Airspace Change SAIP AD6

Step 2B Technical Appendix

Additional information for the Initial Options Appraisal

NATS

London Luton Airport

Analysis performed by Noise Consultants Ltd on behalf of Trax International Ltd

Introduction

This is a technical appendix containing analysis and estimates.
It is presented as a supplementary source of data for a reader interested in the metrics and estimates quoted in the main Step 2B document.

Also note these are illustrative transitions and vectoring areas, subject to change or refinement.

Population counts are based on the CACI 2018 dataset and assume an elevation angle of 48.5° from the horizontal, taking this wider definition of overflight from CAA document CAP1498.

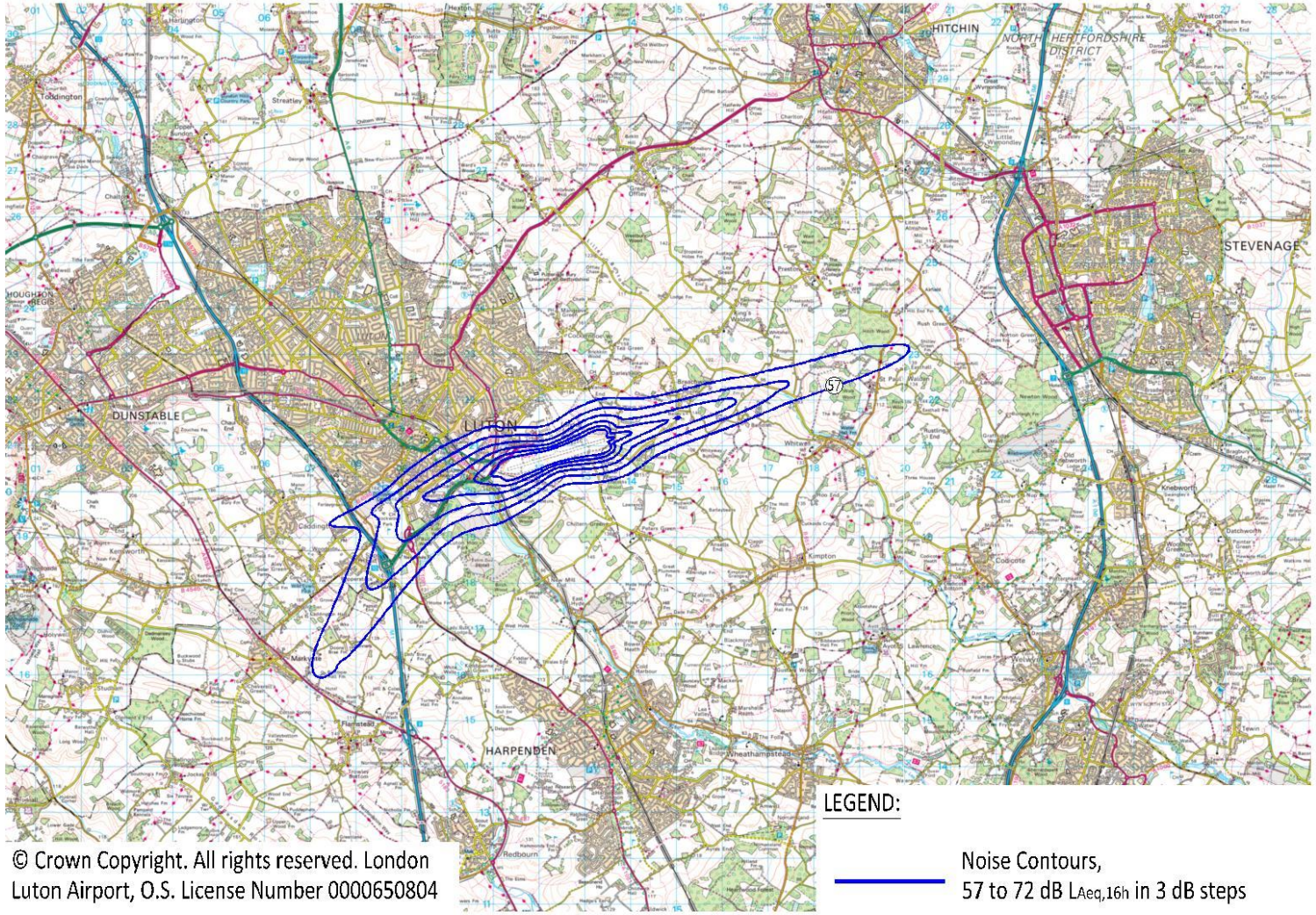
This analysis was performed by Noise Consultants Ltd on behalf of Trax International, LLA's consultant on airspace change matters.

Later in this appendix, we show how we estimated the fuel, CO_2 and costs per flight. These estimates were performed by NATS airspace change staff.

Do nothing

Options 2.1, 2.2

Current noise contours 2018 Summer Actual Day time (LAeq 16h day)

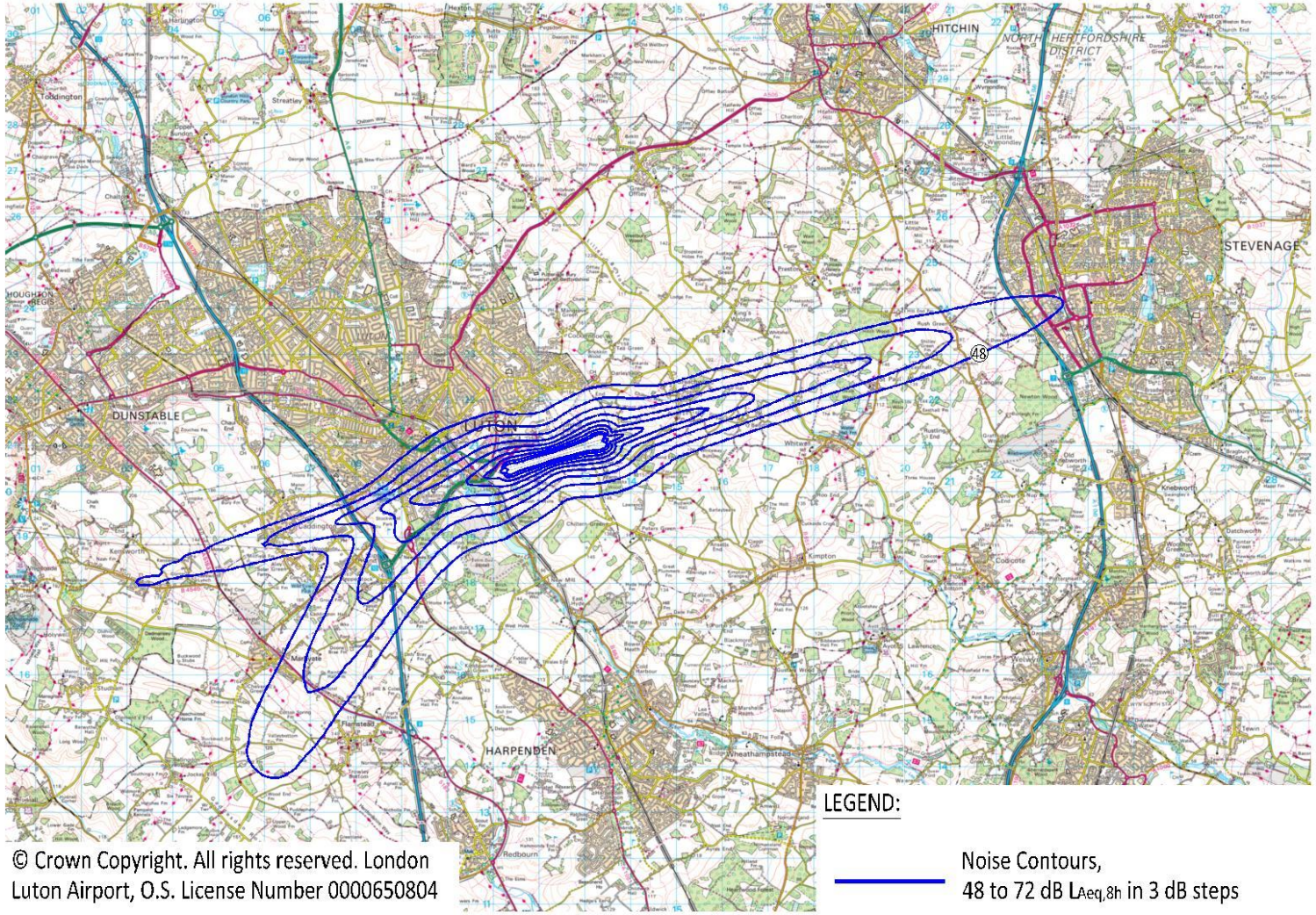


LEGEND:

Noise Contours, 57 to 72 dB $L_{Aeq,16h}$ in 3 dB steps

2.1, 2.2

Current noise contours 2018 Summer Actual Night time (LAeq 8h night)

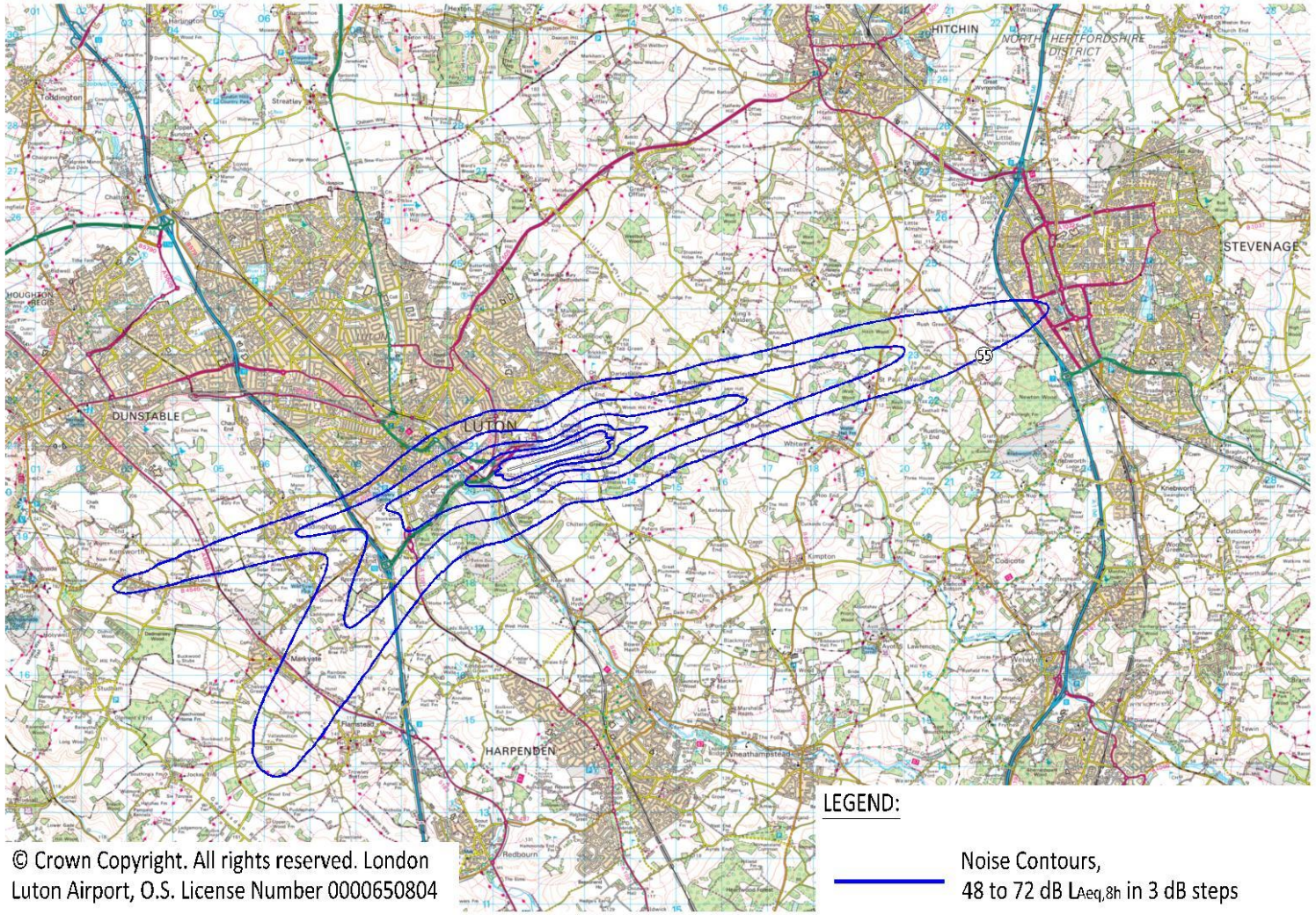


LEGEND:

Noise Contours, 48 to 72 dB $L_{Aeq,8h}$ in 3 dB steps

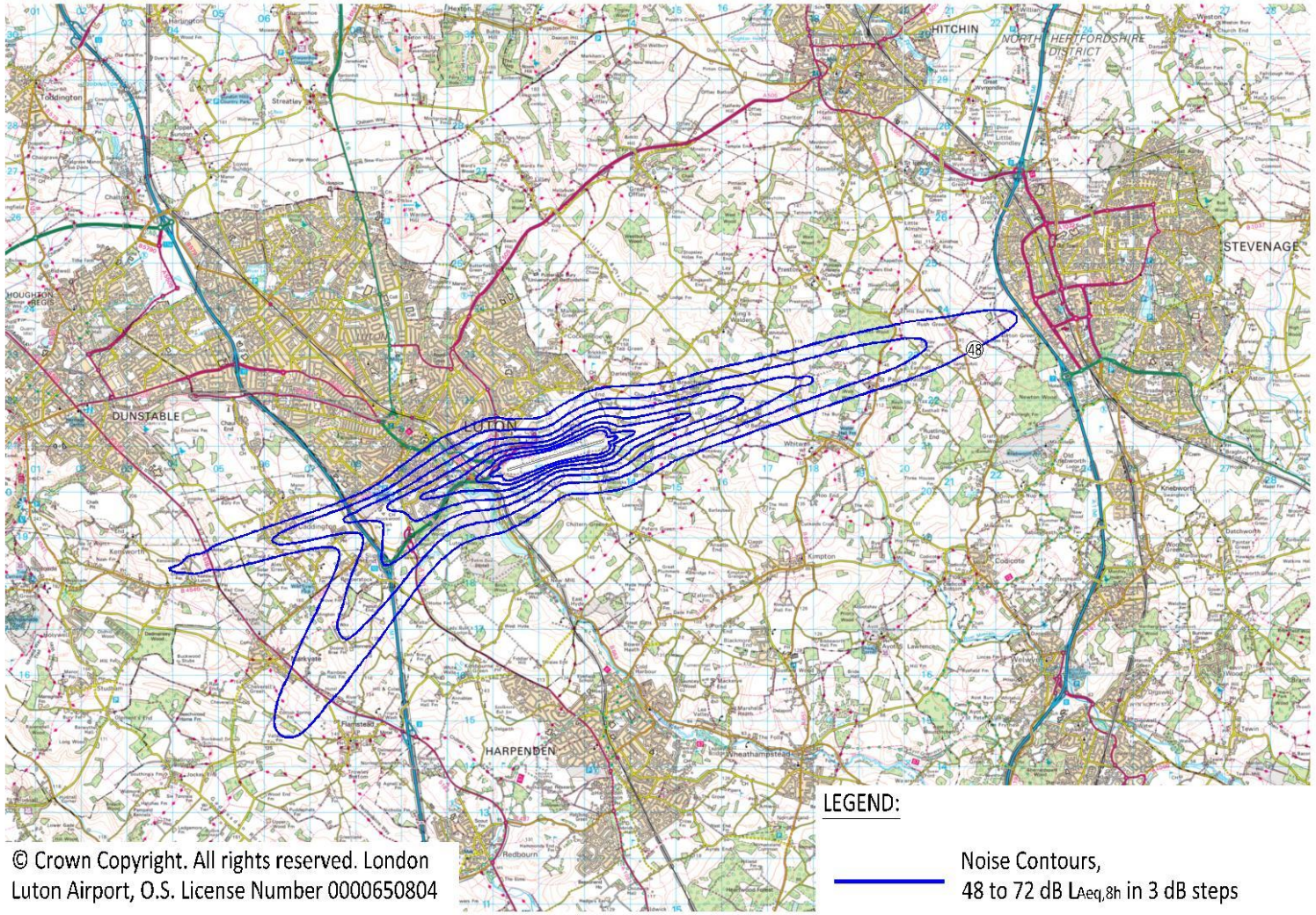
2.1, 2.2

Current noise contours 2018 Annual Lden



2.1, 2.2

Current noise contours 2018 Annual Lnight

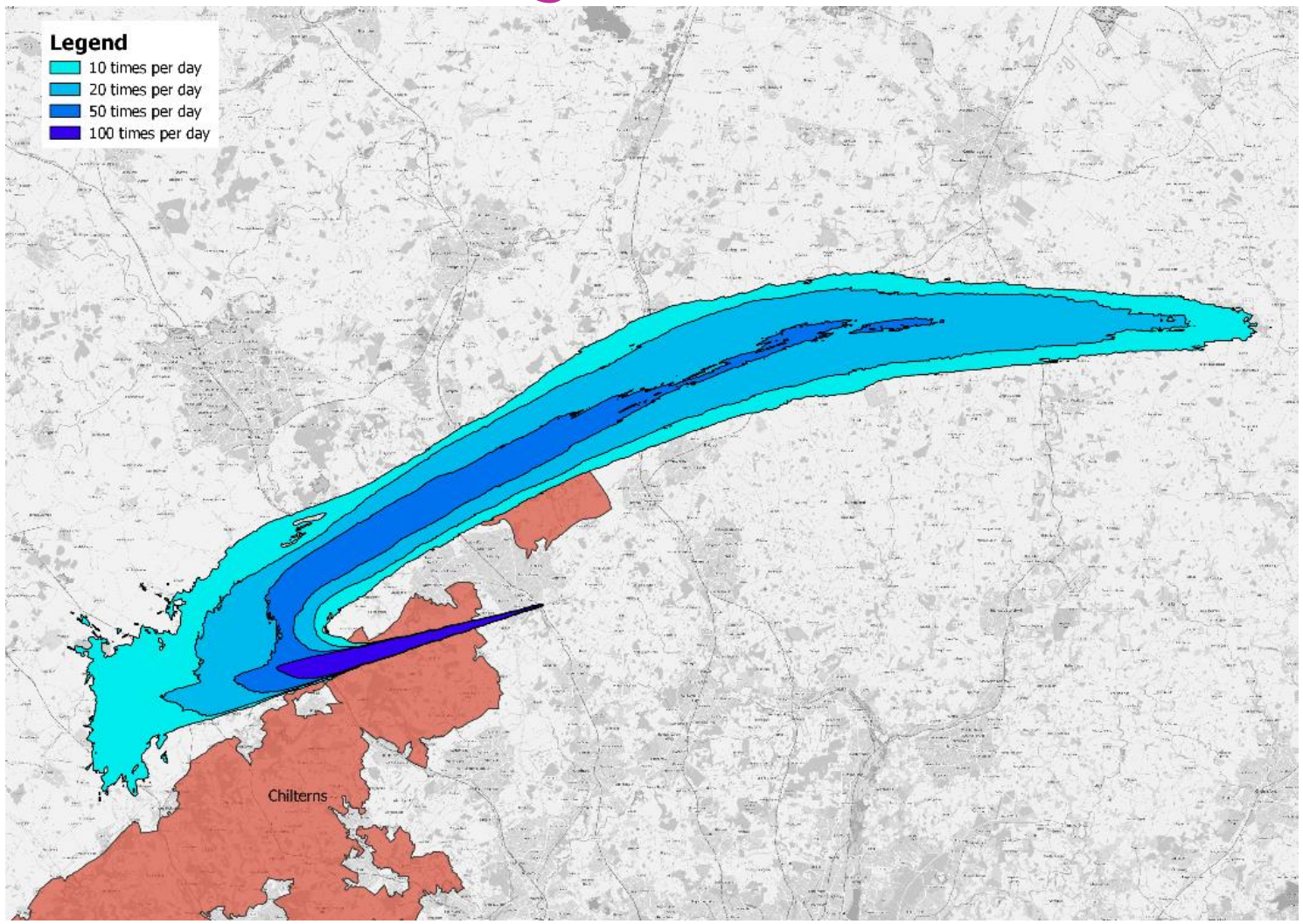


LEGEND:

Noise Contours,
48 to 72 dB $L_{Aeq,8h}$ in 3 dB steps

2.1, 2.2

Current overflight contours Easterly arrivals, 0-7000ft



Times per day	Number of people currently overflown
10	288000
20	186400
50	47700
100	7950

2.1

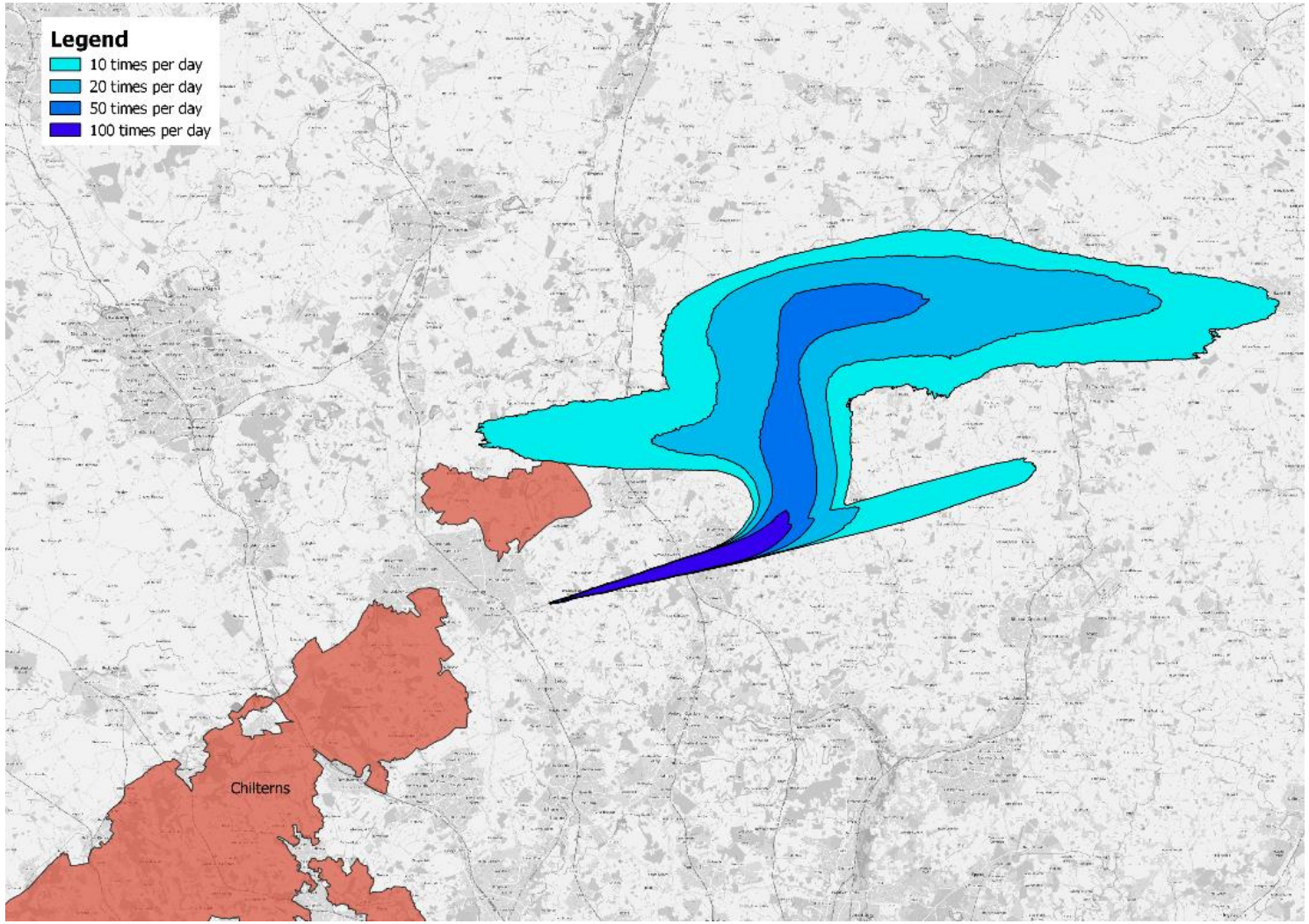
Schools, hospitals, places of worship and registered historic parks and gardens within the current overflight contours

Easterly arrivals, 0-4000ft

Times per day	Schools	Places of worship	Hospitals	Parks
10	5	8	0	2
20	4	8	0	2
50	3	6	0	1
100	3	5	0	1

2.1

Current overflight contours Westerly arrivals, 0-7000ft

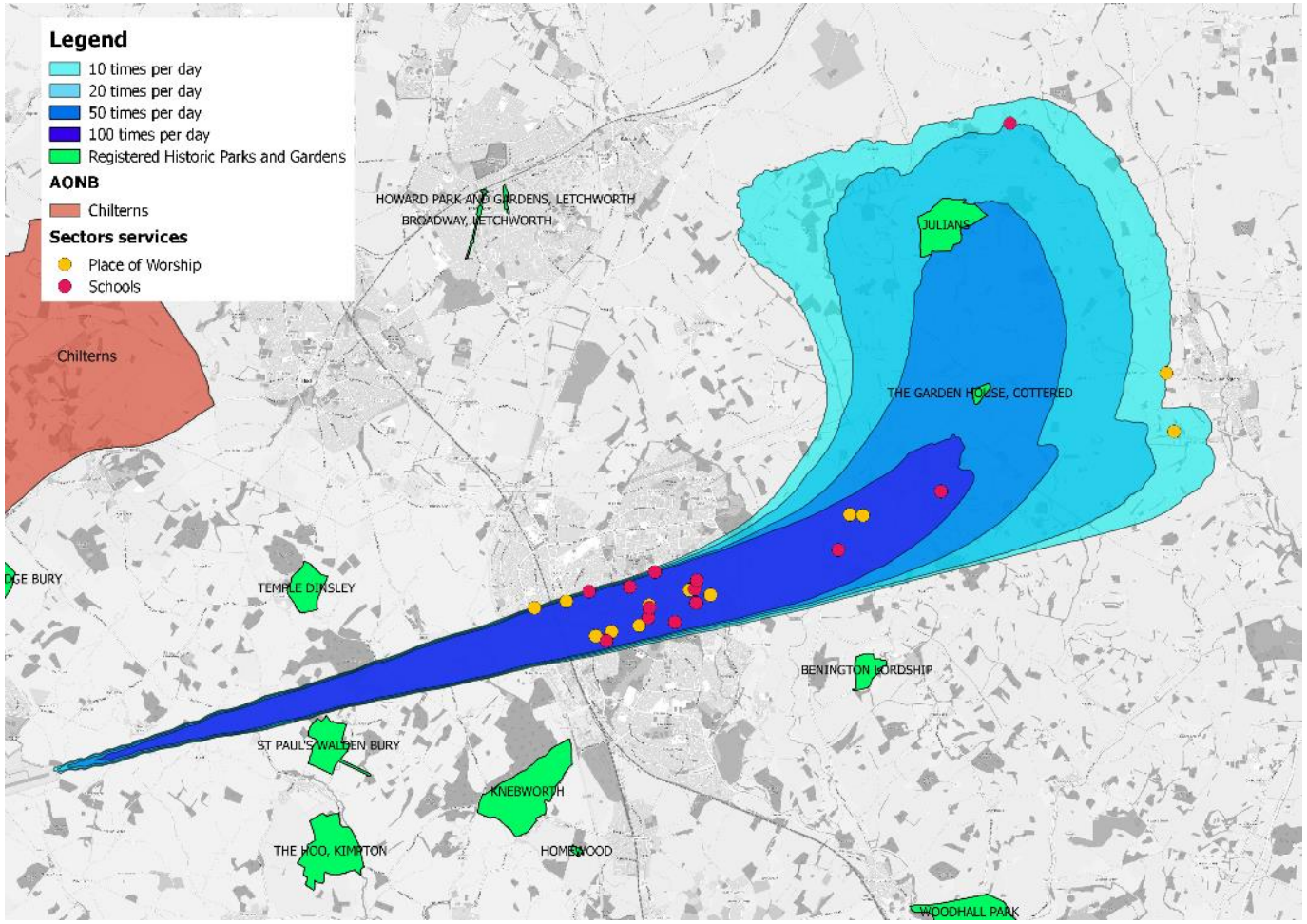


Times per day	Number of people currently overflown
10	162900
20	88700
50	34600
100	23300

2.2

Schools, hospitals, places of worship and registered historic parks and gardens within the current overflight contours

Westerly arrivals, 0-4000ft



Times per day	Schools	Places of worship	Hospitals	Parks
10	13	12	0	2
20	12	10	0	2
50	11	9	0	2
100	10	9	0	0

2.2

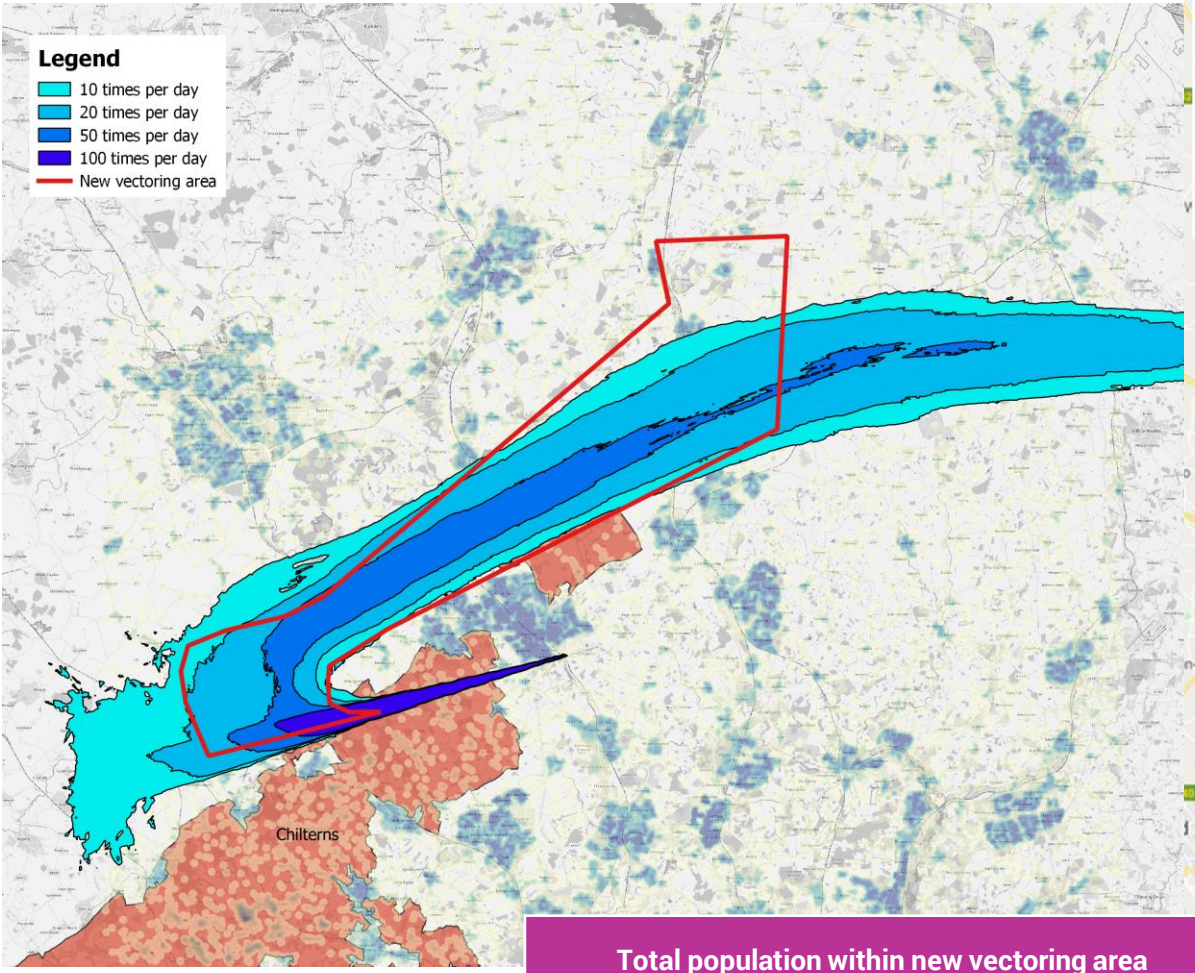
Vectors from new delay absorption area

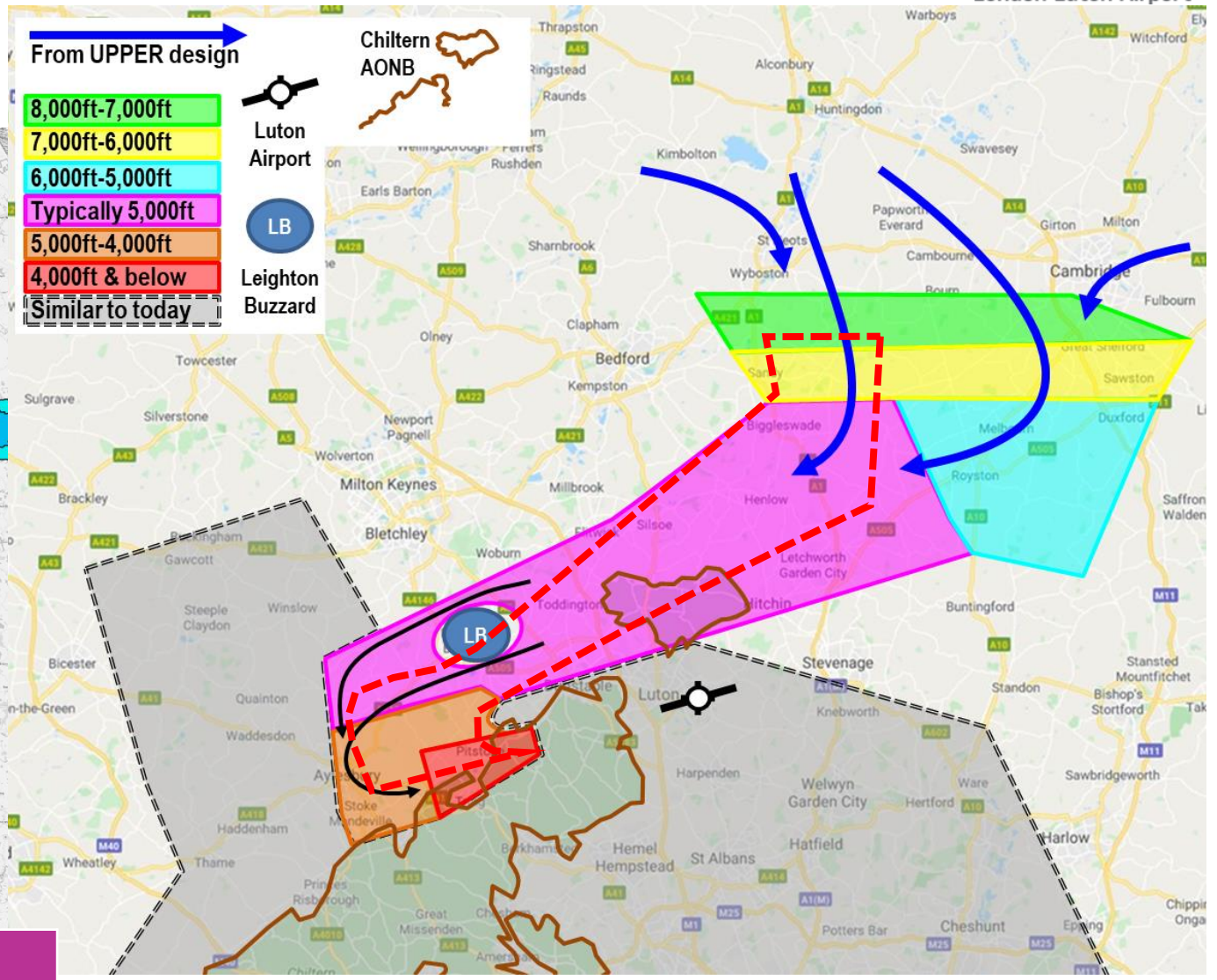
Options 2.3, 2.4

Current overflight contours with likely new vectoring area

Easterly arrivals, 0-7000ft – controllers estimate the most likely area of overflight

2.3



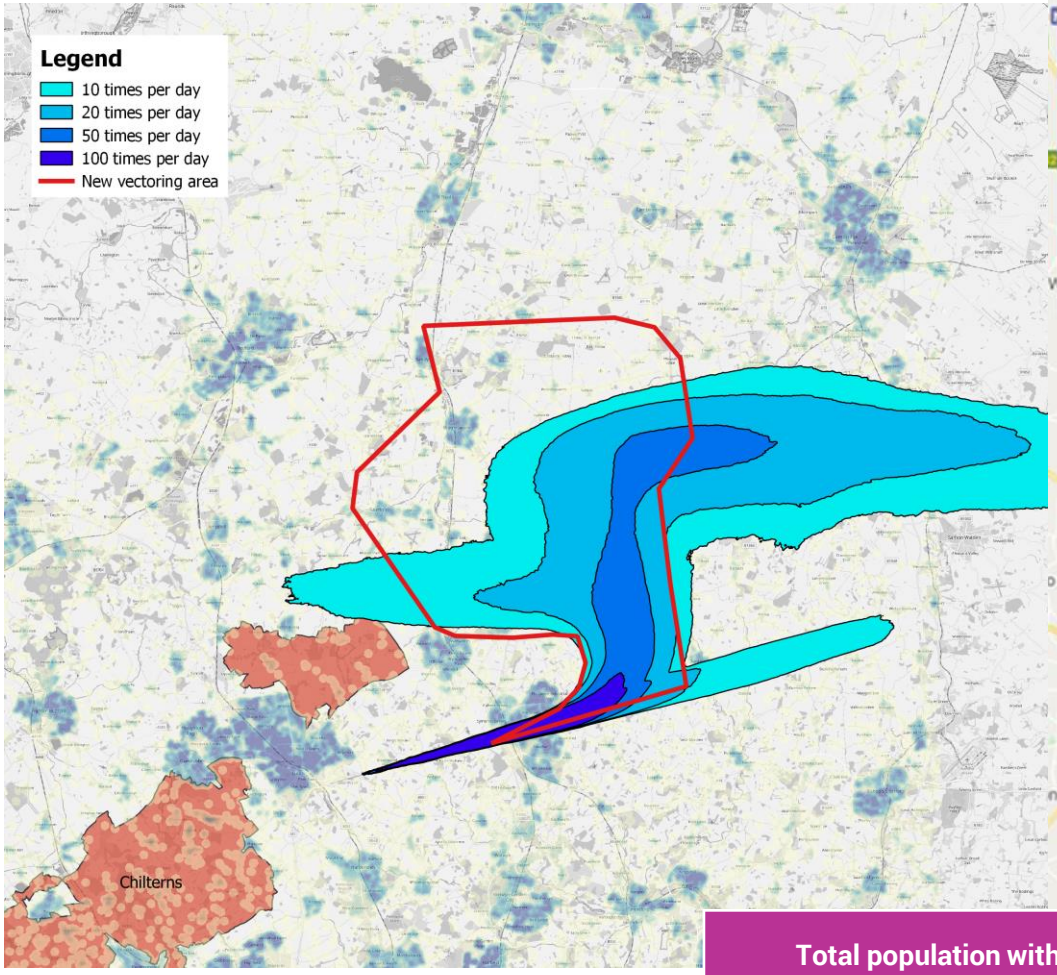


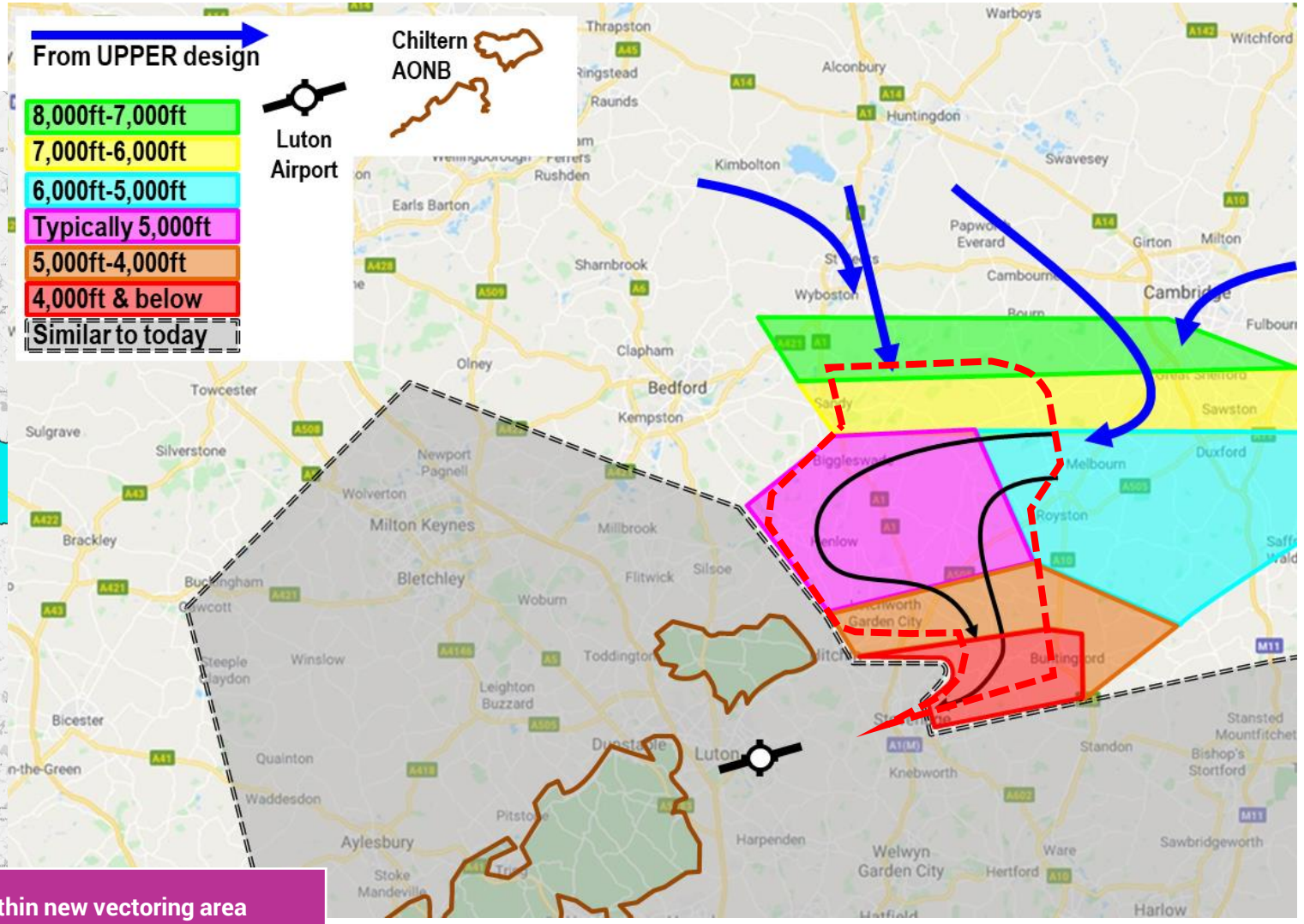
Total population within new vectoring area
139000

Current overflight contours with likely new vectoring area

Westerly arrivals, 0-7000ft – controllers estimate the most likely area of overflight

2.4





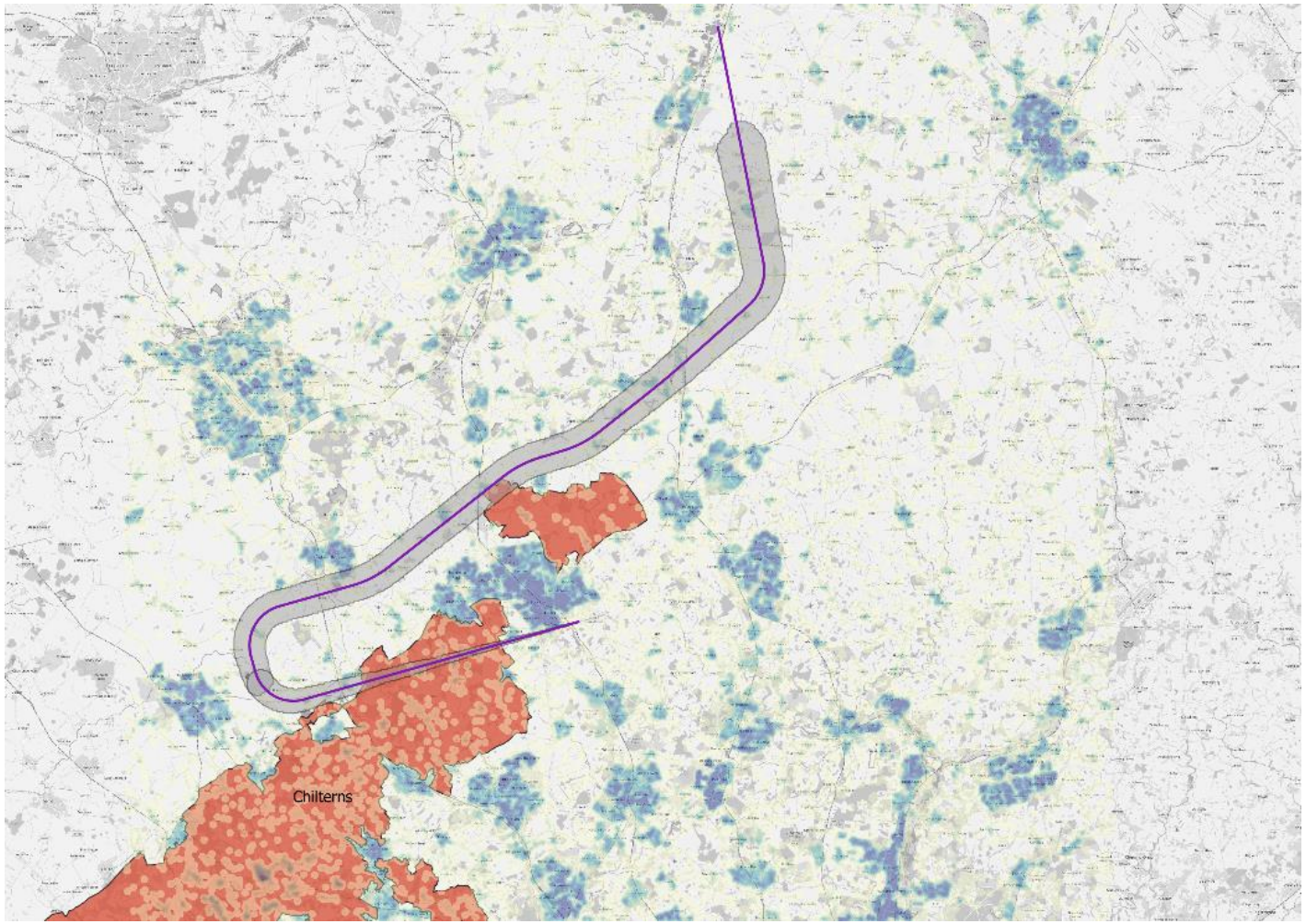
Total population within new vectoring area
144050

RWY08 RNAV1 transition south of Leighton Buzzard

Option 2.5

RWY08 illustrative RNAV1 transition south of Leighton Buzzard

Total population overflown

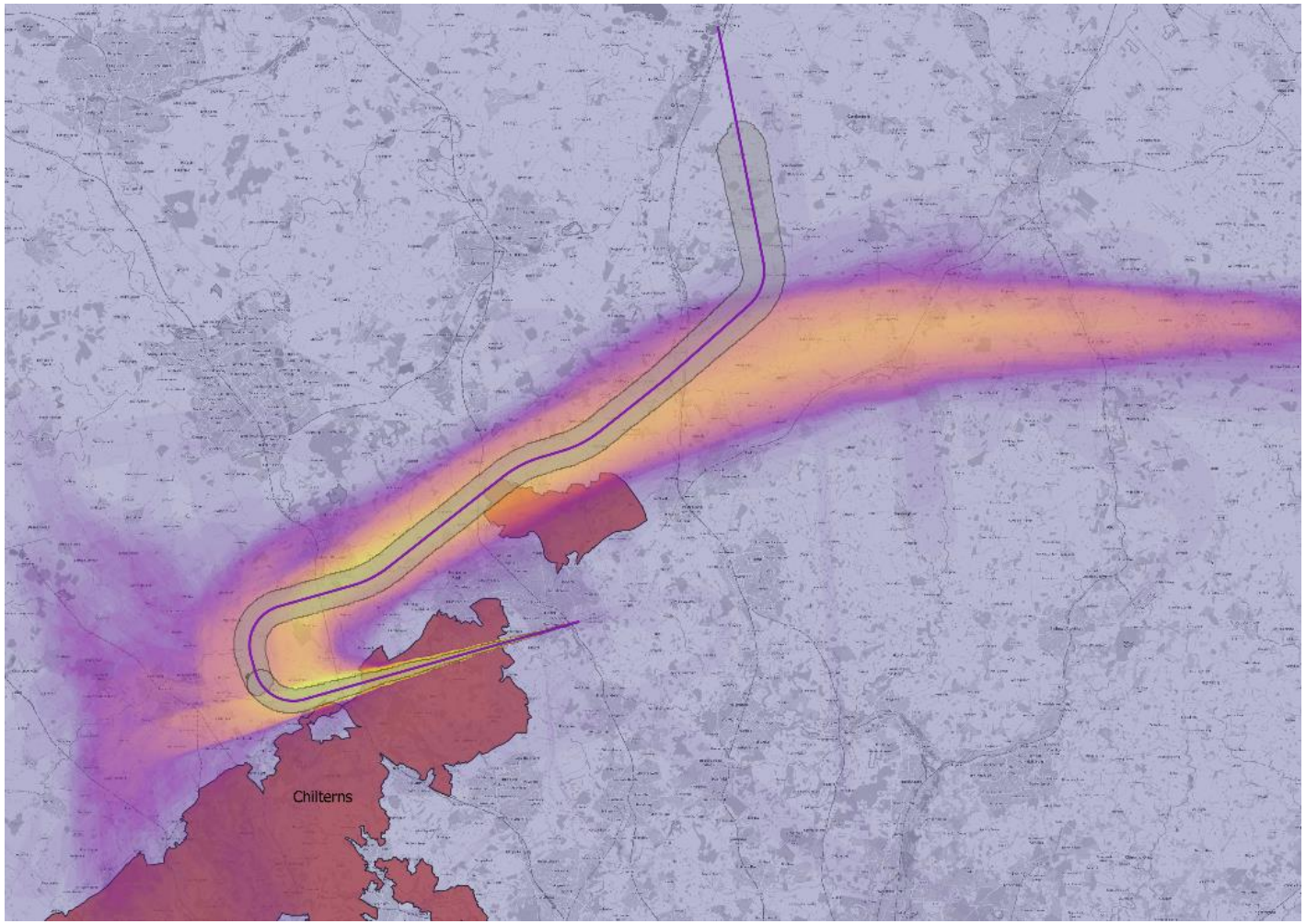


Transition south of LB	0-7000ft
Total population overflown	42250

2.5

RWY08 illustrative RNAV1 transition south of Leighton Buzzard

Newly overflown

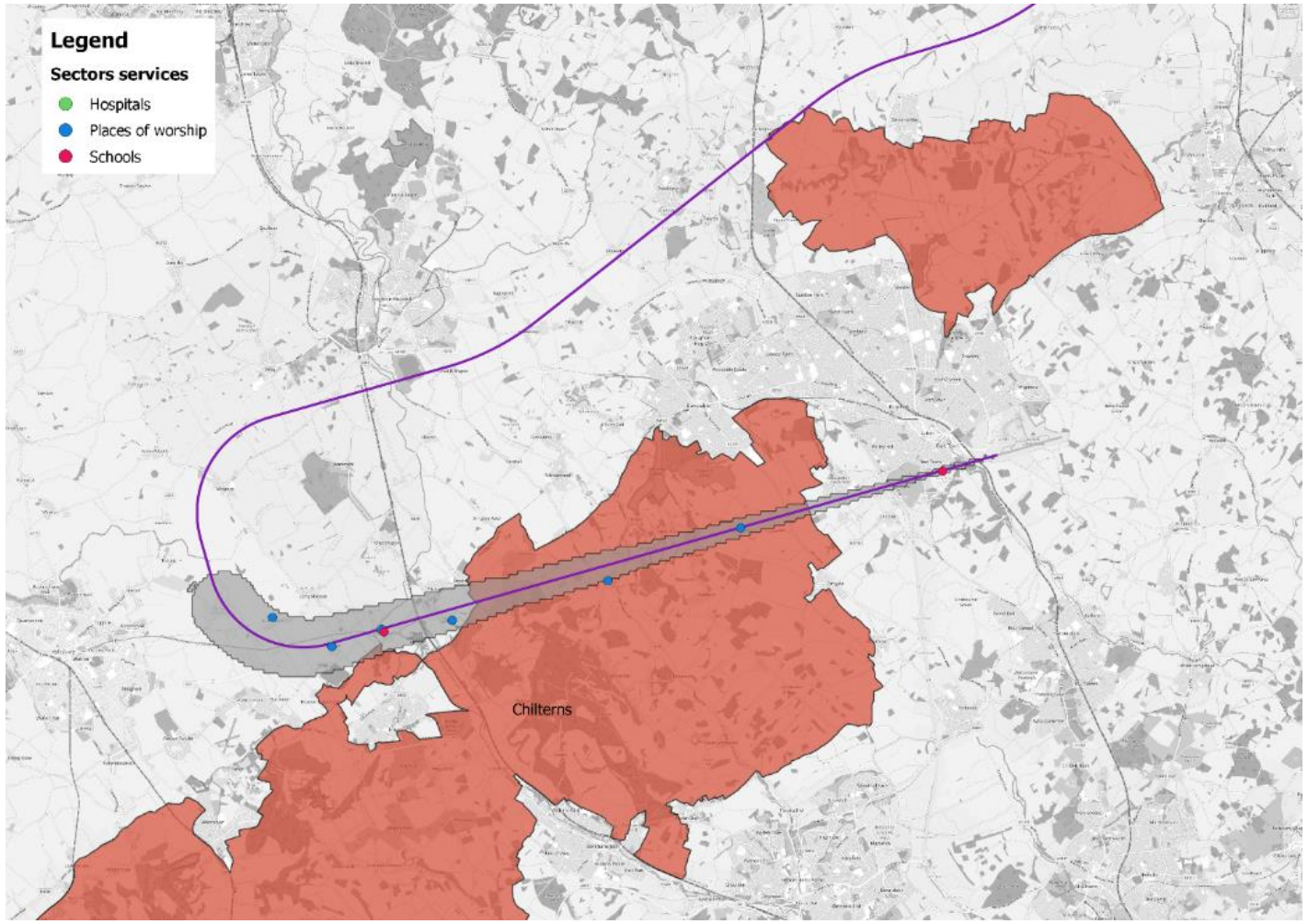


Transition south of LB		0-7000ft
Total population overflown		42250
Percentage of population already overflown (times a day)	10 times	49.4%
	20 times	41.4%
	50 times	48.1%
	100 times	11.8%

2.5

RWY08 illustrative RNAV1 transition south of Leighton Buzzard

Schools, places of worship and hospitals (below 4000ft)

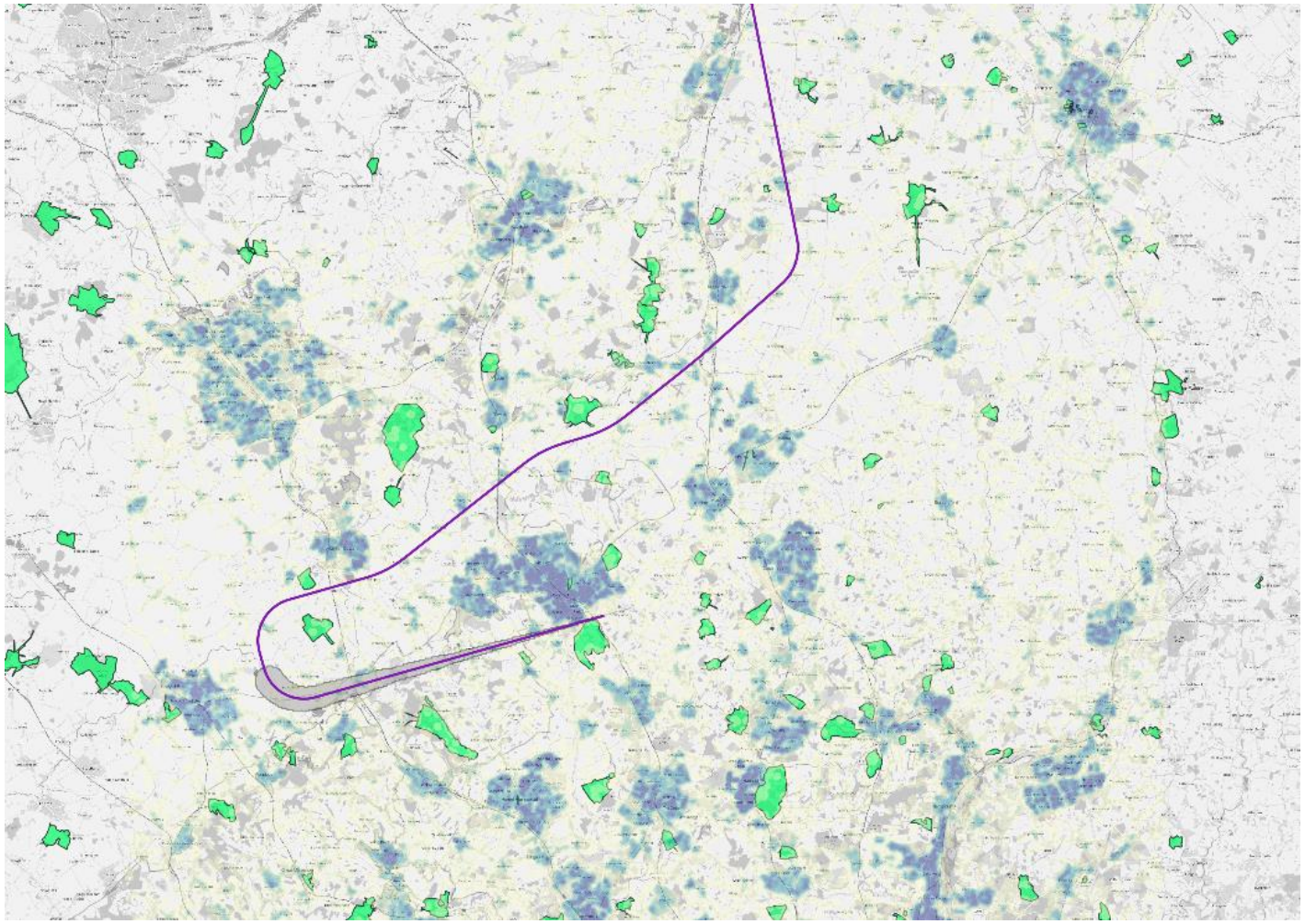


Service	Count
Schools	2
Places of worship	6
Hospitals	0

2.5

RWY08 illustrative RNAV1 transition south of Leighton Buzzard

Registered Historic Parks and Gardens. Overflight contour shown up to 4000ft



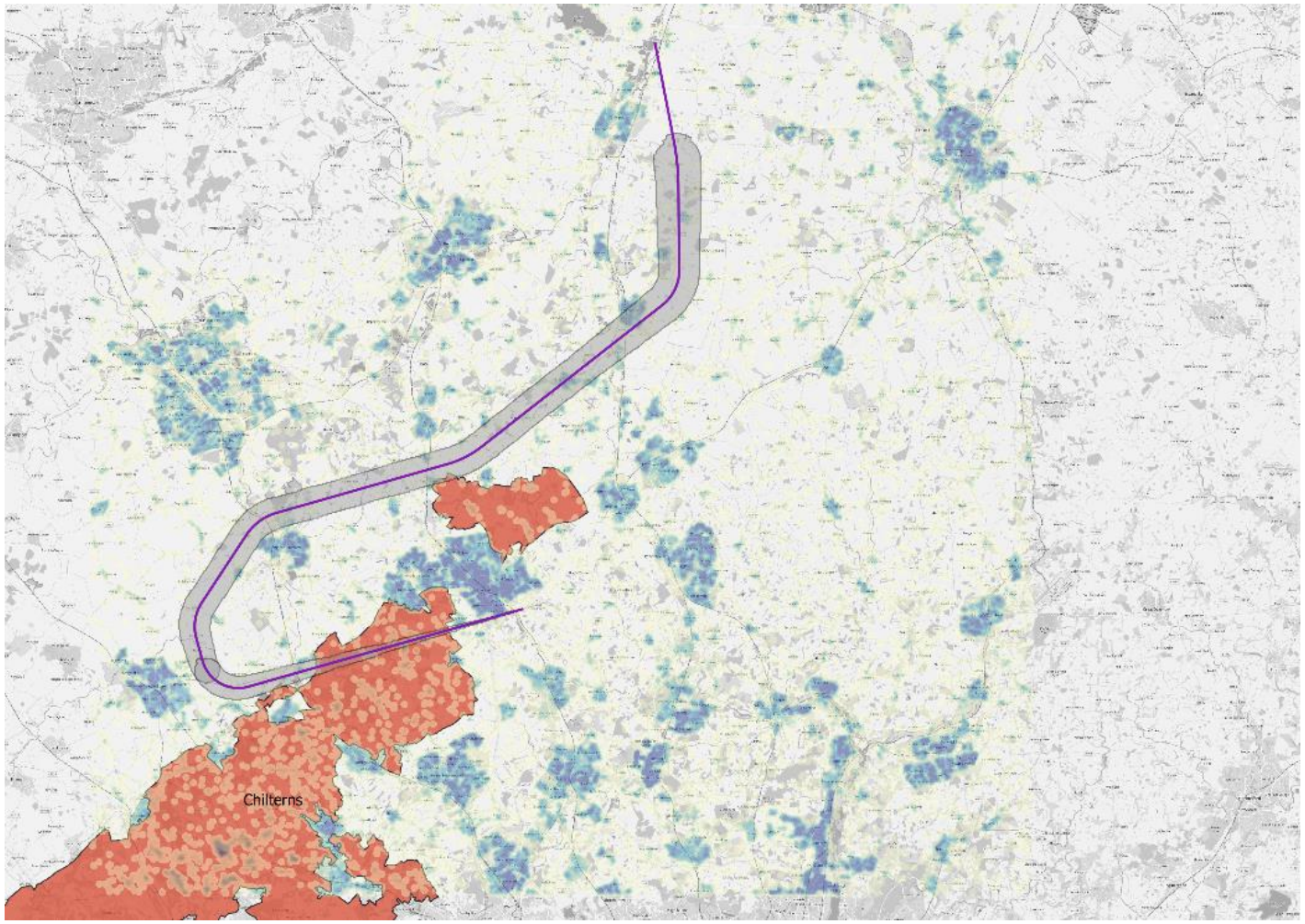
2.5

RWY08 RNAV1 transition north of Leighton Buzzard

Option 2.7

RWY08 illustrative RNAV1 transition north of Leighton Buzzard

Total population overflown

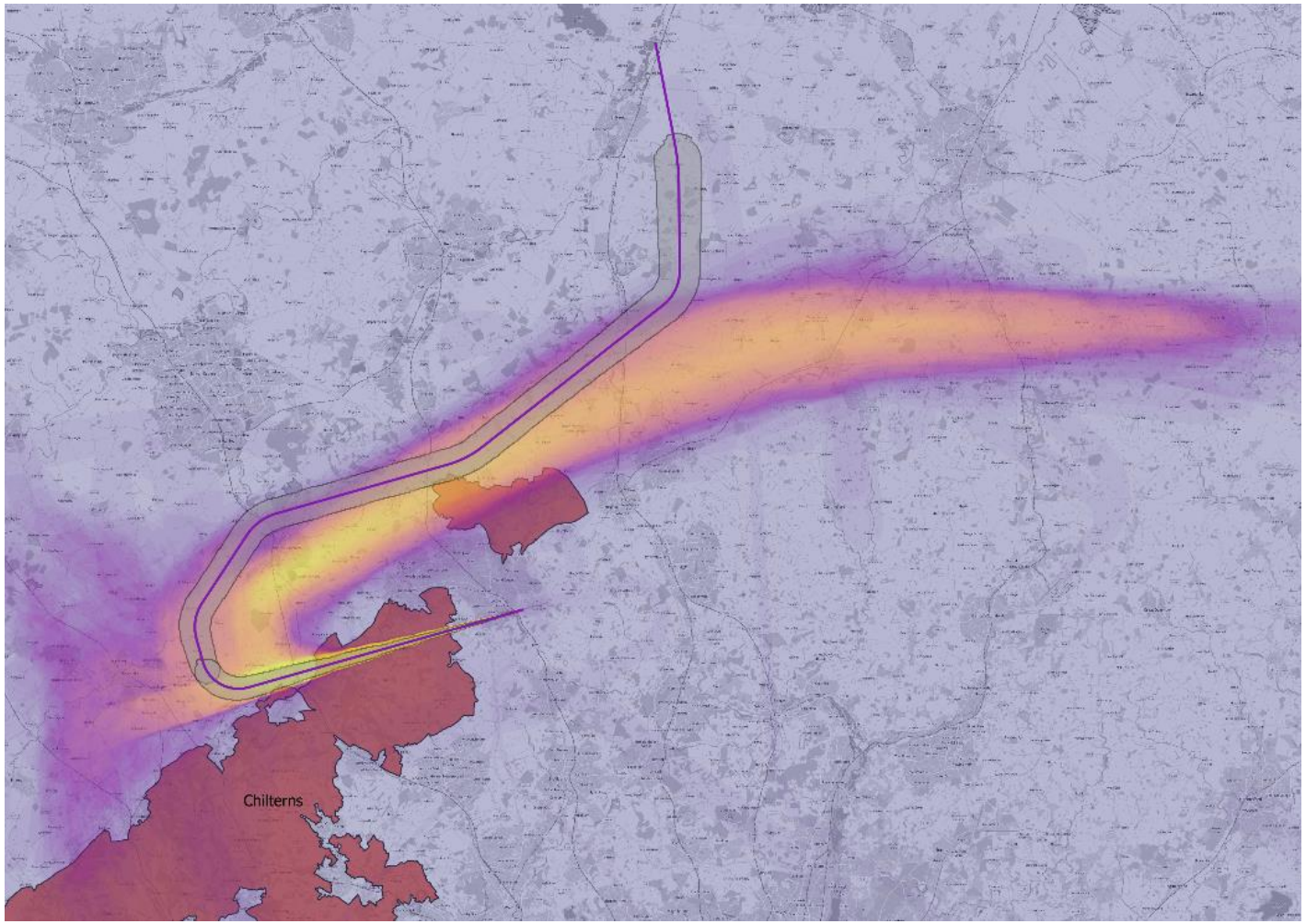


Transition north of LB	0-7000ft
Total population overflown	53850

2.7

RWY08 illustrative RNAV1 transition north of Leighton Buzzard

Newly overflown

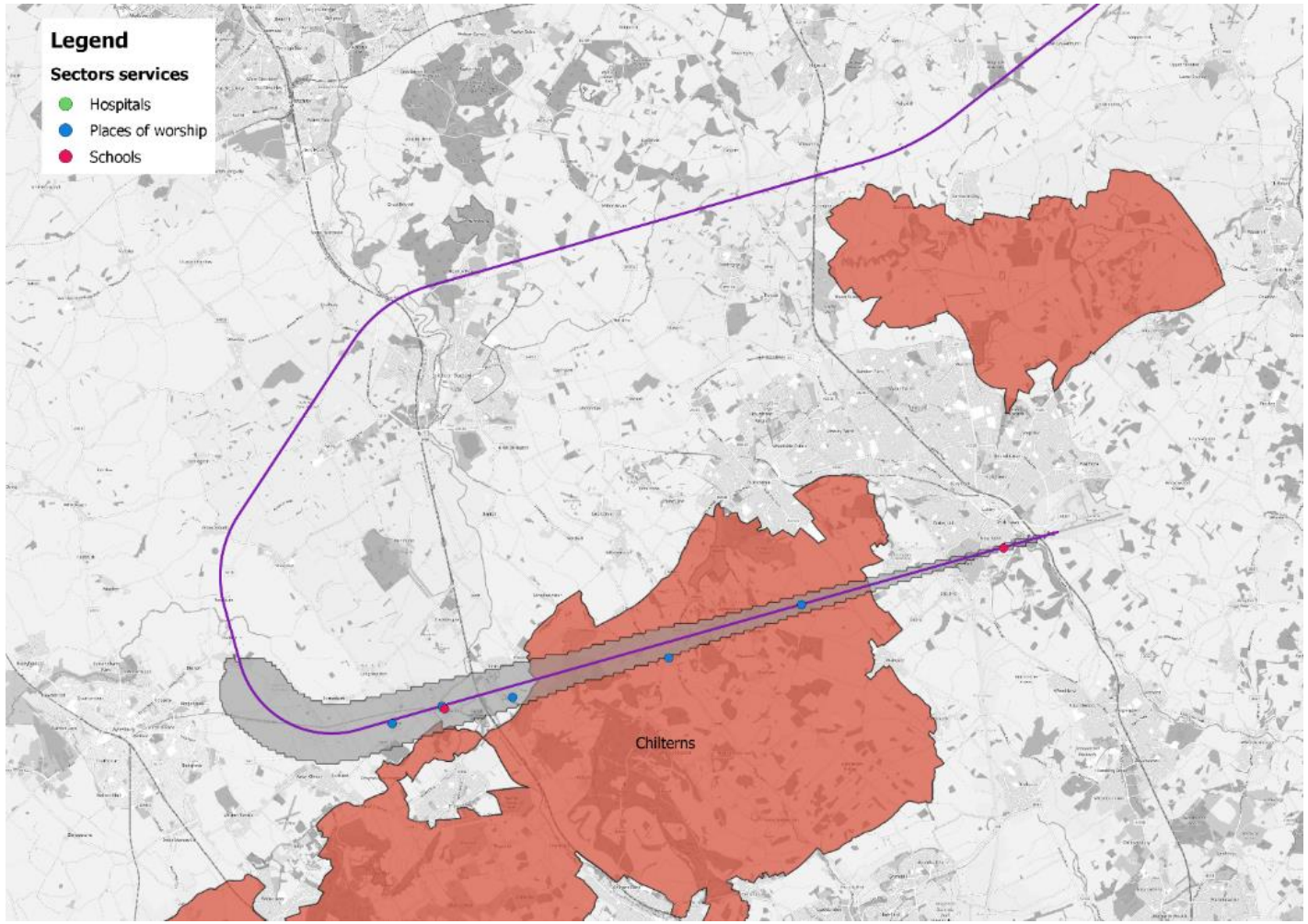


Transition north of LB		0-7000ft
Total population overflown		53850
Percentage of population already overflown (times a day)	10 times	58.7%
	20 times	28%
	50 times	14%
	100 times	9.5%

2.7

RWY08 illustrative RNAV1 transition north of Leighton Buzzard

Schools, places of worship and hospitals (below 4000ft)

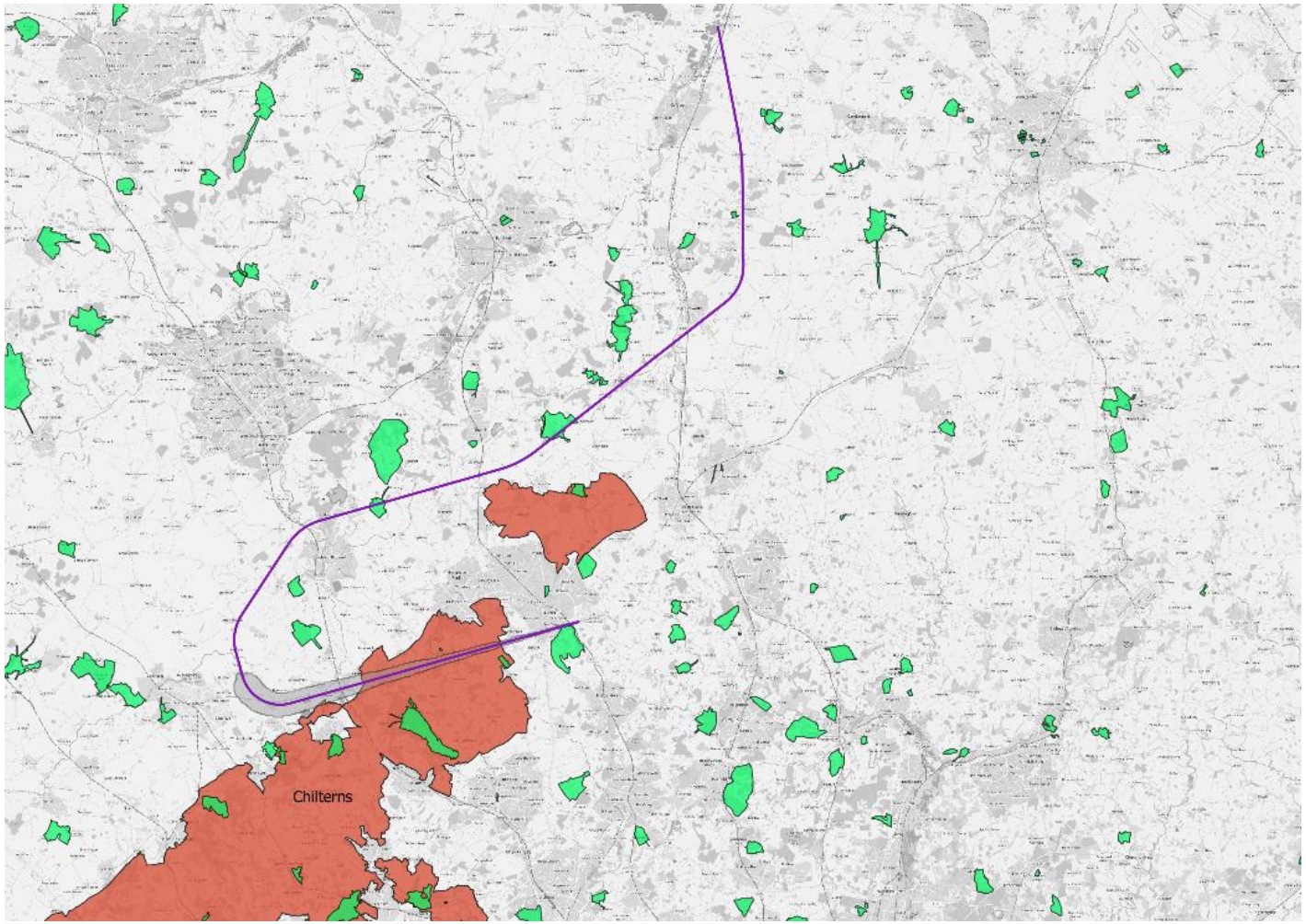


Service	Count
Schools	2
Places of worship	5
Hospitals	0

2.7

RWY08 illustrative RNAV1 transition north of Leighton Buzzard

Registered Historic Parks and Gardens. Overflight contour shown up to 4000ft



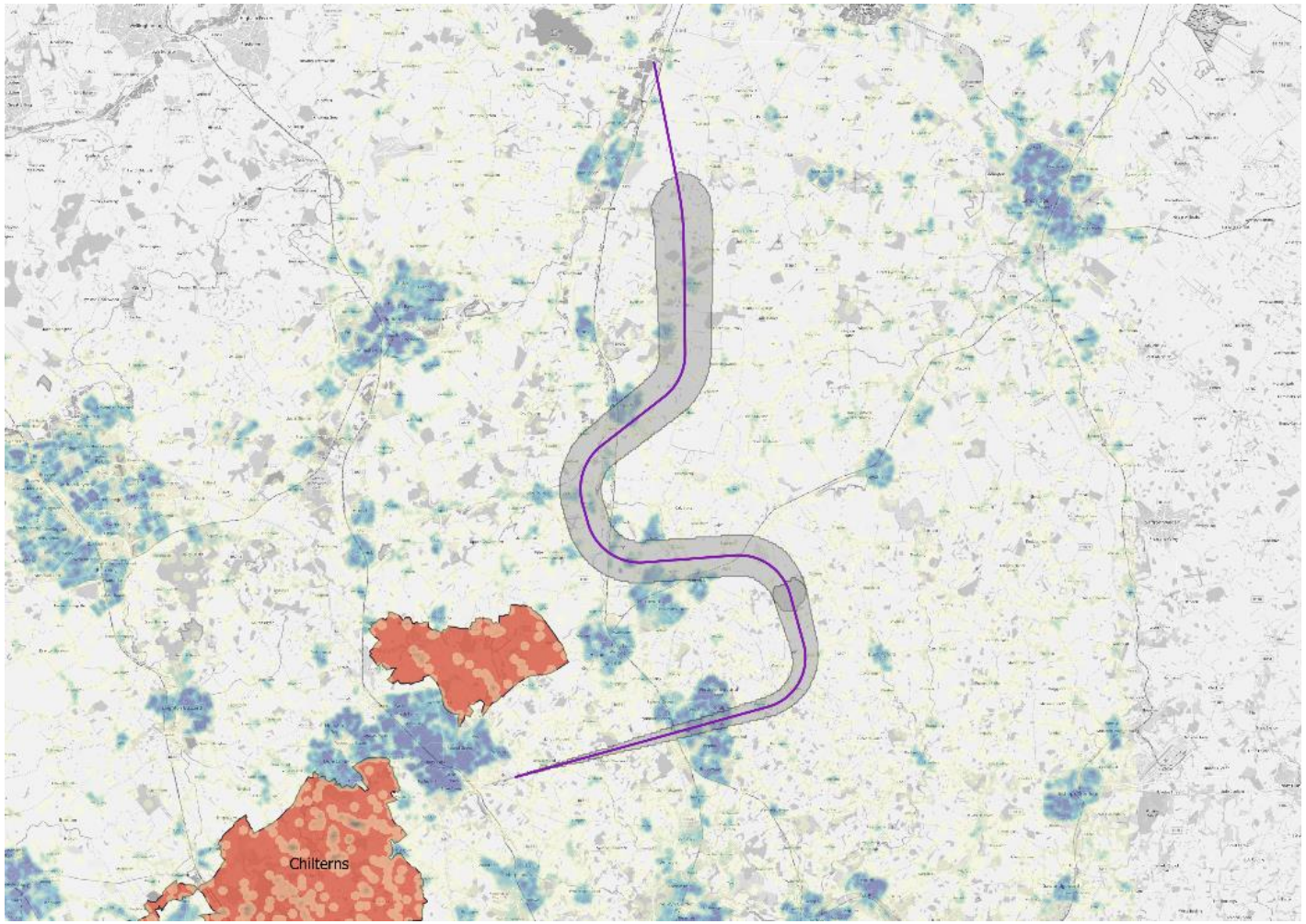
2.7

RWY26 S-bend RNAV1 transition

Option 2.8

RWY26 S-bend RNAV1 transition

Total population overflown

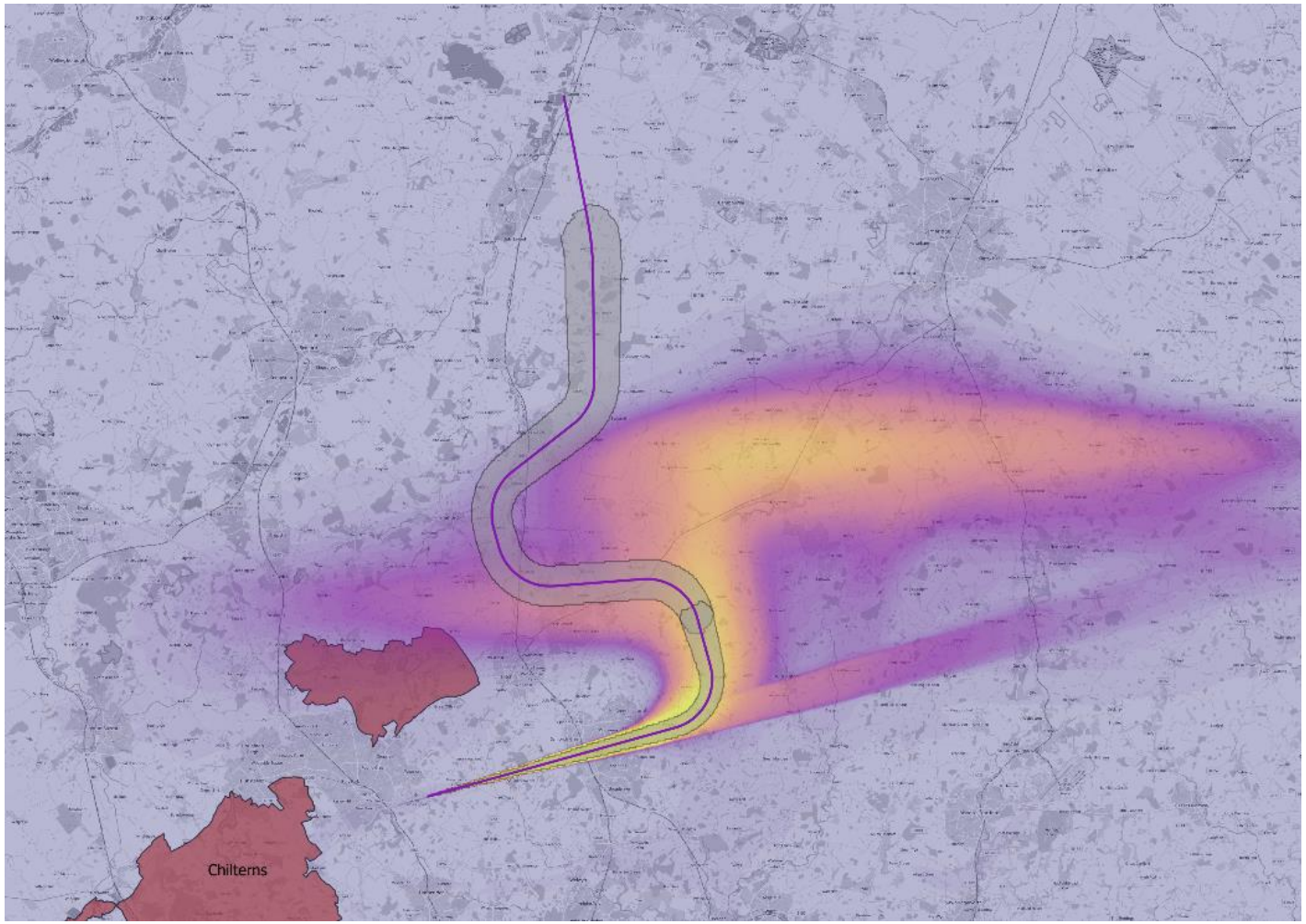


S-bend transition	0-7000ft
Total population overflown	71850

2.8

RWY26 S-bend RNAV1 transition

Newly overflown



S-bend transition		0-7000ft
Total population overflown		71850
Percentage of population already overflown (times a day)	10 times	48.3%
	20 times	37.2%
	50 times	26.4%
	100 times	25.5%

2.8

RWY26 S-bend RNAV1 transition

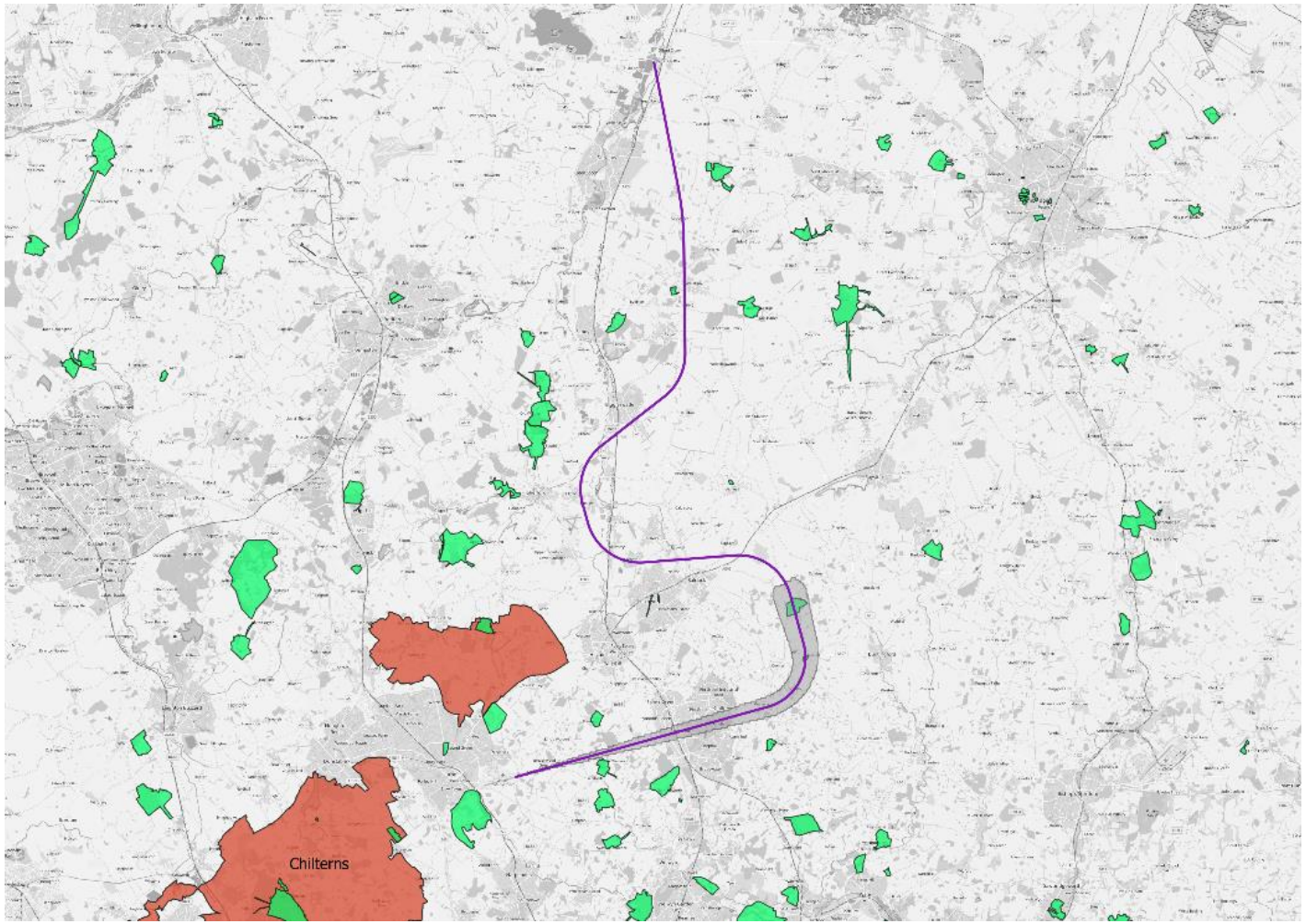
Schools, places of worship and hospitals (below 4000ft)

Service	Count
Schools	9
Places of worship	8
Hospitals	0

2.8

RWY26 S-bend RNAV1 transition

Registered Historic Parks and Gardens. Overflight contour shown up to 4000ft



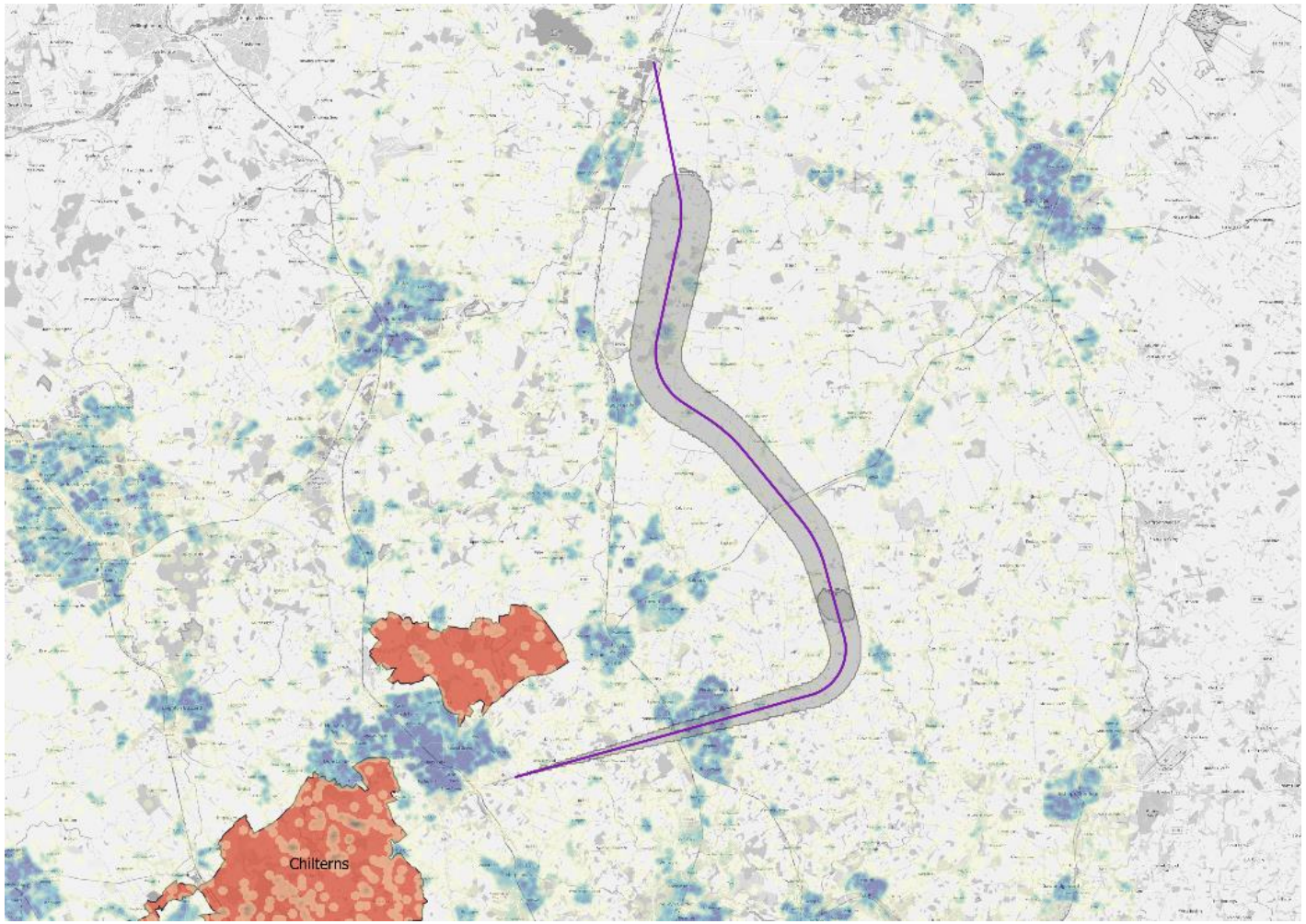
2.8

RWY26 Straight in RNAV1 transition

Option 2.9

RWY26 straight in RNAV1 transition

Total population overflown

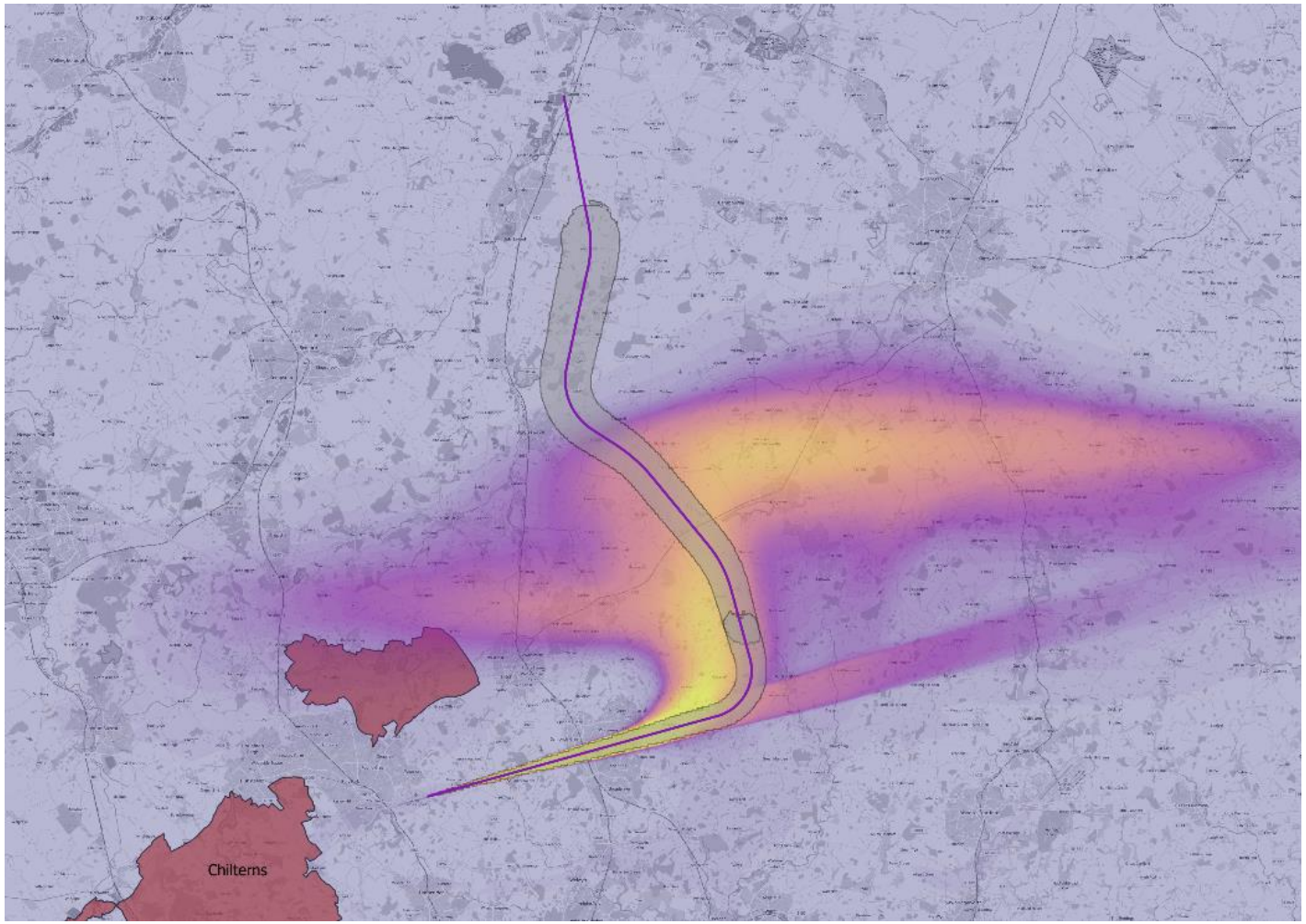


Straight in transition	0-7000ft
Total population overflown	32450

2.9

RWY 26 straight in RNAV1 transition

Newly overflown



Transition south of LB		0-7000ft
Total population overflown		32450
Percentage of population already overflown (times a day)	10 times	68.7%
	20 times	67.7%
	50 times	64.3%
	100 times	63.1%

2.9

RWY 26 straight in RNAV1 transition

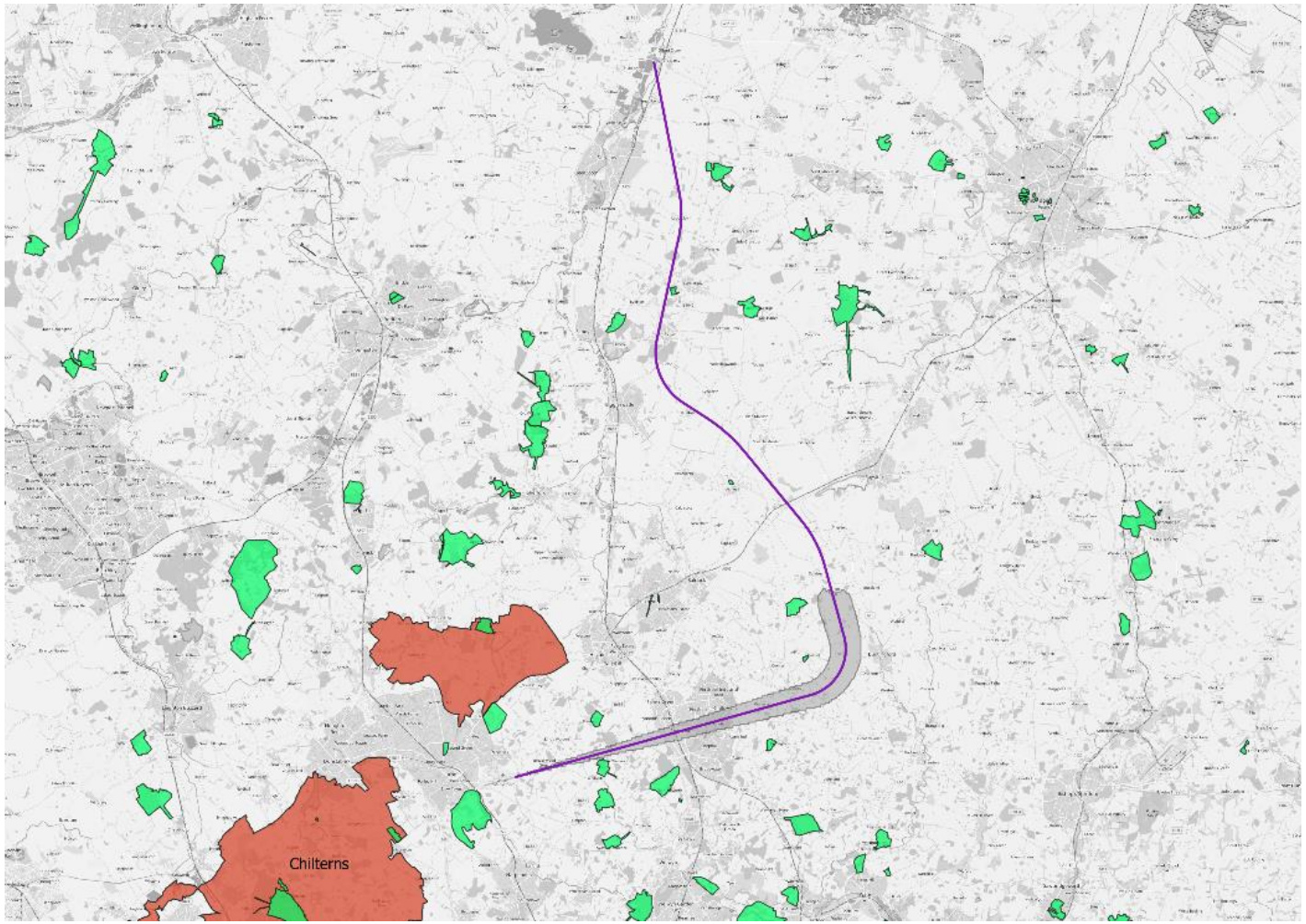
Schools, places of worship and hospitals (below 4000ft)

Service	Count
Schools	9
Places of worship	8
Hospitals	0

2.9

RWY 26 straight in RNAV1 transition

Registered Historic Parks and Gardens. Overflight contour shown up to 4000ft



2.9

Summary of overflight analysis

Summary of overflight analysis

		Option	Total overflown 0-7000ft
Easterlies	2.1	Do nothing Runway 08 (>10 times per day)	288,000
	2.7	RWY08 RNAV1 transition north of Leighton Buzzard	53,850
	2.5	RWY08 RNAV1 transition south of Leighton Buzzard	42,250
	2.3	Vectors from new Luton stack to Runway 08	139,000
Westerlies	2.2	Do nothing Runway 26 (>10 times per day)	162,900
	2.9	RWY26 Straight in RNAV1 transition	32,450
	2.8	RWY26 S-bend RNAV1 transition	71,850
	2.4	Vectors from new Luton stack to Runway 26	144,050

			0-4000ft				0-7000ft	0-4000ft	4-7000ft
		Option	Schools	Hospitals	Places of worship	Registered historic parks and gardens	National Parks	AONB	AONB
Easterlies	2.1	Do nothing Runway 08 (>10 times per day)	5	0	8	2	0	Chilterns	Chilterns
	2.7	RWY08 RNAV1 transition north of Leighton Buzzard	2	0	5	1	0	Chilterns	Chilterns (lesser extent than today)
	2.5	RWY08 RNAV1 transition south of Leighton Buzzard	2	0	6	1	0	Chilterns	Chilterns (lesser extent than today)
	2.3	Vectors from new Luton stack to Runway 08	5	0	8	2	0	Chilterns	Chilterns
Westerlies	2.2	Do nothing Runway 26 (>10 times per day)	13	0	12	2	0	0	0
	2.9	RWY26 Straight in RNAV1 transition	9	0	8	0	0	0	0
	2.8	RWY26 S-bend RNAV1 transition	9	0	8	1	0	0	0
	2.4	Vectors from new Luton stack to Runway 26	13	0	12	2	0	0	0

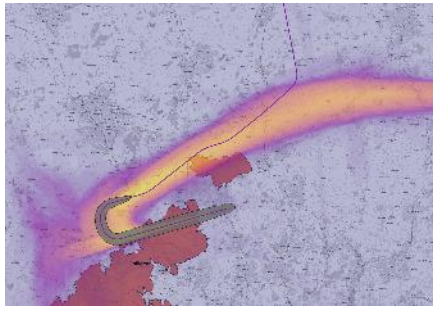
Luton A320 event analysis

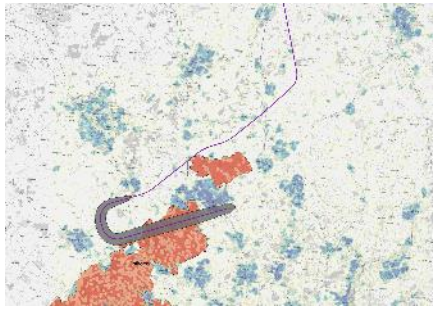
A320-232

RWY08 RNAV1 transition south of Leighton Buzzard

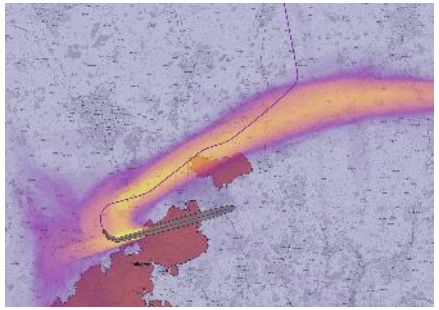
LAMAX A320-232	Number of people
55dB	34550
60dB	21600
65dB	11650
70dB	5150

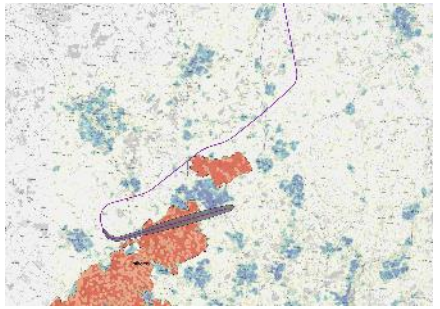
55dB



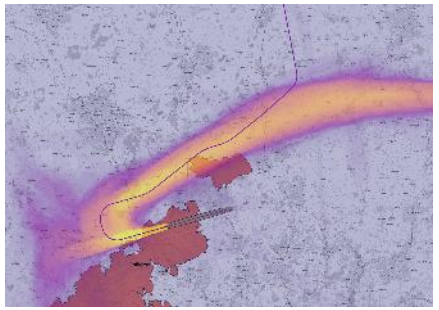


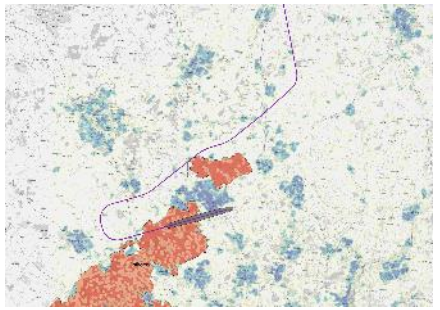
60dB



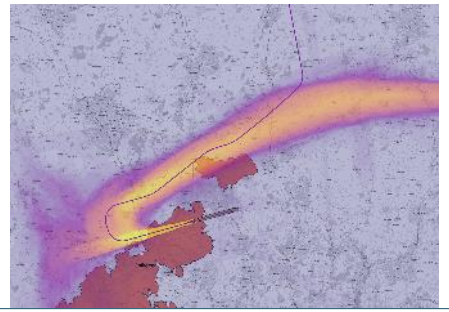


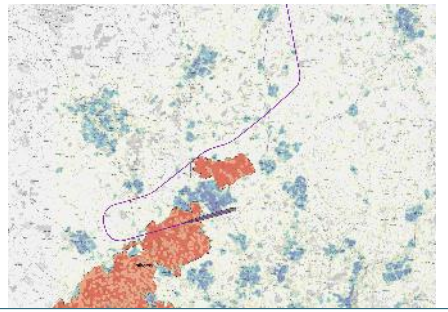
65dB





70dB



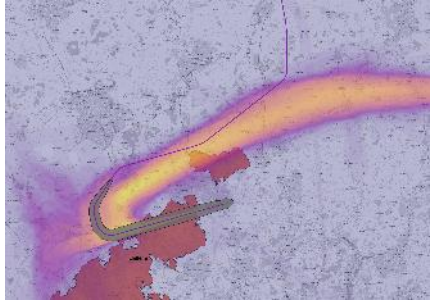


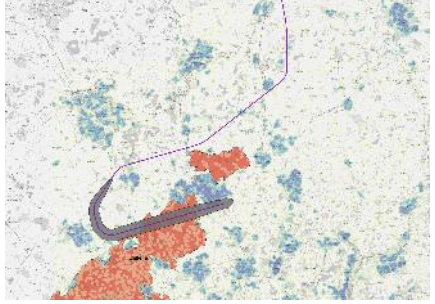
2.5

RWY08 RNAV1 transition north of Leighton Buzzard

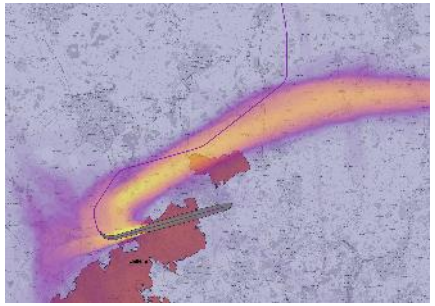
LAMAX A320-232	Number of people
55dB	33850
60dB	21600
65dB	11650
70dB	5150

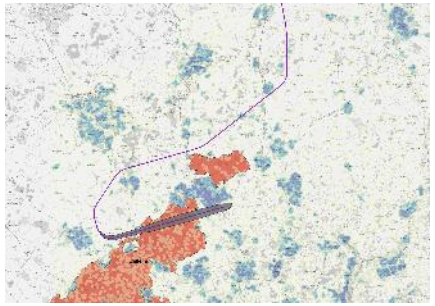
55dB



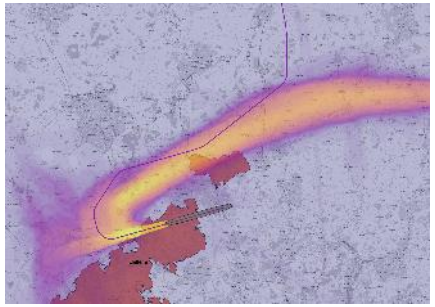


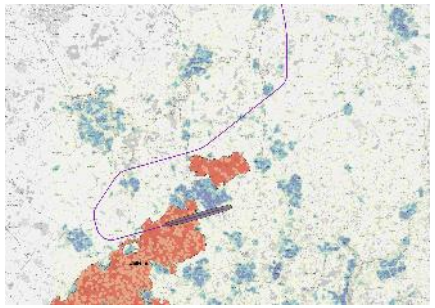
60dB



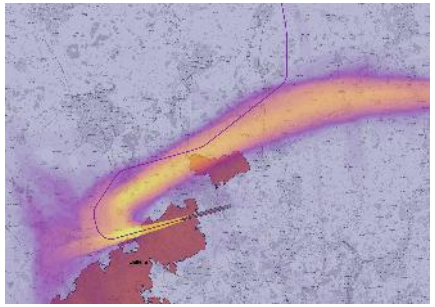


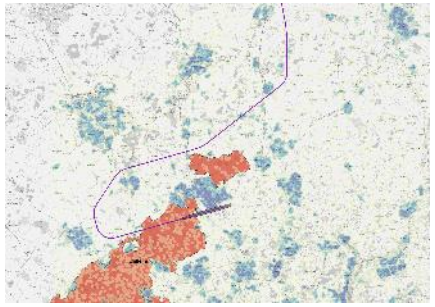
65dB





70dB



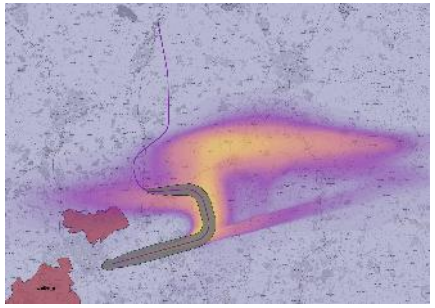


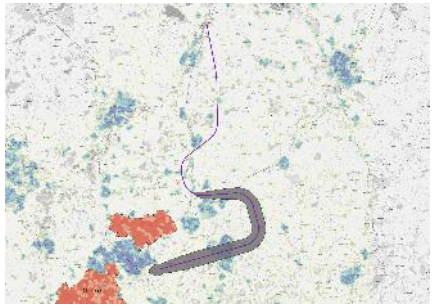
2.7

RWY26 s-bend RNAV1 transition

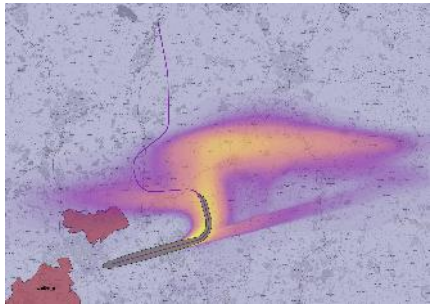
LAMAX A320-232	Number of people
55dB	56550
60dB	31300
65dB	5550
70dB	350

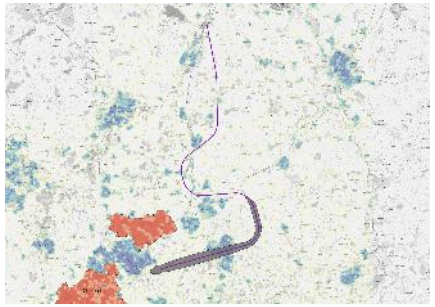
55dB



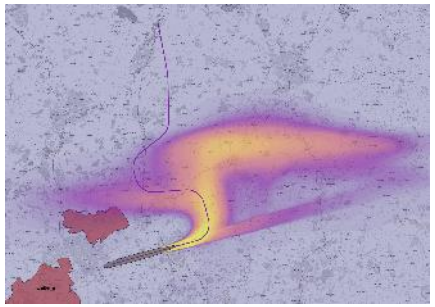


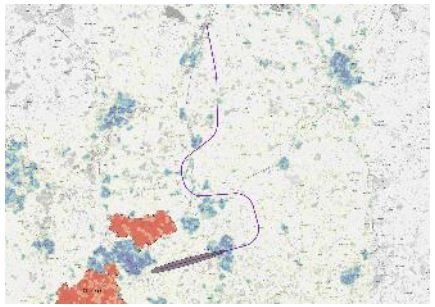
60dB



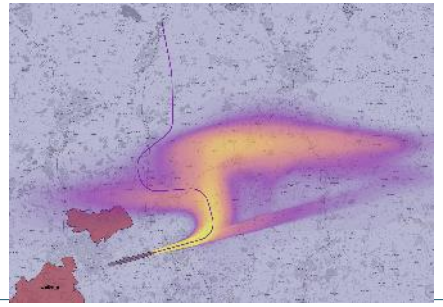


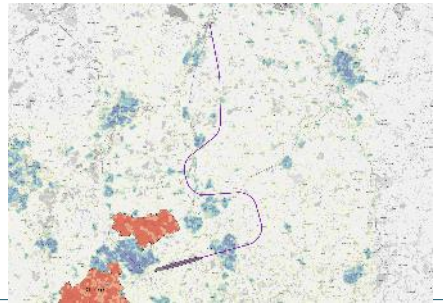
65dB





70dB



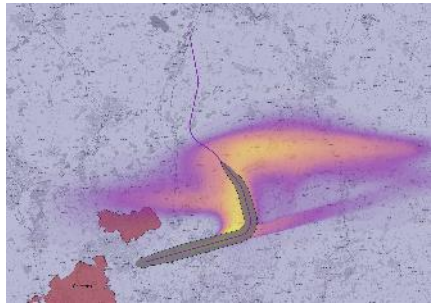


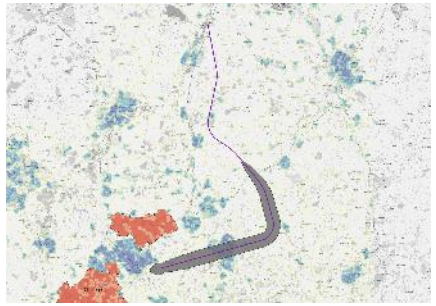
2.8

RWY26 straight in RNAV1 transition

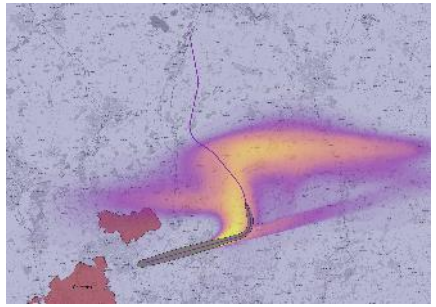
LAMAX A320-232	Number of people
55dB	50500
60dB	31050
65dB	5550
70dB	350

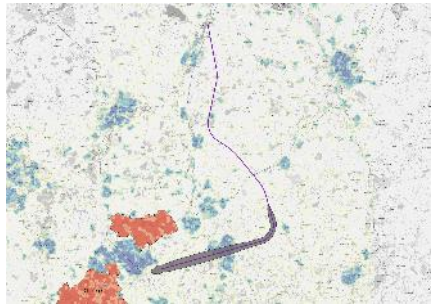
55dB



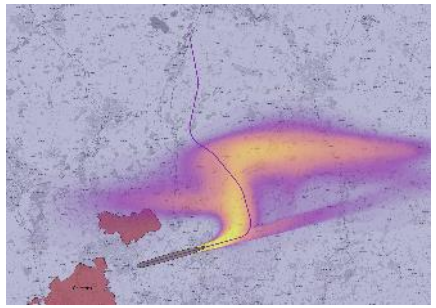


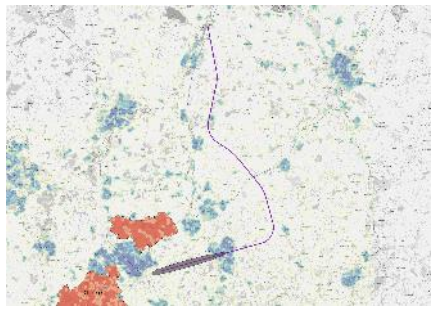
60dB



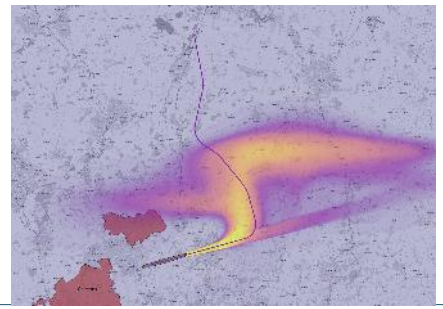


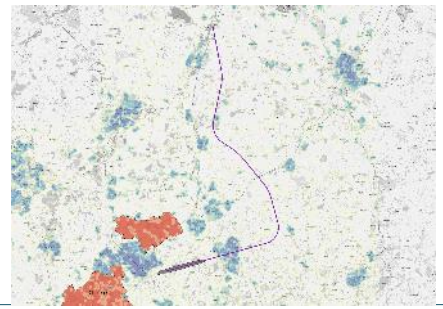
65dB





70dB





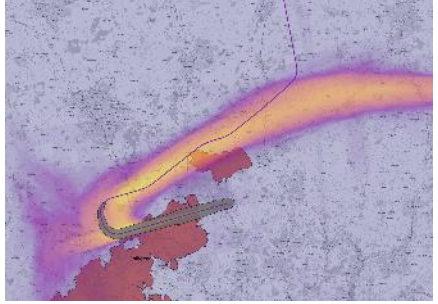
2.9

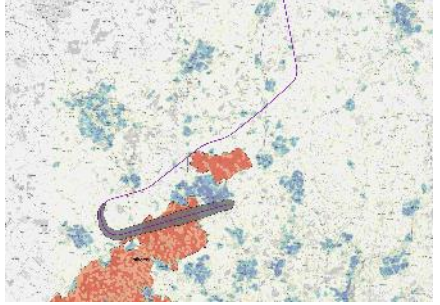
A320neo

RWY08 RNAV1 transition south of Leighton Buzzard

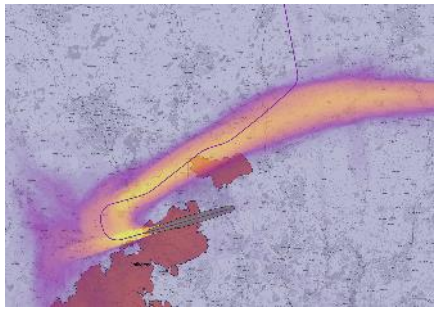
LAMAX A320neo	Number of people
55dB	30300
60dB	16150
65dB	8550
70dB	3450

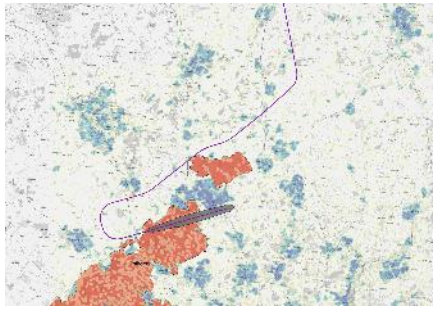
55dB



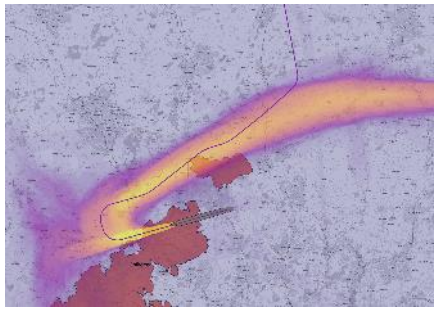


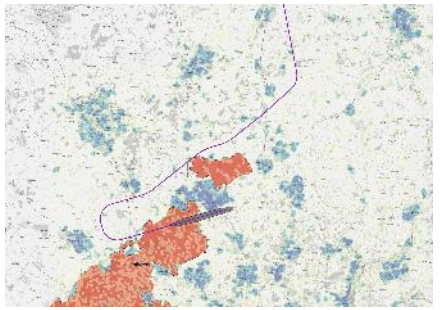
60dB



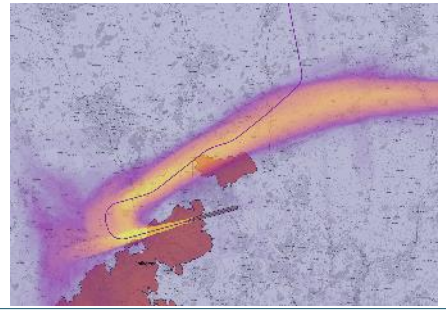


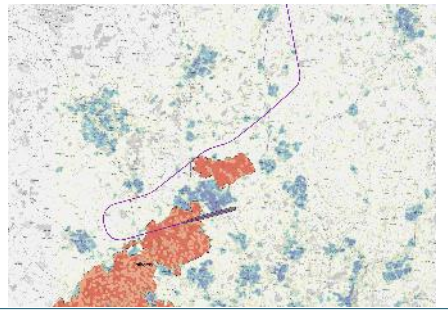
65dB





70dB



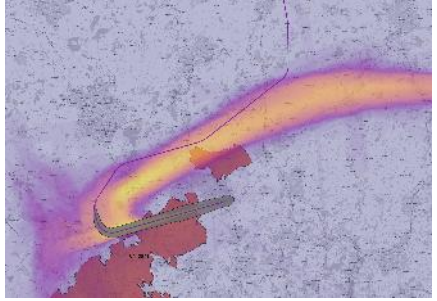


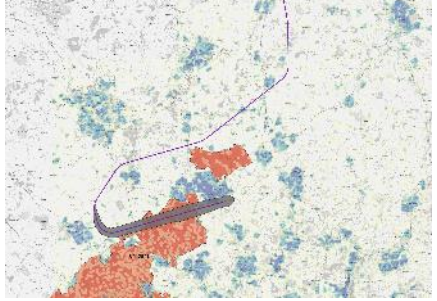
2.5

RWY08 RNAV1 transition north of Leighton Buzzard

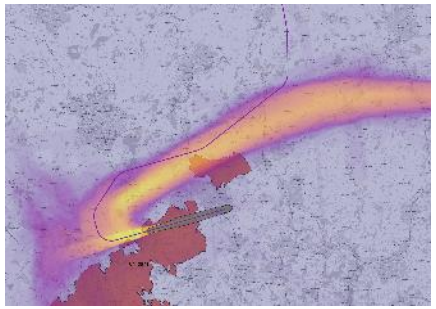
LAMAX A320neo	Number of people
55dB	29600
60dB	16150
65dB	8550
70dB	3450

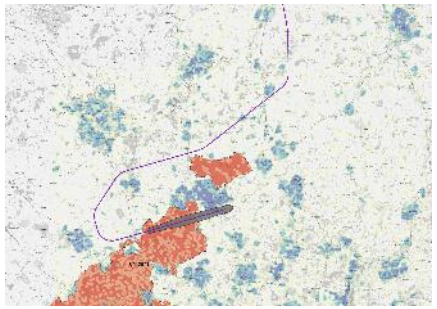
55dB



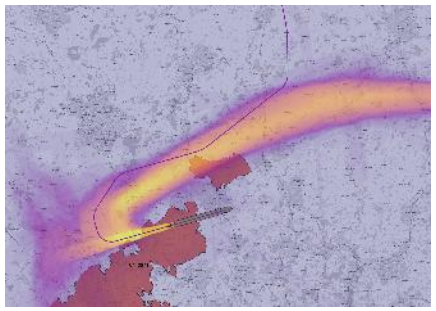


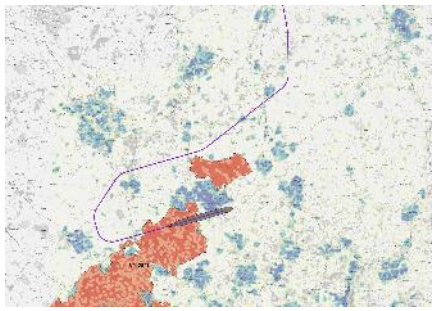
60dB



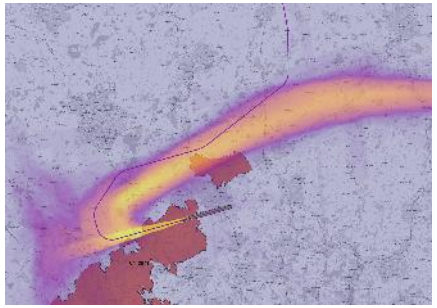


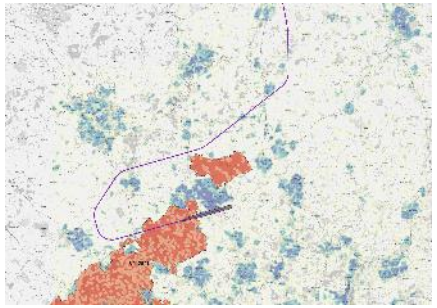
65dB





70dB



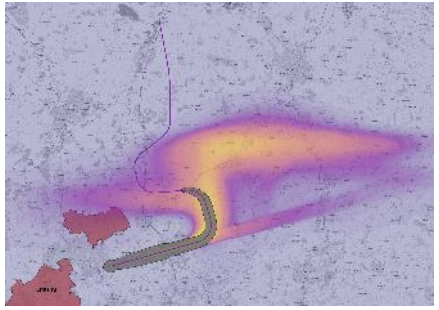


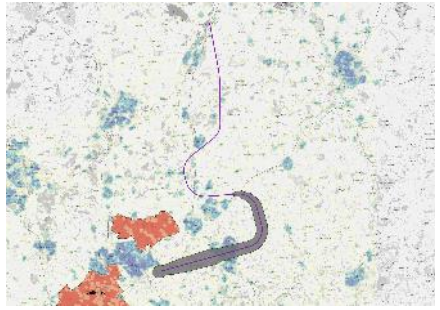
2.7

RWY26 s-bend RNAV1 transition

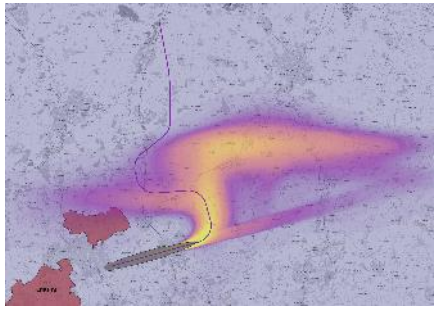
LAMAX A320neo	Number of people
55dB	44300
60dB	23450
65dB	700
70dB	150

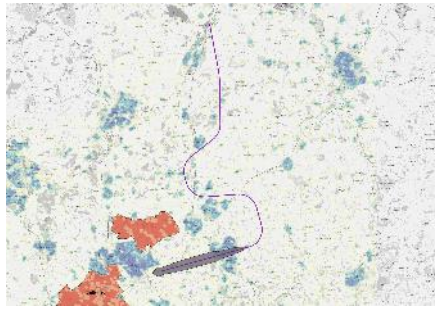
55dB



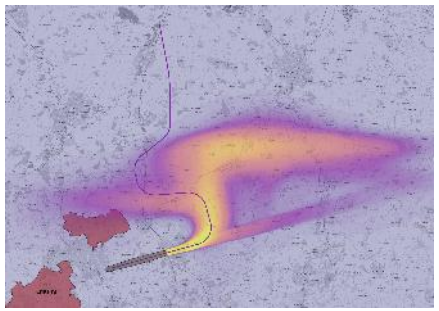


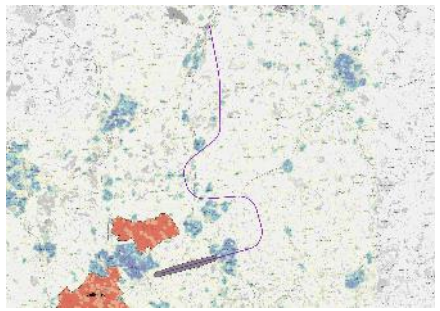
60dB



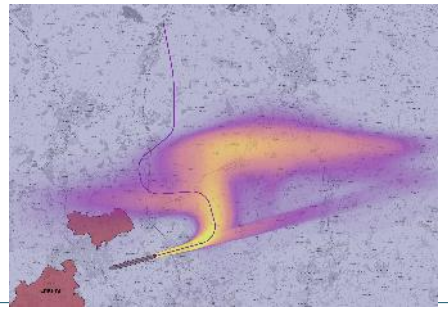


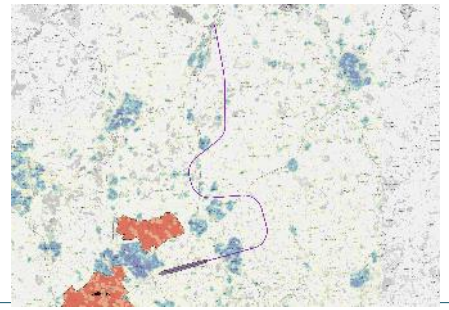
65dB





70dB



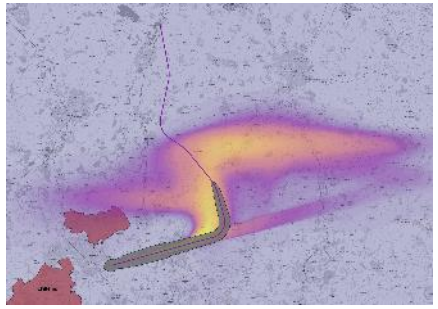


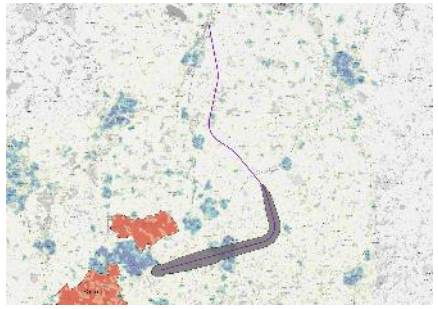
2.8

RWY26 straight in RNAV1 transition

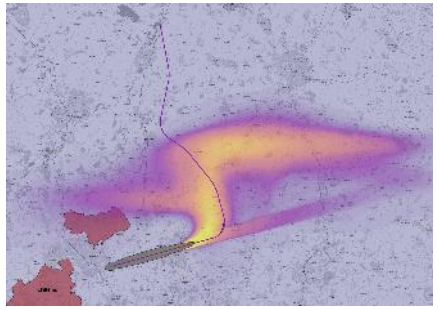
LAMAX A320neo	Number of people
55dB	44000
60dB	23500
65dB	700
70dB	150

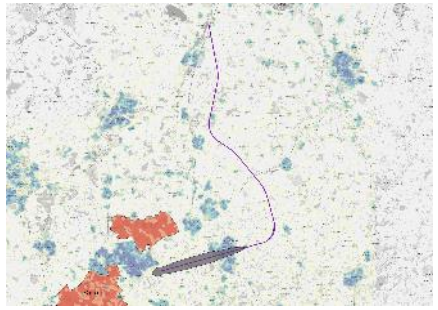
55dB



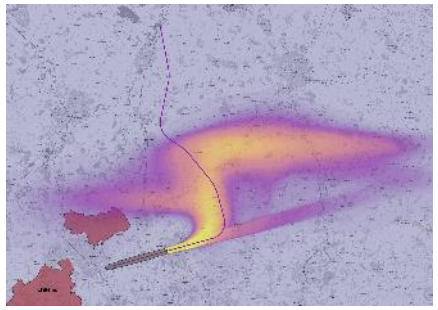


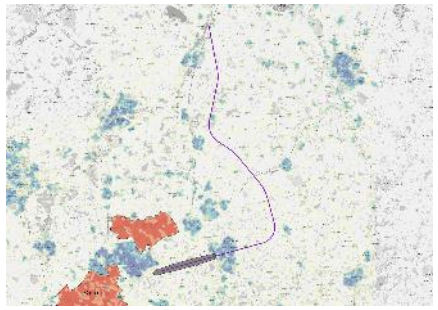
60dB



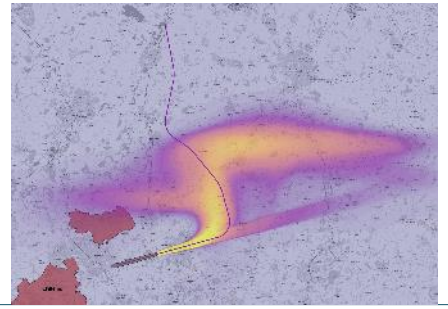


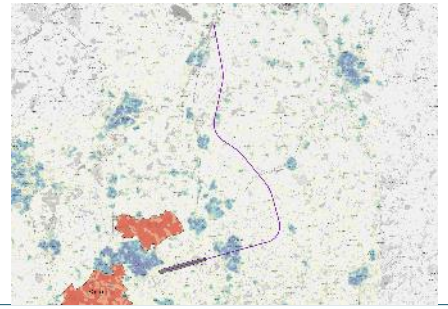
65dB





70dB





2.9

Summary of A320 event analysis

Summary of A320 event analysis

			A320-232				A320neo			
		Option	Num people within 55dB Lamax	Num people within 60dB Lamax	Num people within 65dB Lamax	Num people within 70dB Lamax	Num people within 55dB Lamax	Num people within 60dB Lamax	Num people within 65dB Lamax	Num people within 70dB Lamax
Easterlies	2.7	RWY08 RNAV1 transition north of Leighton Buzzard	33,850	21,600	11,650	5,150	29,600	16,150	8,550	3,450
	2.5	RWY08 RNAV1 transition south of Leighton Buzzard	34,550	21,600	11,650	5,150	30,300	16,150	8,530	3,450
Westerlies	2.9	RWY26 Straight in RNAV1 transition	50,500	31,050	5,550	350	44,000	23,500	700	150
	2.8	RWY26 S-bend RNAV1 transition	56,550	31,300	5,550	507	44,300	23,450	700	150

The following slide was created by NATS airspace change specialists. It estimates the difference in track distances likely to be flown by a single hybrid average flight, via the flightpath options for this proposal.

It estimates the differences in fuel, CO_2 and costs, due to that track distance difference only.

It does not account for:

- Aircraft staying higher for longer – they are more fuel-efficient at higher levels
- Reduction in holding (whether in a racetrack pattern or airborne delay absorption by controller tactical vectoring) – each racetrack takes 4 minutes to fly
- Tactical shortcutting, where a controller spots an opportunity to bring a flight in on a shorter route – we assume the average flight follows the full path

The methodology is deliberately simplified and is proportional to the needs of the initial options appraisal. We believe it to be conservative.

The Step 2B Initial Options Appraisal document will use the figures for the single average flight for each option. If you wish, you may use this data to estimate the worst case or best case example, if you are interested in flights arriving from one particular direction.

Per-flight estimates of fuel, CO_2 equiv. and cost

UPPER DIFFERENCES

New STARs Opt 1.4		Legs nm					Total
Via waypt BARMI (from NE)	20.4	10	38.9	22.5	6.4	6.4	**104.6**
Via waypt IDESI (from E)	25.7	25.3	22.5	6.4	6.4		**86.3**
Via waypt CLIPY (from W, NW)	13.1	16.9	7.5	6.4			**43.9**
Via waypt VATON (from S)	21	14.9	12.4	11.7	6.4	6.4	**72.8**

Current STARs opt 1.1		Legs nm			Leave ABBOT to LOREL gate		Total
Via waypt BARMI (from NE)	19.8	10	24.7	23.4	24.2		**102.1**
Via waypt IDESI (from E)	28.3	23.4			24.2		**75.9**
Via waypt CLIPY (from W, NW)	26	17					**43**
Via waypt VATON (from S)	21	15.7	6.2				**42.9**

Difference	Newer route is longer	Proportion of flights using route #	Weighted mileage impact to get to new hold Newer average route is longer	
BARMI old minus new	2.5	1%	0.03	nm
IDESI old minus new	10.4	51%	5.30	nm
CLIPY old minus new	0.9	12%	0.11	nm
VATON old minus new	29.9	36%	10.76	nm

Weighted average single flight equivalent mileage disbenefit due to option 1.4 vs 1.1 - common disbenefit before getting to any lower option **16.2**

(Analytics report on proportions of Luton STAR usage, 2018)

LOWER DIFFERENCES

New arrival routes - Hold to Rwy	Opt	Length nm
08 Vectors	2.3	53
26 Vectors	2.4	37
08 S of LB	2.5	53
08 N of LB	2.7	54
26 S bend	2.8	39
26 Straight in	2.9	35

Current arrivals all via vicinity of LOREL gate to rwy	Opt	ATC expert estimate - Length nm
LOREL to 08	2.1	50
LOREL to 26	2.2	28

Difference between...	Newer route longer by... (nm)
2.1-2.3	**3**
2.2-2.4	**9**
2.1-2.5	**3**
2.1-2.7	**4**
2.2-2.8	**11**
2.2-2.9	**7**

TOTALS PER FLIGHT

Opt	Total track length increase (nm)	A320 fuel increase at FL160 (kg)	CO2 equiv increase (mt)	Fuel cost increase £
2.3	19.2	142.1	0.45	£ 68.27
2.4	25.2	186.5	0.59	£ 89.60
2.5	19.2	142.1	0.45	£ 68.27
2.7	20.2	149.5	0.48	£ 71.82
2.8	27.2	201.3	0.64	£ 96.71
2.9	23.2	171.7	0.55	£ 82.49

These are all increases (disbenefits) compared with today.
See assumptions and limitations.

FUEL

BADA 4.2 Typical A320 at FL160

7.4

approx kg fuel/nm of flight

CO_2

Conversion of jet fuel to CO_2

3.18

CO_2 equivalent ratio

COSTS

IATA jet fuel Cost per mt $

615.99 (08 Nov 19)

USD to GBP

0.78 (13 Nov 19)

ASSUMPTIONS, LIMITATIONS

Doesn't calc difference: staying higher for longer expected

Doesn't calc difference: significantly less holding expected

Doesn't calc shortcutting, assumes all go to new hold fix

This section combines upper arrivals from all directions into a single flight representing the average track distance change due to Option 1.4

This section finds the differences between the lower options

This section calculates the totals per lower option for a single A320 arrival, assuming the upper change is common. Also provides the data sources and lists some assumptions & limitations.

End

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Analysis performed by Noise Consultants Ltd on behalf of Trax International Ltd