GENERAL AVIATION AIRFIELDS STUDY

Resilience Tests

Department for Transport

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Contents

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1. GA Network Resilience Testing

Introduction

In this report, we set out an analysis of the resilience of the GA airfield network in the UK to change. The analysis is based on the categorisation of airfields developed in York Aviation's 2021 GA Airfields Study for the Department for Transport. The reason for undertaking this analysis is the continued closure pressure on GA airfields stemming from the general poor financial viability in the sector and the potential value of airfield land for alternative uses, notably to meet housing demand. It should be recognised that the COVID-19 pandemic is likely to have worsened the financial position of GA airfields generally, and there may now be more 'at risk' than previously.

Approach to Resilience Testing

How is Resilience Defined?

The purpose of the analysis is to examine the airfield network's ability to provide access to GA services for the UK population. Hence, the measure that is considered is the proportion of the UK population that is deemed to be within a 'reasonable' distance of a GA airfield of a given category.

The definition of a reasonable distance is, of course, open to debate. However, in our 2018 research into the GA network, we consulted with stakeholders on what constituted a reasonable access time for GA services. The consensus answer to this was around one hour. Unfortunately, it is not practical to calculate the journey time from each Lower Super Output Area (LSOA) in the UK, the geographic area used to consider population, and each GA airfield given the number of both. Therefore, we have used a proxy of 35 miles as the approximate distance that can be travelled in one hour in the UK. Consultations undertaken with the GA community as part of the 2018 GA Strategic Network Study identified one hour as a reasonable travel time to access to GA services. This is, of course, not perfect but we believe provides a reasonable basis for analysis.

How is Resilience Tested?

The resilience of the network has been tested by removing airfields from the network to examine the extent to which this impacts on the proportion of the UK population that lives within a 'reasonable' distance of a GA airfield of a particular category. The airfields to be removed from the network have been selected in two ways:

- Randomly – a random number generator has been used to assign an identity code to each airfield in the database. The bottom 10%, 20%, 30%, 40% and 50% of the random numbers generated and assigned to airfields have then been excluded from the population coverage analysis. It should be noted that this analysis does, of course, mean that if the analysis were run again, the results would likely be different. However, we would not expect them to alter substantially;

- GAAC Airfields Under Threat List – the General Aviation Awareness Council (GAAC) periodically produces a list of airfields around the UK that are believed to be at risk of closure. This list has been used as an alternate basis for removing airfields from the population coverage analysis. It should be noted that this list is reviewed on a regular basis but that it does generally change substantially between iterations. The latest version of the list, accessed in January 2021, can be found at www.gaac.org.uk/wp-content/uploads/2021/01/AERODROMES-UPDATE-12JAN21.pdf.

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The analysis has been undertaken on a category-by-category basis. In other words, the analysis measures the proportion of the UK population within 35 miles of an airfield of a particular category. However, for Category 3 and 4 airports, we have allowed for some substitutability. If an area loses access to a Category 4 airfield, the model will see if there is a Category 3 or a Category 2 airfield available on the assumption that activity would be able to switch to a higher category airfield. Similarly, for a Category 3 airfield, the model will examine whether there is a Category 2 airfield available. Users are assumed only to 'trade up' between categories and not down. Category 1 airfields are not included as an option for other categories given that their focus is quite different on many occasions. As we have seen above, Category 1 airfields are considerably more focussed on Business Aviation activities and there have been instances in recent years of Category 1 airfields actively discouraging more leisure focussed, private flying. Hence, 'trading up' from other categories is assumed to be limited. Also, this process is only included within the analysis of a change in the network. It is not reflected in the base coverage. In other words, the base position purely reflects the coverage by the stated category or airfields. It is not until an airfield is lost that the database might seek to identify a higher category alternative. We have summarised these substitutability assumptions in Table 1.1.

Table 1.1: Summary of Airfield Substitutability Assumptions for Resilience Testing

		Category of Airfield Lost			
		Category 1	Category 2	Category 3	Category 4
Can this category act as a substitute for the lost airfield?	Category 1	Yes	No	No	No
	Category 2	No	Yes	Yes	Yes
	Category 3	No	No	Yes	Yes
	Category 4	No	No	No	Yes

It should be recognised that this is not a perfect solution to the problem of substitutability. It does not reflect particular specialisms at some airfields, and it does not consider capacity at alternate airfields. It also worth noting that commercial airports are not included within the analysis and these may act as substitutes for Category 1 airfields in some cases. Similarly, given the broad nature of the categorisation and the diversity of airfields even within categories, it might in some cases be possible for some higher category airfield users to 'trade down' to lower category airfields. This is not something that we have been able to systematically allow for within our analysis. On balance, and with these caveats in mind, we do, however, believe the analysis serves to provide a reasonable understanding of the flexibility in the network.

It is also important to note that the exercise we have undertaken is of a general nature to provide some indication of the strength of the network and its resilience. This does not and cannot substitute for a more detailed analysis should any individual airport be deemed at risk, using the criteria suggested in the *Aviation 2050 The Future of UK Aviation Consultation Document* (Page 154).

Geographic Scope of the Resilience Testing

The random resilience tests have been run at national level but also for each individual region of the UK. The regions examined correspond to the former government office regions. The primary assessment is at a national level as, ultimately, network resilience is a national issue. However, we have included the regional analysis in order to take account of the skewed distribution of GA airfields across the UK and the importance of ensuring that individual regions are adequately served.

There is a concentration of airfields in the Greater South East and density is considerably lower in other regions. This does, in part, reflect population concentration in the UK but equally it was felt to be important to consider potential differential effects across the UK. In essence, it was felt to be helpful to test the hypothesis that areas with a greater concentration of airfields might be better able to deal with the loss of some airfields than areas with a lower concentration.

This particular analysis also highlighted an additional factor that is worthy of consideration in considering the results. It highlighted a peculiarity in the modelling that if a region had a very small number of airfields, randomly deleting airfields tended to produce 'lumpy' results because the analysis became almost binary. In some regions, the initial loss of the bottom 10% might, in practice, remove considerably more than 10% because it is not possible to remove a fraction of an airfield. For instance, in a region with only two airfields in a category, removing the bottom 10% of random numeric identifiers is the same as removing the bottom 50%. This effect does, however, highlight the need to consider the size of the overall pool of airfields in a category as, if numbers are small, although the resilience test may not see a significant loss in population coverage, it may substantially increase vulnerability given the paucity of airfields in the first place. In other words, where there are limited numbers of airfields, the loss of one may not have much of an effect, but the loss of the next one may have a disproportionately large effect in comparison.

The regional analysis was only undertaken in relation to the random approach to removing airfields. The number of airfields on the GAAC 'at risk' list is not sufficient to effectively consider the impact on a region by region basis, as changes to the network are generally not large enough.

There is one final issue to be aware of in terms of the regional analysis. The resilience test does allow populations within a region to be served by airfields that are outside of that region. So it is possible for a region to have no airfields in a particular category but for its population to still have access to that category of airfields via those in other regions within a reasonable access time.

Results of Random Resilience Test Approach

Below, we have set out the results of the resilience testing using the random approach to removing airfields from the network. Results are presented for each category of airfield. As described above, the approach removes 10% of airfields through to 50% of airfields. For each category, we have set out the results in a table, which includes information on the base number of airfields.
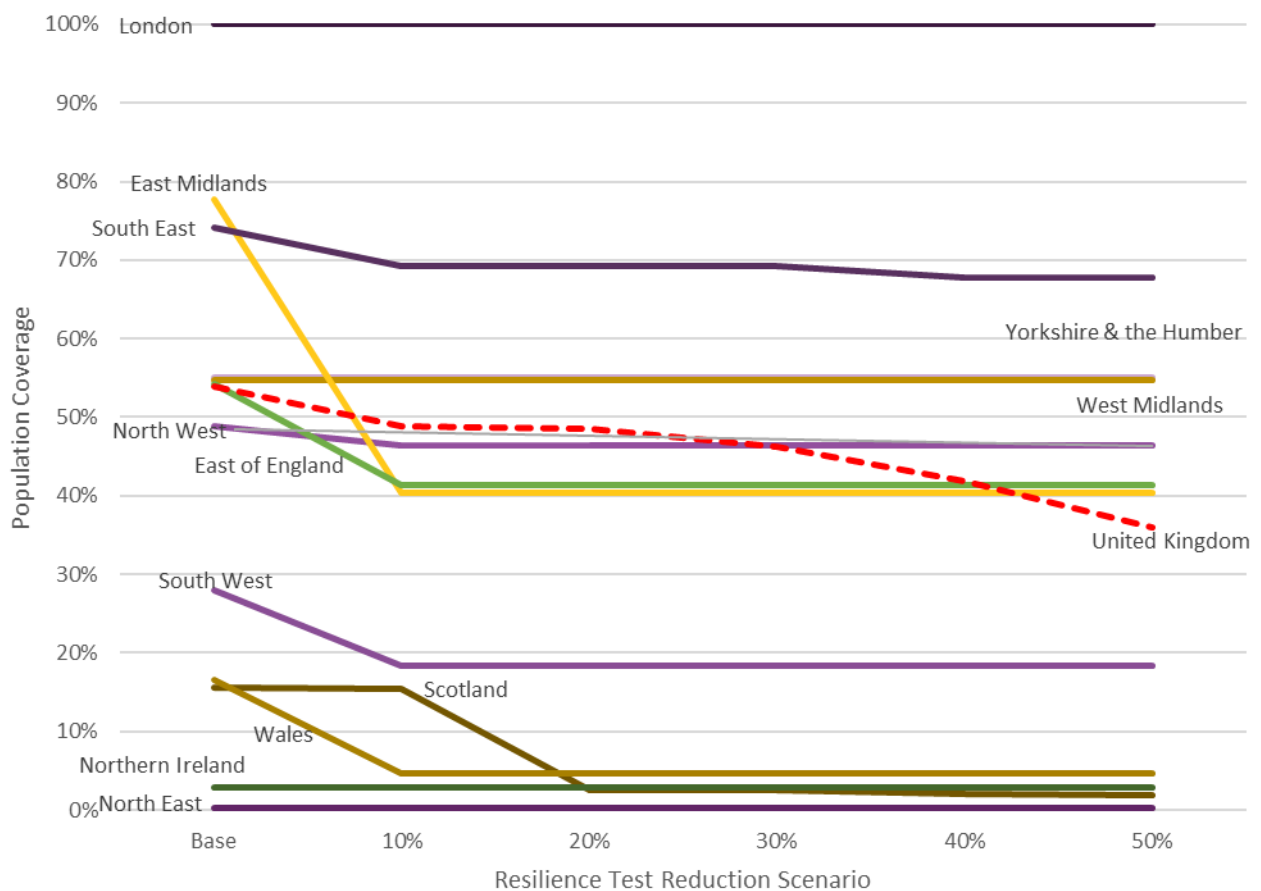
Category 1 Airfields Resilience Test

The results of the random resilience test approach for Category 1 airfields are shown in Table 1.2. It shows the percentage of the UK population within 35 miles of a Category 1 airfield at the different testing levels described above. These results are also summarised in Figure 1.1.

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Table 1.2: % of the UK Population within 35 miles of a Category 1 Airfield Resilience Test Results: (Random Approach)

Region	No. Airfields	Base	10%	20%	30%	40%	50%
North East	0	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
North West	2	48.8%	46.4%	46.4%	46.4%	46.4%	46.4%
Yorkshire & the Humber	1	55.1%	55.1%	55.1%	55.1%	55.1%	55.1%
West Midlands	1	54.7%	54.7%	54.7%	54.7%	54.7%	54.7%
East Midlands	2	77.8%	40.3%	40.3%	40.3%	40.3%	40.3%
East of England	2	54.2%	41.4%	41.4%	41.4%	41.4%	41.4%
London	1	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
South East	4	74.1%	69.2%	69.2%	69.2%	67.8%	67.8%
South West	2	27.9%	18.4%	18.4%	18.4%	18.4%	18.4%
Scotland	7	15.6%	15.5%	2.6%	2.6%	2.0%	1.9%
Wales	2	16.6%	4.6%	4.6%	4.6%	4.6%	4.6%
Northern Ireland	1	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%
United Kingdom	**25**	**53.9%**	**48.9%**	**48.6%**	**46.3%**	**41.9%**	**36.0%**

Figure 1.1: % of the UK Population within 35 miles of a Category 1 Airfield Resilience Test Results: (Random Approach)

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There are 25 Category 1 airfields around the UK and, currently, around 53.9% of the UK population is within 35 miles of such an airfield. This limited coverage is reflected in the resilience testing at national level, with a steady decline in coverage as airfields are removed from the analysis. If 50% of airfields were removed, then only 36% of the UK population would be within 35 miles of a Category 1 airfield. Given the importance of this group in driving the economic value of the sector, this level of decline would be a considerable concern.

From a regional perspective, the limited number of airfields in many regions hampers the effectiveness of the analysis, but as described above, this limited effect does mask that the limited number of such airfields means that there is a very real vulnerability in access from closures.

The largest share of Category 1 airfields, excluding Scotland, where the airfields in question are often in reality small commercial airports, is in the Greater South East (South East, London and the East of England). Within this area, resilience in the South East and London is undoubtedly better. For instance, coverage in the South East only drops from 74.1% to 67.8% even if 50% of airfields are removed. However, the initial decline with only 10% loss in airfields, is relatively large and, of concern.

In other regions, the loss of even one Category 1 airfield would be material in terms of its impact on the coverage of the population able to access the services provided by these airfields. In several areas, the North East, North West, South West, Scotland, Wales and Northern Ireland, the base level of coverage is poor, with less than 50% of the population in convenient reach of such airfields.
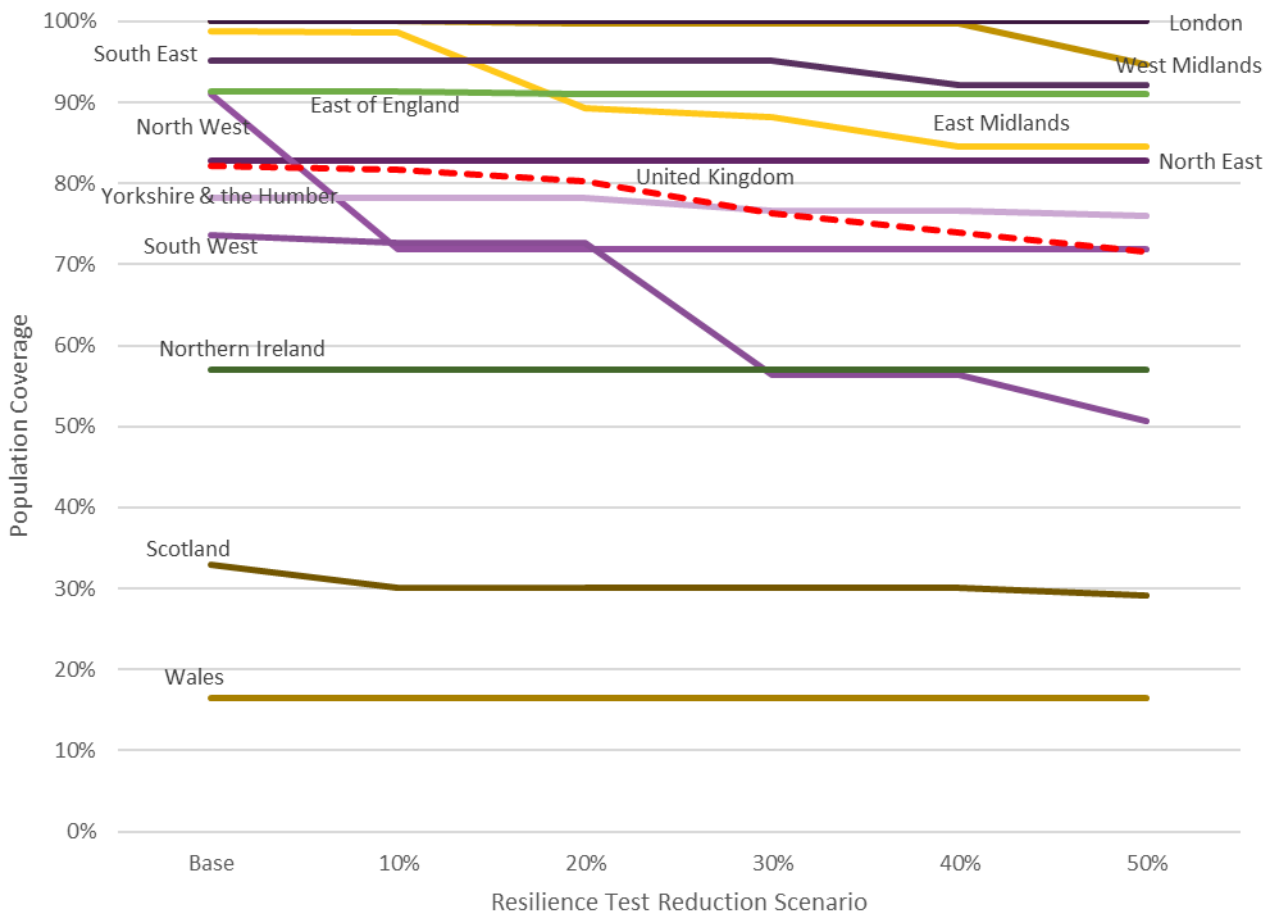
Category 2 Airfields Resilience Test

The results of the random resilience test approach for Category 2 airfields are shown Table 1.3. It shows the percentage of the UK population within 35 miles of a Category 2 airfield at the different testing levels described above. These results are also summarised in Figure 1.2.

Table 1.3: % of the UK Population within 35 miles of a Category 2 Airfield Resilience Test Results (Random Approach)

Region	No. Airfields	Base	10%	20%	30%	40%	50%
North East	1	82.8%	82.8%	82.8%	82.8%	82.8%	82.8%
North West	2	91.1%	71.9%	71.9%	71.9%	71.9%	71.9%
Yorkshire & the Humber	5	78.2%	78.2%	78.2%	76.7%	76.7%	76.0%
West Midlands	8	100.0%	100.0%	99.8%	99.8%	99.8%	94.7%
East Midlands	9	98.8%	98.7%	89.3%	88.2%	84.6%	84.6%
East of England	8	91.4%	91.4%	91.1%	91.1%	91.1%	91.1%
London	1	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
South East	14	95.1%	95.1%	95.1%	95.1%	92.1%	92.1%
South West	5	73.7%	72.6%	72.6%	56.3%	56.3%	50.6%
Scotland	3	33.0%	30.1%	30.1%	30.1%	30.1%	29.2%
Wales	0	16.5%	16.5%	16.5%	16.5%	16.5%	16.5%
Northern Ireland	1	57.0%	57.0%	57.0%	57.0%	57.0%	57.0%
United Kingdom	**57**	**82.2%**	**81.7%**	**80.2%**	**76.3%**	**73.9%**	**71.5%**

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Figure 1.2: % of the UK Population within 35 miles of a Category 2 Airfield Resilience Test Results (Random Approach)

Category 2 airfields are considerably more numerous, but there remain regions where coverage is very limited, for instance the North East, North West, South West and the devolved administrations.

At a national level, resilience is initially relatively strong, with only a limited effect on population coverage from a 20% decline in airfields. However, the effect does become more noticeable as the level of airfield losses increases. The category has, however, greater resilience than Category 1 at the national level

Again, the regional analysis highlights vulnerabilities in a number of regions, given the simple lack of airfields. However, in regions where there is a concentration of Category 2 airfields, resilience is generally strong. The South East, the East of England, the West Midlands and Yorkshire & the Humber all see relatively limited impacts even with relatively significant reductions in airfield numbers. The exceptions are the East Midlands and the South West, where population coverage does decline relatively rapidly.

Category 3 Airfields Resilience Test

The results of the random resilience test approach for Category 3 airfields are shown in Table 1.4. It shows the percentage of the UK population within 35 miles of a Category 3 airfield at the different testing levels described above. These results are also summarised in Figure 1.3.

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Table 1.4: % of the UK Population within 35 miles of a Category 3 Airfield Resilience Test Results (Random Approach)

Region	No. Airfields	Base	10%	20%	30%	40%	50%
North East	2	95.9%	95.2%	95.2%	95.2%	95.2%	95.2%
North West	5	81.5%	80.3%	80.3%	79.1%	79.1%	75.1%
Yorkshire & the Humber	5	65.3%	65.3%	65.3%	65.1%	65.1%	65.0%
West Midlands	2	83.6%	83.6%	83.6%	83.6%	83.6%	83.6%
East Midlands	8	86.4%	86.4%	86.4%	86.4%	86.4%	86.2%
East of England	20	100.0%	100.0%	97.0%	95.7%	95.7%	95.1%
London	0	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
South East	8	100.0%	100.0%	96.2%	96.2%	95.5%	93.5%
South West	8	74.5%	70.2%	66.4%	57.9%	57.9%	54.4%
Scotland	8	82.9%	79.2%	78.5%	45.2%	45.2%	43.6%
Wales	2	51.4%	45.4%	45.4%	45.4%	45.4%	45.4%
Northern Ireland	1	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
United Kingdom	**69**	**84.7%**	**83.2%**	**82.6%**	**80.5%**	**80.0%**	**75.1%**

Figure 1.3: % of the UK Population within 35 miles of a Category 3 Airfield Resilience Test Results (Random Approach)

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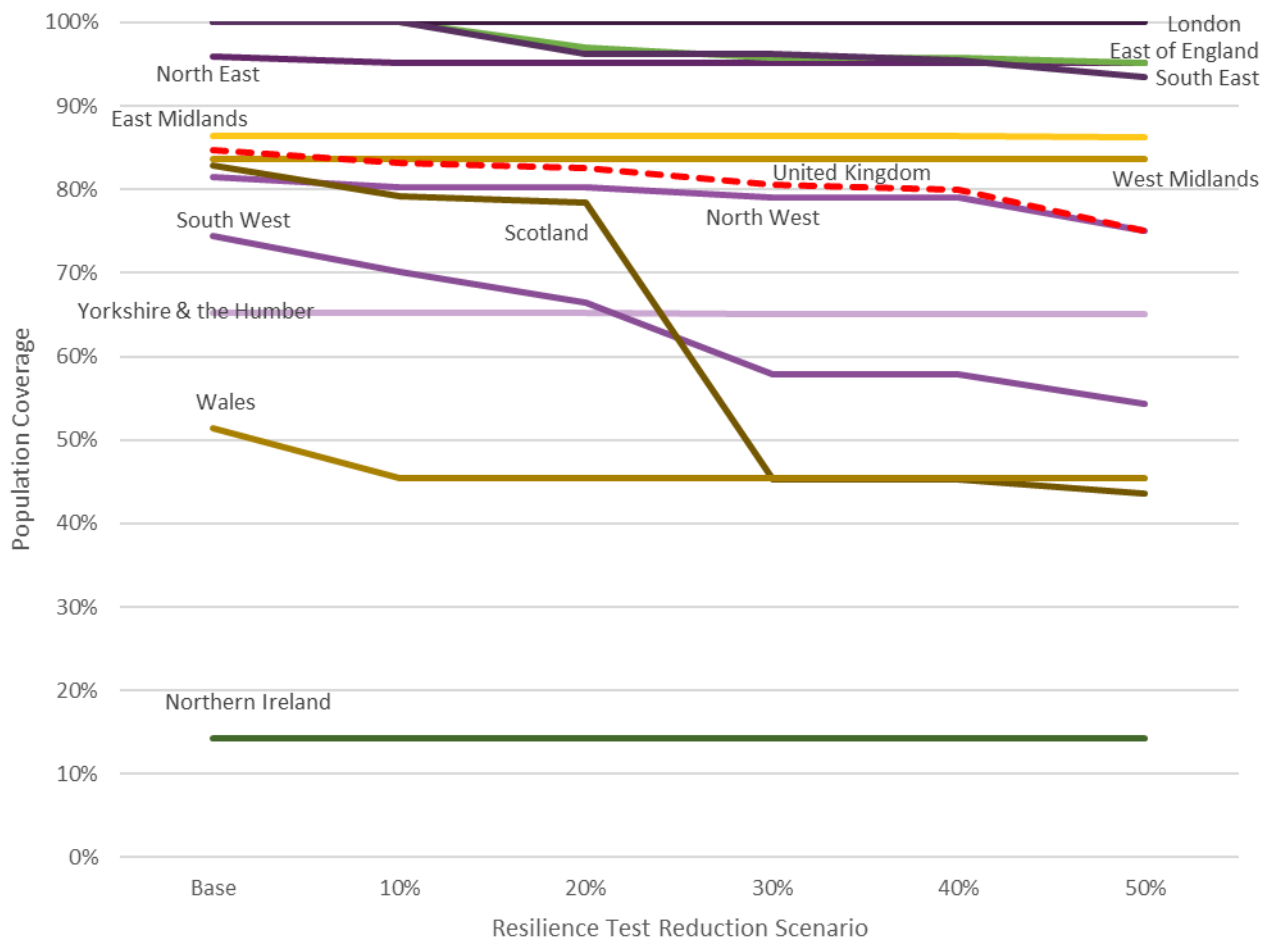
Category 3 airfields are, again, relatively numerous and most regions have at least 2 such airfields, the exceptions being London and Northern Ireland. Overall, population coverage is generally strong. At a UK level, 84.8% of the population are within 35 miles of such an airfield. This is in itself helps to articulate the important role that this category of airfields plays in providing connectivity coverage for GA services.

At a national level, resilience is relatively strong, with a limited impact on coverage until 50% of airfields are removed from the database. Even with 50% of the airfields removed, 75.1% of the population remain within 35 miles of a Category 3 airfield. It should be remembered that this may be affected to some degree by 'trading up' to Category 2 airfields.

At a regional level, the picture is mixed. In most regions with a significant number of Category 3 airfields, resilience is generally strong, for instance in Yorkshire & the Humber, the East Midlands, the East of England and the South East. There are, however, exceptions. The South West and Scotland both see significant declines in accessibility as airfields are removed. This likely reflects the distribution of airfields and population density in these areas.

Category 4 Airfields Resilience Test

The results of the random resilience test approach for Category 4 airfields are shown in Table 1.5. It shows the percentage of the UK population within 35 miles of a Category 4 airfield at the different testing levels described above. These results are also summarised in Figure 1.4.

Table 1.5: % of the UK Population within 35 miles of a Category 4 Airfield Resilience Test Results (Random Approach)

Region	No. Airfields	Base	10%	20%	30%	40%	50%
North East	4	99.8%	99.8%	99.8%	99.8%	99.3%	99.3%
North West	9	99.0%	99.0%	99.0%	99.0%	99.0%	98.7%
Yorkshire & the Humber	17	99.9%	99.9%	99.9%	99.9%	99.7%	99.7%
West Midlands	18	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
East Midlands	30	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
East of England	38	100.0%	100.0%	98.3%	98.3%	98.3%	98.3%
London	2	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
South East	32	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
South West	35	100.0%	100.0%	100.0%	100.0%	100.0%	92.5%
Scotland	42	64.5%	64.3%	64.3%	63.5%	63.4%	61.7%
Wales	11	96.3%	92.5%	92.3%	92.2%	87.4%	87.4%
Northern Ireland	5	60.6%	60.5%	60.5%	57.6%	57.6%	53.3%
United Kingdom	**243**	**95.9%**	**95.9%**	**95.8%**	**95.1%**	**94.8%**	**94.5%**

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Figure 1.4: % of the UK Population within 35 miles of a Category 4 Airfield Resilience Test Results (Random Approach)
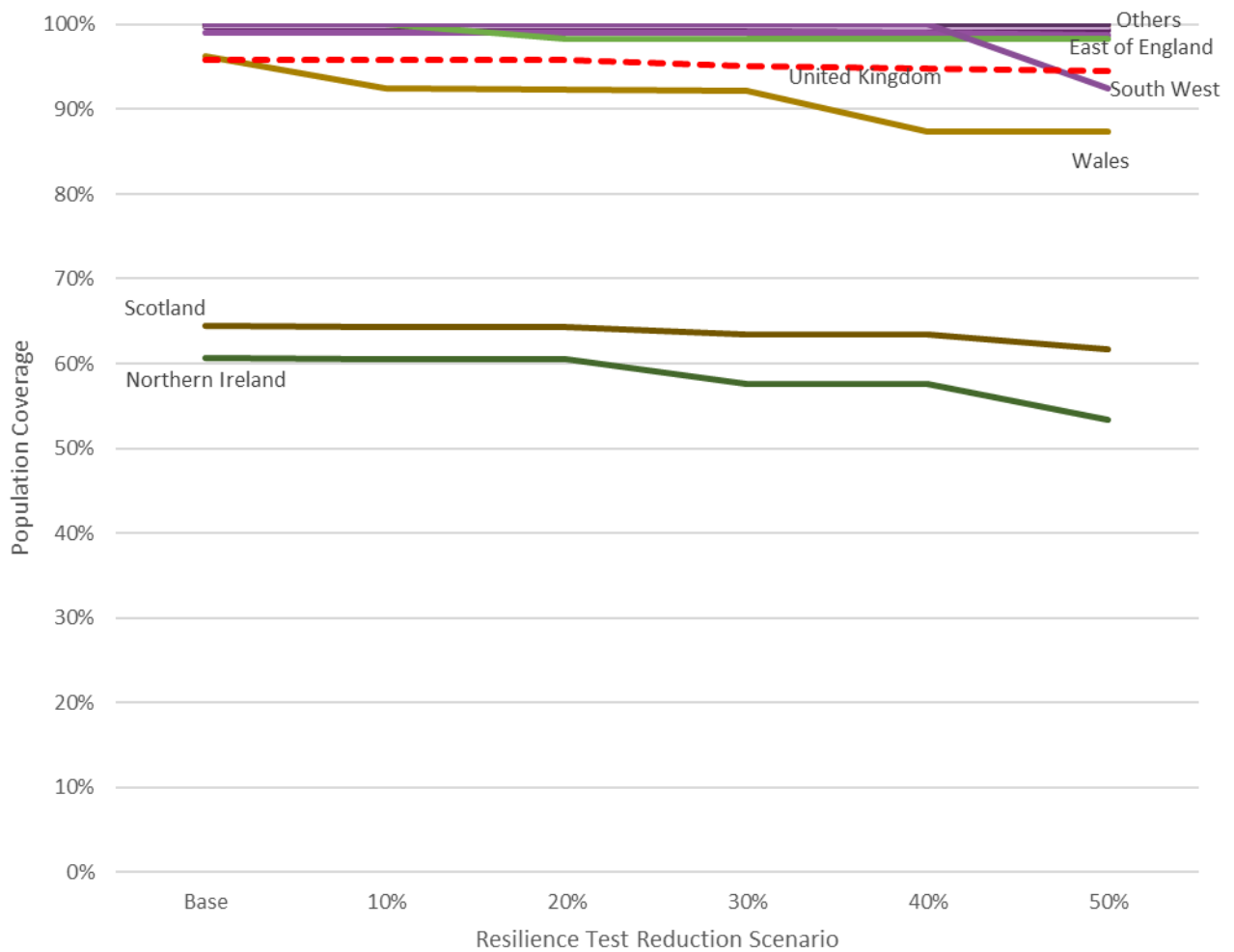
Category 4 airfields are by far the most numerous in the UK, with over 240 of them in the database. This is reflected in the general level of coverage of the UK population, around 95.9%, which is substantially higher than any other category. As with Category 3 airfields, this helps to articulate the value of these airfields in supporting GA connectivity around the UK. At a national level, the impact of removing airfields from the database is very limited, even with 50% of airfields removed. Again, it should be remembered, this resilience may be being supported to some degree of 'trading up'.

In general, regional resilience in this category is very strong. The only areas where there are notable effects are Wales and Northern Ireland but, even in these instances, the effects are limited.

Results of GAAC At Risk List Resilience Test Approach

In this section, we set out the impact of removing the airfields on the GAAC 'At Risk' Airfields list from the database on UK population coverage. The version of the list used here was published in January 2021. As described above, this analysis is undertaken at the national level.

The list currently contains 26 airfields (not including MoD airfields that are not included within the analysis). The breakdown of these across the categories is shown in Figure 1.5. This shows that around 10% of the list are Category 1 airfields, 26% Category 2, 22% Category 3 and 43% Category 4. This suggests that categories 1 to 3 are over-represented in the 'At Risk' list compared to the overall make up of airfields across the UK.
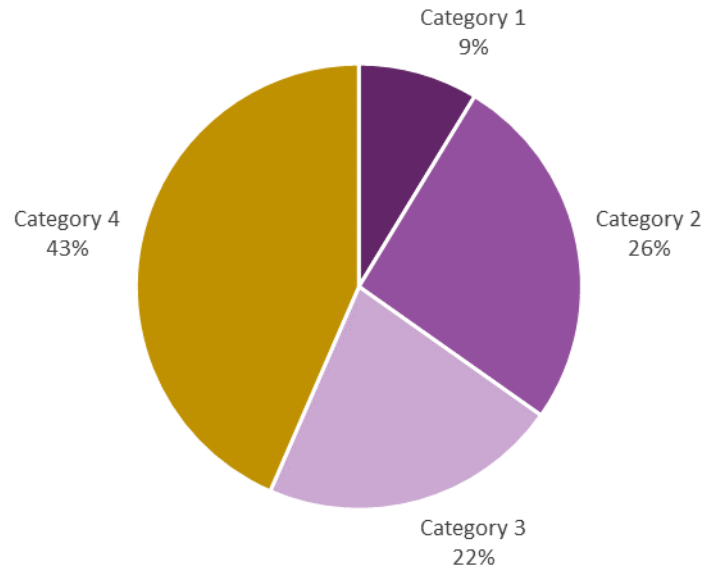
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Figure 1.5: GAAC 'At Risk' Airfields by Category

Table 1.6 shows the results of this resilience testing based on the GAAC 'At Risk' list.

Table 1.6: Airfield Network Resilience Results: % of the UK Population within 35 miles of an Airfield in each Category (GAAC 'At Risk' List Approach)

	Base Coverage	GAAC At Risk' List Removed
Category 1	53.5%	49.0%
Category 2	82.2%	81.8%
Category 3	84.8%	84.8%
Category 4	95.9%	95.9%

This resilience test suggests that for the majority of airfield categories, the threat to the resilience of the network from known airfields at risk is limited. For Category 3 and 4, there is no effect on population coverage, and for Category 2, the effect is very limited. For Category 1 airfields, the threat is more significant but still relatively limited. However, given the importance of this category in driving economic value, it is, however, worth noting that the network's resilience is less strong here. This means that losses in this category are likely have disproportionate effect on the GA's ability to support economic value in the UK, as it is likely to impact on Business Aviation users in particular.

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Conclusions

The airfield network resilience testing reveals a number of interesting points. It demonstrates that, in the main, the GA airfield network is relatively resilient but there are vulnerabilities. The concentration of airfields in the Midlands and in the Greater South East means that these regions are generally resilient, but elsewhere the relative scarcity of airfields means that the same is not true. It is also noticeable that resilience is generally poorer in Category 1 and to some extent Category 2. This may be partly driven by the lack of an ability to 'trade up' in these categories, but it is also likely to be in large part because there are simply fewer of them. Given the importance of Category 1 airfields, in particular, in driving economic value, this greater vulnerability should be noted in terms of ensuring that the economic contribution of the sector is maintained.

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