosing to route overhead, particularly below 4,000ft.

With a DACS being afforded there may be an increase in aircraft opting to route through the Keevil overhead whilst the Danger Area is active as they will be able to receive information of any activity over the airfield.

However, there will be an increased amount in aircraft routing around or over the airspace, adding an additional 0.7Nm (when active) if they are not equipped with or qualified to operate a radio as it will not be possible to obtain a Crossing Service.

- With Option 2 – Design 1, the routing around the North will have a negligible effect on the additional risk of MAC due to the DA not extending North sufficiently to increase the funnelling effect.
- With Option 2 – Design 2, the funnelling effect is increased due to the DA extending too far North, closing the gap between the DA and Melksham. This will increase the risk of MAC in this area.

Group	Impact	Level of Analysis
General Aviation / Commercial Airlines	Economic impact from increased effective capacity	Qualitative

Evidence

There are no changes to air transport or passenger numbers brought on by this proposal. The altitude and location of the proposed airspace does not impact on any airline activity.

Group	Impact	Level of Analysis
General Aviation / Commercial Airlines	Fuel Burn	Qualitative

Evidence

ADS-B traces and SkyDemon user data indicates that GA are largely already routing around Keevil or climbing above it. Additionally, any climb that would be required as a result of the DA being activated is inconsequential in fuel burn.

There is no identified fuel burn impact on commercial airlines.

Group	Impact	Level of Analysis
Commercial Airlines	Training Costs	N/A
Evidence		
It is assessed that there will be no impact on commercial airline training costs as a result of this design option. Should a pilot currently not be equipped with or qualified to operate a radio and would like to use the DACS facility to access the airspace when active, they will be required to: • Purchase an airband radio at a price of approximately £250 • Obtain their Flight Radio Telephony Operator Licence at a cost of £200.		

Group	Impact	Level of Analysis
Commercial Airlines	Other Costs	N/A
Evidence		
It is assessed that there will be no additional costs to commercial airlines as a result of this design option.		

Group	Impact	Level of Analysis
Airport / Air Navigation Service Provider	Infrastructure Costs	N/A
Evidence		
There are no additional infrastructure costs for airports or ANSPs associated with this option.		

Group	Impact	Level of Analysis
Airport / Air Navigation Service Provider	Operational Costs	N/A
Evidence		
There are no additional operational costs for airports or ANSPs associated with this option.		

Group	Impact	Level of Analysis
Airport / Air Navigation Service Provider	Deployment Costs	N/A
Evidence		
There are no deployment costs for airports or ANSPs associated with this option.		

Summary of Option 2 Full Appraisal

2.2 It is assessed that a Danger Area with a simple design, as small as possible to achieve technical requirements, best adheres to the Design Principles. The Sponsor has determined that the altitude of the DA can be reduced from 3,500 to 3,200ft AMSL in order to further reduce the impact to aircraft wishing to transit over it. This is at the same altitude as the Glider Site navigation warning and will thus have a positive Human Factor impact in avoiding the publication of multiple altitudes for different purposes over the same area. The introduction of a DA at 3,200ft AMSL will have a negligible impact on both the environment and the majority of air users although it is noted that it will, when active, affect non-radio equipped aircraft and those wishing to utilise the railway line for VFR navigation at low level. It is concluded that:

- A DA such as Option 2 – Design 1 (Image 6.A) will not increase the funnelling effect between SPTA and Bristol CTR as it is able to limit any unnecessary encroachment to the North of Keevil.

- Option 2 – Design 2 (Image 6.B), as the most basic in design, is too simplistic and therefore inefficient as it extends too far North of the airfield into areas in which segregated airspace is not required. A circular design, similar to an offset ATZ will be an inefficient method of generating segregated airspace for the purpose of RPAS operations. As a result it will increase the funnelling effect to the North of Keevil compared to Option 2 Design 1 (Image 6.A).

2.3 Option 2 Design 1 (Image 6.A) is the preferred option to be retained.

2.4 Option 2 Design 2 (Image 6.B) is an inefficient design and increases the likelihood of funnelling to the North of Keevil and will therefore not be retained

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Option 3 - Danger Area (multi-sector design)

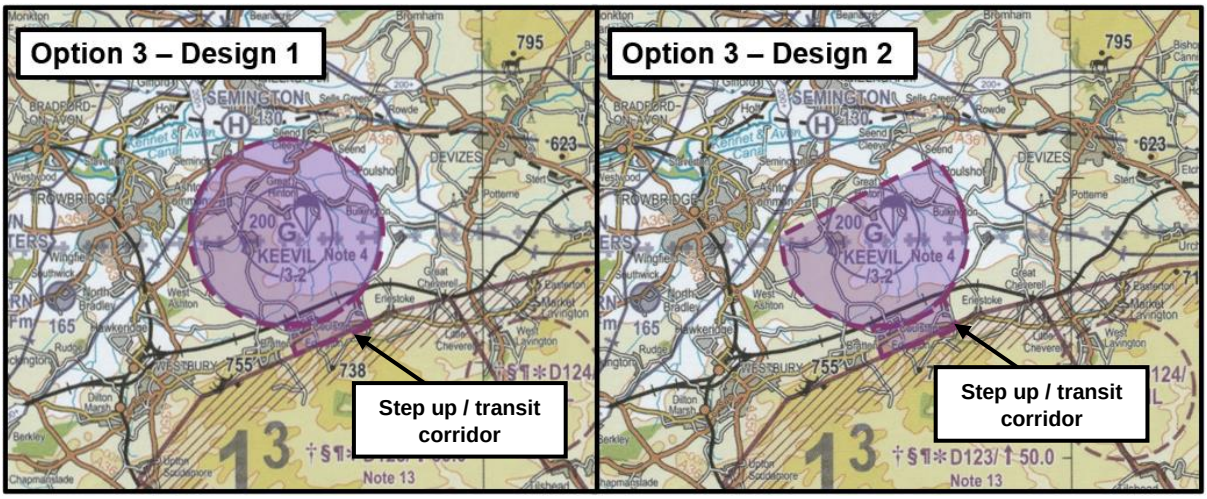

Image 7.A – Multi-Sector Design – Circular Image 7.B – Multi-Sector Design – Semi-Circular
Source: CAA 1:250k Aeronautical Chart, Sheet 7

Note: The multi-sector design consists of several structures (the corridor is "hanging airspace" not connected to the surface).

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

It is concluded that the activation of this Danger Area shape will result in:

A Danger Area with a Multi-Sector design allows for the DA to be created on the Drop-Zone, allowing for a level of familiarity to Stakeholders by using the dimensions of an existing structure. An additional DA connecting the circular DA with SPTA, serving as a hanging airspace Transit Corridor, will allow RPAS transit into SPTA. Aircraft electing to climb over a Danger Areas when they are active will create less noise impact that those currently routing at lower altitudes through or around the area when the DA is not active. The types of aircraft will not differ from those in the Option 0 'do nothing' scenario.

ADS-B flight trace data demonstrates that due to the existing airspace structures over Keevil, the majority of aircraft already elect to avoid the glider site / DZ, with very few choosing to route directly overhead. A lesser amount route through the gap between the glider site and SPTA D123 following the railway line for navigation. It is assessed that should the DA be activated with the DAs, aircraft will either continue to route North of the Drop Zone or elect to climb above thereby causing no change to noise impact on communities compared with the 'do nothing' option. A lesser amount may attempt to cross underneath the newly created hanging airspace DA connecting the circular DA with SPTA. These aircraft will be forced to fly lower in a very condensed area, causing an increase in noise in those areas.

It is therefore assessed that a Multi-Sector Danger Area will lead to:

- No change in the level of noise compared with the 'do nothing' option.
- No change in noise patterns for aircraft on a direct track using a Crossing Service.
- A decrease in noise for aircraft choosing to climb to transit over the activated airspace.
- A slight increase in noise due to lower flying aircraft following the railway line in between the DZ and SPTA.

Group	Impact	Level of Analysis
Communities	Air quality	Qualitative

Evidence
The Sponsor has concluded that a Danger Area around Keevil will not result in an increase of CO2 emissions. It is assessed that there is no additional impact on air quality compared to when the existing DZ or glider site is activated. Due to more definitive flight planning possible compared to the current situation (due to certainty of the DA over a glider site or note on VFR charts), pilots should be better able to plan their routing either around or over the airspace. This will allow a gradual climb to altitude over a greater distance, displacing the emissions over a larger area compared to initiating an orbital climb once at the boundary of the DA. ADS-B and SkyDemon data shows that aircraft approaching Keevil seeking to route overhead are already at the appropriate altitude for a transit therefore air quality will remain unchanged. Aircraft expecting to navigate following the railway track may choose to route to the North resulting in additional flight time and a slight increase of CO2 emissions compared with the 'do nothing' option. See Ref. D for further analysis.

Group	Impact	Level of Analysis
Wider society	Greenhouse gas impact	Qualitative
Evidence		
No additional greenhouse gas emissions would arise compared to when the current DZ is activated. It is expected that if more aircraft choose to route through the airspace rather than around it will result in a minor reduction in aircraft emissions. Aircraft expecting to navigate following the railway track may choose to route to the North resulting in additional flight time and a slight increase of CO2 emissions compared with the 'do nothing' option. See Ref. D for further analysis. WebTAG could not provide any quantifiable data due to the unknown amount and type of aircraft transiting the area. Further rationale for a qualitative analysis can be found at Ref. D		

Group	Impact	Level of Analysis
Wider society	Capacity / resilience	Qualitative
Evidence		
The Sponsor assessed that there may be some reduction in traffic North of Keevil and a resultant increase to the current use of the Keevil airspace by those pilots who are currently avoiding the overhead due to Note 4 in the VFR (Sheet 7 Ed 13) chart or possible glider activity. Since a crossing service can be afforded for the majority of GA, transiting pilots who normally route around Keevil may now choose to cross through the overhead using a crossing service, slightly reducing their route length, fuel consumption and aircraft congestion North of Keevil.		

Group	Impact	Level of Analysis
General Aviation	Access	Qualitative
Evidence		

ADS-B traces and Sky Demon data demonstrate that GA are largely already routing around the Keevil area due to the possibility of gliding activity and Note 4 in VFR charts (Sheet 7 Ed 13) advising aircraft to avoid Keevil at all times. ADS-B traces also suggest that a lesser number of pilots are routing via the railway line between the airfield and D123. Even fewer pilots are choosing to route overhead, particularly below 4,000ft.

A Danger Area activated by NOTAM when required will see GA access limited only during periods when RPAS are operating when a DACS is unavailable or air users are unable to obtain a crossing service. When a DACS is afforded there may be an increase in aircraft opting to route through the Keevil overhead. Additionally, when not active aircraft may choose to route overhead whilst currently air users are advised to avoid.

The key difference between options 2 and 3 is the aim to facilitate VFR navigation using the railway line between D123 and Keevil. It is assessed that:

- Only a small amount of air users utilise the railway line to navigate the gap between SPTA and Keevil as demonstrated by the heatmaps and ADS-B data.
- There is scope to develop procedures for low-flying military helicopters to continue to utilise the low flying routes.
- 'Hanging Airspace' could create a very small transit gap that may increase the risk of MAC or airspace infringements if aircraft are forced into a small gap, intensified by the fact that some may not be operating radios or electronic conspicuity.

Group	Impact	Level of Analysis
General Aviation / Commercial Airlines	Economic impact from increased effective capacity	Qualitative
Evidence		
There are no changes to air transport or passenger numbers brought on by this proposal. The altitude and location of the proposed airspace does not impact on any airline activity.		

Group	Impact	Level of Analysis
General Aviation / Commercial Airlines	Fuel Burn	Qualitative
Evidence		
Air user flight data indicates that GA are largely already routing around Keevil or climbing above. Additionally, any climb that would be required as a result of the DA being activated is inconsequential in fuel burn. For aircraft already routing between D123 and Keevil there will likely be no additional fuel burn should this Design Option be able to facilitate continued access. There is no identified impact on commercial airlines.		

Group	Impact	Level of Analysis
Commercial Airlines	Training Costs	N/A
Evidence		
It is assessed that there will be no impact on commercial airline training costs as a result of this design option. The same training costs associated with obtaining a FRTOL (as per Option 2) will be required if access to the airspace by currently untrained radio operators is desired.		

Group	Impact	Level of Analysis
Commercial Airlines	Other Costs	N/A
Evidence		
It is assessed that there will be no additional costs to commercial airlines as a result of this design option.		

Group	Impact	Level of Analysis

Airport / Air Navigation Service Provider	Infrastructure Costs	N/A
Evidence		
There are no additional infrastructure costs for airports or ANSPs associated with this option.		
Group	**Impact**	**Level of Analysis**
Airport / Air Navigation Service Provider	Operational Costs	N/A
Evidence		
There are no additional operational costs for airports or ANSPs associated with this option.		
Group	**Impact**	**Level of Analysis**
Airport / Air Navigation Service Provider	Deployment Costs	N/A
Evidence		
There are no deployment costs for airports or ANSPs associated with this option.		

Summary of Option 3 Full Appraisal

2.5 It can be concluded that, as with Option 2, this Danger Area option will have a negligible environmental impact compared with the 'do nothing' option.

2.6 Whilst Options 3 is not the simplest DA option, it was considered in order to attempt to continue to provide aircraft the opportunity to transit in the gap between the airfield and the SPTA boundary. It is assessed that this will only benefit a small number of air users and may increase both the risk of airprox, mid-air collision as well as airspace infringements due to the "Hanging Airspace Danger Area" connecting the Circular DA with Salisbury Plain.

2.7 Additionally, as both airspace structures would be required to be activate at the same time in order to facilitate RPAS transit to and from Salisbury Plain, it results in additional administrative and operational considerations to ATC and pilots requesting access.

2.8 Due to the additional risk of MAC and airspace infringement, as well as the limited benefit for the majority of air users, Option 3 has been discounted.

Section 3

Conclusion and Next Steps

Summary and Preferred Option

3.1 Option 2 Design 1 (a Danger Area of a simple multi-point design) is the preferred option and has been retained. Following consultation and flight simulations, the altitude has further been reduced to 3,200ft AMSL and is the same as the Glider Site navigation warning. It is assessed that it will have a negligible impact on the majority of air users and guarantees regulatory compliance for BVLOS operations.

3.2 Option 2 Design 2 has been discounted due to inefficient use of airspace.

3.3 Option 3 has been discounted due to the introduction of additional risks of mid-air collision and airspace infringements for only a marginal benefit to a minority of air users.

Specific Challenges Identified

3.3 **HEMS.** The area is regularly utilised by the Wiltshire Air Ambulance. During consultation, other emergency services have indicated that they may require access to the DA at short notice. As a result, a Letter of Agreement- similar to that agreed during the Temporary Danger Area of Spring 2021- will be required in order to ensure access to HEMS regardless of the airspace status. This is to includes establishing robust communications between Keevil Ops and the Emergency Services, specifically Wiltshire Air Ambulance and creating procedural deconfliction measures.

3.4 **Local Clubs and Private Air Strips.** Letters of Agreement stipulating arrival, departure and operating procedures inside agreed areas of the DA to minimise the impact to their operations will be created between the MOD, SPTA, Avon Hang Gliding and Paragliding Club and Eddington Farm strip.

ACP Timeline

3.5 The Sponsor will submit all Stage 4 documentation to the CAA by Wednesday 2nd November.

3.6 All documentation will be made available on the Portal for Stage 5, pending the DECIDE gateway, currently scheduled for 24th February 2023.

Annex A to
Stage 4 –
Final Options Appraisal

SkyDemon Users Aircraft Heat Map – 2018 to 2020*

Redacted on request from SkyDemon – Original document provided to the CAA.

Annex B to
Stage 4 –
Final Options Appraisal

RPAS Circuit and Noise Abatement Transit Routes

Redacted due to Official Sensitive information – Original document provided to the CAA.