Farnborough Airport

Airspace Change Post Implementation Review

CAA Reference ACP-2013-07

Annex A Traffic Dispersion and
Environmental Overflight Diagrams Items 34 and 49

Record of Revisions

Issue	Date	Reason for Change
1.0	2023-05-15	Published

Contents

1 About this document

1.1 Introduction

1.1.1 This document is part of the Farnborough Airport airspace change post-implementation review (ACP PIR). It should be read in conjunction with the main PIR document which provides the structure, the majority of the evidence, and details the regulatory requirements for the PIR. It should also be read in conjunction with Annex D Stakeholder Feedback and Complaints.

1.1.2 This document's purpose is, in essence, to provide evidence of pre-ACP flightpaths, post-ACP flightpaths, and provide context on whether the change is as expected.

1.1.3 Specifically, its purpose is to cover the following items from the CAA's PIR list:

Traffic dispersion 34a-34c

- 34a: Density plots that show concentration and lateral dispersion.
- 34b: Density plots that show vertical profiles.
- 34c: Weather/MET impacts.

Environmental: Overflight and Operational Diagrams 49k-49m

- 49k: Operational diagrams (for example, radar track diagrams and track density diagrams) overlaid on Ordnance Survey maps or similar.
- 49l, 49m: Calculation of overflight

Environmental: Tranquillity and Visual Intrusion 49r

- 49r: Operational diagrams clearly identifying traffic over relevant AONBs and National Parks up to 7,000ft.

1.2 Analysis Method

1.2.1 This document provides maps of the region overlaid with processed radar data of actual flights, to illustrate how this airspace change proposal (ACP) changed flightpaths, in turn helping indicate how impacts due to overflight would change.

1.2.2 As required by the CAA and informed by the 2014 Government guidance (ANG2014) in place at the time, air traffic flows will be illustrated from the runway to 7,000ft, and zoomed in from the runway to 4,000ft.

1.2.3 Our data samples are the months of June 2019 (pre-change) and August 2022 (post-change). These were chosen because they are considered by Farnborough Airport air traffic control experts to be representative of typical traffic flows, before and after the airspace change, for both easterly and westerly operations. Each data sample month has a sufficient set of Runway 06 (easterly) operations, which many months do not have, given that Runway 24 (westerly) is typically used three times as frequently.

1.2.4 The primary information will show radar data processed into density plots, with each colour associated with a number of times overflight over a place occurred per day. The density plots show all traffic (arrivals and departures) for both runways. The outer grey density indicates fewer than one overflight per day and is not considered a significant impact, but is included to illustrate the overall situation.

1.2.5 The tool used to perform the density plotting task is unable to consistently differentiate between arrivals and departures, providing potentially inaccurate results under test conditions. To mitigate this, each diagram therefore shows the full month of density plot data for combined arrivals and departures, and easterly and westerly operations.

1.2.6 The plots are then overlaid with colour-keyed altitude swathes, arrows and other annotations to allow the reader to understand how the air traffic flows worked before

and after the airspace change. This overlaying was carried out and validated by expert air traffic controllers.

1.2.7 The diagrams also show the outlines of relevant Areas of Outstanding Natural Beauty (AONB) and the South Downs National Park.

1.2.8 The diagrams are followed by explanations on how and where the flows operate, the differences between pre and post-ACP operations, and we compare the post-ACP results with our original expectations from the consultation material.

1.2.9 June 2019 was hot and sometimes rainy, August 2022 was also hot with some rain. These were not considered significant weather events to affect the data samples.

1.2.10 Separate diagrams later in this document (Section 4 from page 33) provide information on population overflown, an indicator of predicted noise impacts. This is done twice, as required and recommended by the CAA; first using a simple method as per the original ACP, second using a more accurate, complex method known as CAP1498. The latter was defined and developed by the CAA after this ACP had been submitted.

2 Departures: Runway to 4,000ft, and 4,000ft-7,000ft

2.1.1 The diagrams on the following pages illustrate Runway 06 departures before and after the airspace change, up to 4,000ft, followed by Runway 24 departures likewise, and then again from 4-7,000ft.

2.2 Pre-ACP departures from Runway 06 up to 4,000ft

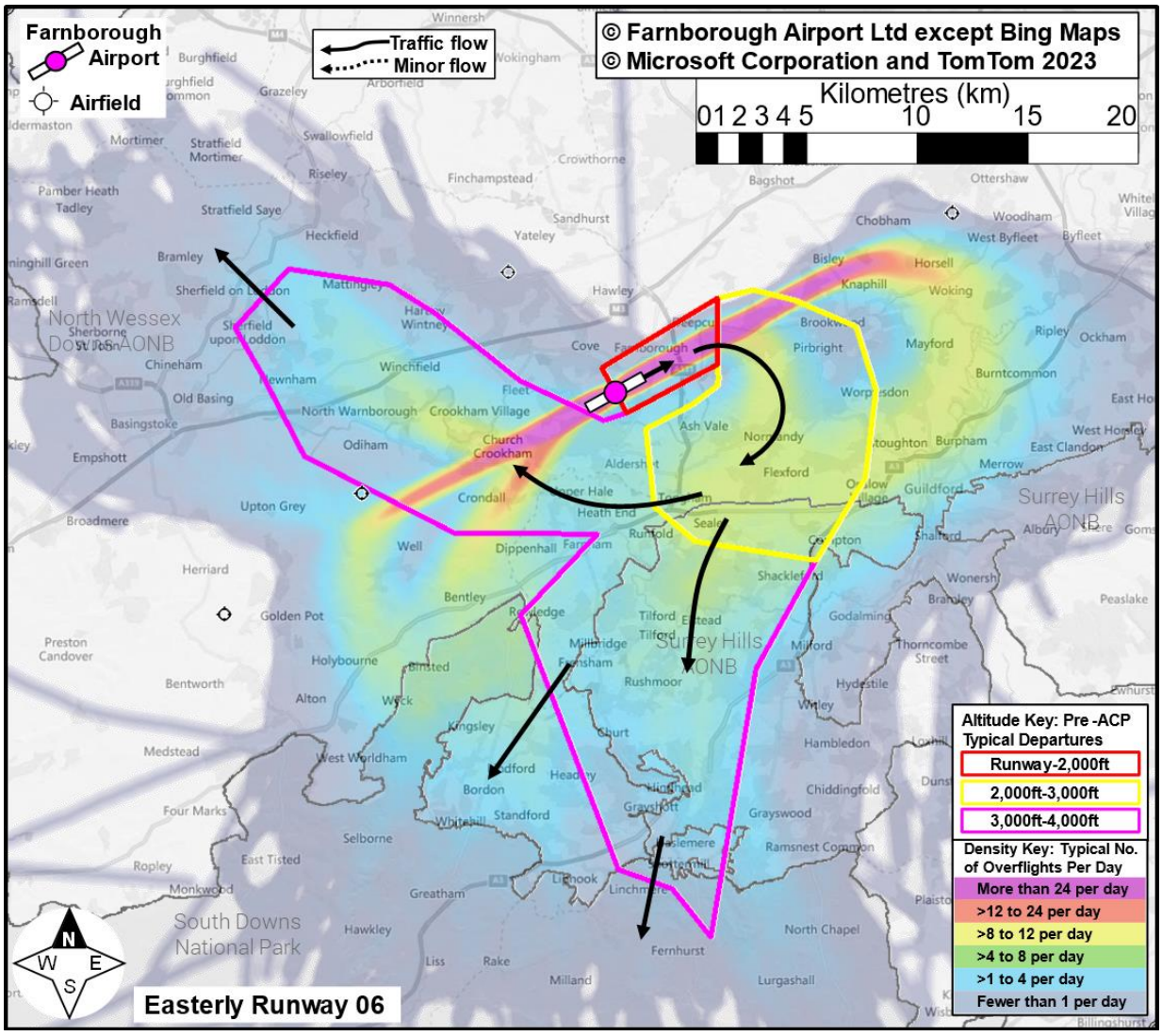

Figure 1 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Departures to 4,000ft from Easterly Runway 06

2.2.1 Pre-ACP departures from Runway 06 climbed through 2,000ft and start a right turn between Deepcut and Pirbright. Typically they were spread between 2-3,000ft until after the A31 Hog's Back.

2.2.2 Northbound departures continued the right turn towards Church Crookham and generally remained below 4,000ft until 6-7km past the M3.

2.2.3 Southbound departures climbed from 3-4,000ft after the A31 towards Elstead and Haslemere in a relatively wide swathe.

2.2.4 Southwest bound departures were generally routed towards Frensham.

2.2.5 South and southwest bound departures overflew the Surrey Hills AONB in a spread from below 3,000ft to 4,000ft where they cross over the northern boundary of the South Downs National Park.

2.2.6 This is consistent with the original consultation material (link to 2014 consultation material, see Part B Figure B5 on page B37).

2.2.7 See Section 2.6 on page 11 for Pre-ACP departures from Runway 06, 4-7,000ft.

2.3 Post-ACP departures from Runway 06 up to 4,000ft

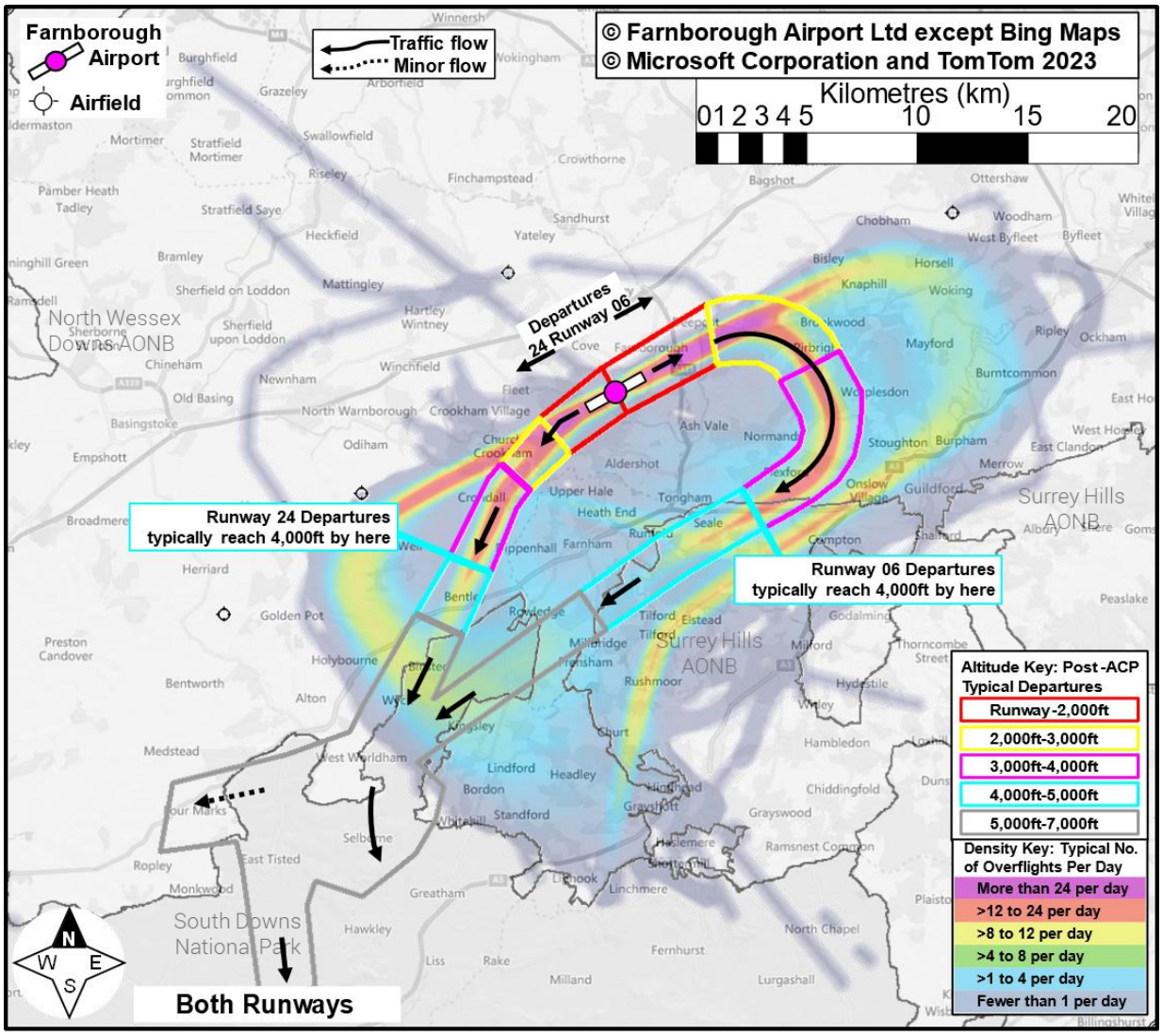

Figure 2 Density Plot and Flow Diagram: Aug 2022 Post-ACP Departures to 4,000ft from Easterly Runway 06

2.3.1 Flights reach 4,000ft much more quickly than pre-ACP. This diagram illustrates radar data up to 4,000ft but the swathes show the climb to 7,000ft fits within the same area as the 4,000ft climb pre-ACP. Also, the tracks to 4,000ft are so short that departures from both runways can be shown on the same diagram.

2.3.2 Post-ACP departures from Runway 06 climb through 2,000ft and start a right turn at Deepcut not dissimilar to pre-ACP.

2.3.3 Typically all departures closely follow the same defined route, continuing their climb above 2,000ft, reaching 3,000ft around Pirbright.

2.3.4 After Pirbright, Worplesdon and Wood Street the turn and climb continues southwest towards the A31 Hog's Back, at which point flights are typically at or above 4,000ft as shown by the end of the pink swathe.

2.3.5 The A31 Hog's Back is the northern boundary of the Surrey Hills AONB, so most departures from Runway 06 are typically reaching or exceeding 4,000ft.

2.3.6 As expected, this is c.1,000ft higher than pre-ACP; few Runway 06 departures overfly Surrey Hills AONB below 4,000ft and none overfly the South Downs National Park below 4,000ft. Also as expected, the spread of flights is narrower, closely following the programmed route.

2.3.7 This is all consistent with Feedback Report B's prediction following the original consultation (link to Feedback Report B, see Figure 4 on page B17).

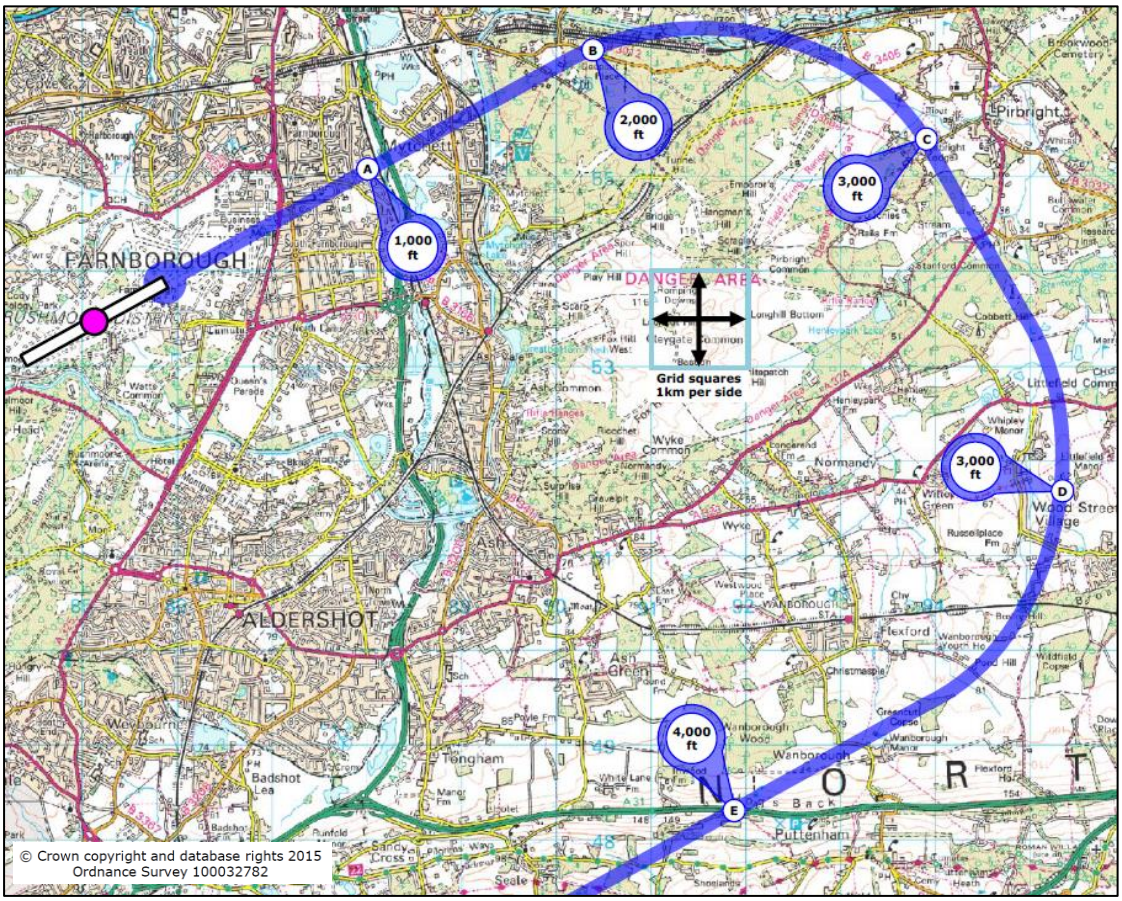

Figure 3 Extract from original material, illustrating the same region

2.3.8 See section 2.8 on page 13 for Post-ACP departures from both runways, 4-7,000ft.

2.4 Pre-ACP departures from Runway 24 up to 4,000ft

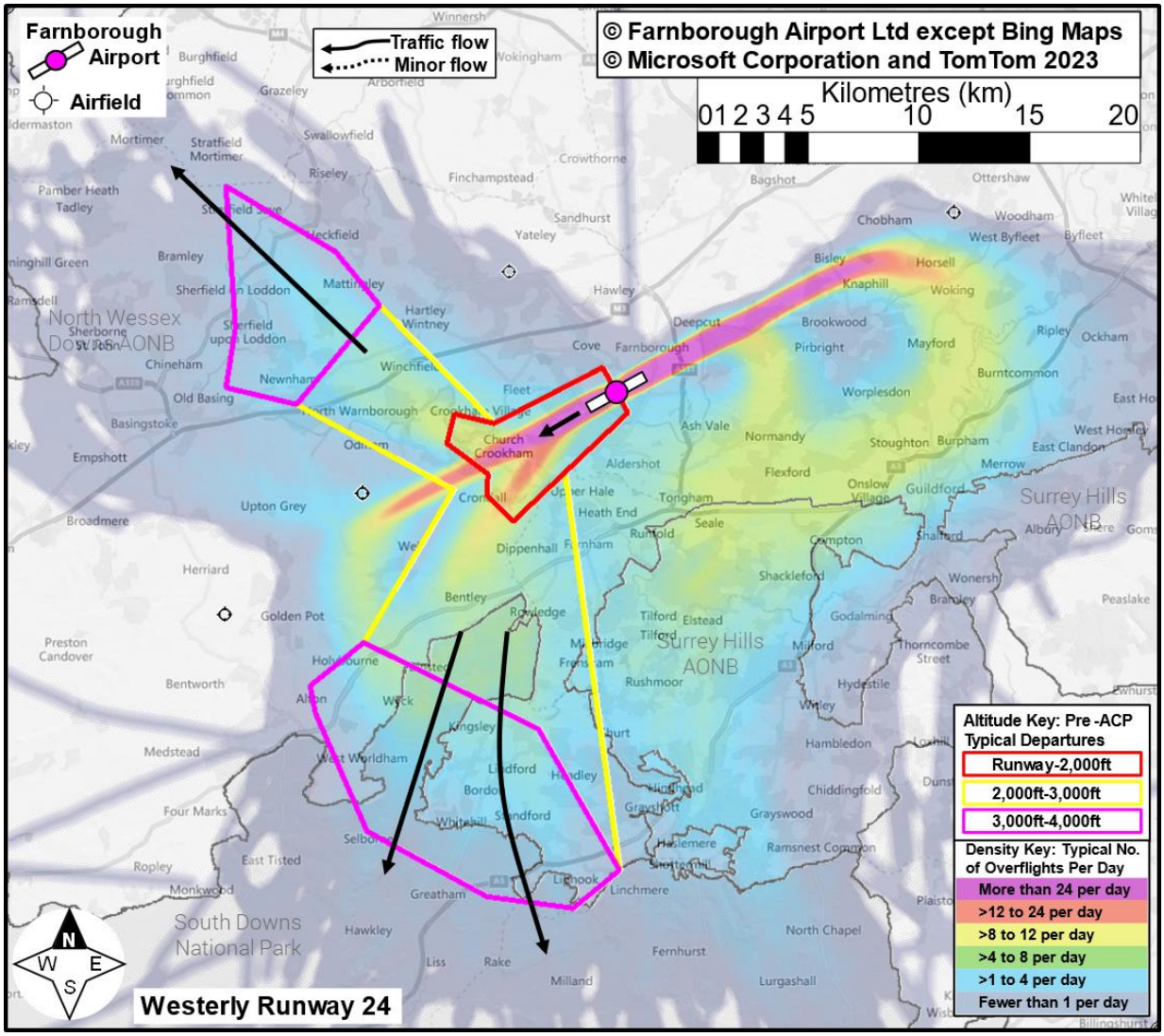

Figure 4 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Departures to 4,000ft from Westerly Runway 24

2.4.1 Pre-ACP departures from Runway 24 climbed through 2,000ft around Church Crookham. About half were instructed to turn right, and the rest were turned left to avoid RAF Odiham.

2.4.2 Those that turned right generally passed 3,000ft north of the M3 in a swathe tracking northwest. They reached or exceeded 4,000ft after crossing the A33 near Sherfield-On-Loddon.

2.4.3 Those that turned left typically headed south towards Rowledge, or southwest towards Bentley and the A31.

2.4.4 The southbound flow passed 3,000ft around Kingsley or Headley, and then reached or exceeded 4,000ft near Liphook and the A3.

2.4.5 The southwest bound flow passed 3,000ft around Binsted and then reached or exceeded 4,000ft around Selborne.

2.4.6 The south and southwest bound flows overfly the South Downs National Park from below 3,000ft to 4,000ft, with a few grazing the western edge of the Surrey Hills AONB near Frensham between 2-3,000ft.

2.4.7 This is consistent with the original consultation material (link to 2014 consultation material, see Part B Figure B6 on page B38).

2.4.8 See section 2.7 on page 12 for Pre-ACP departures from Runway 24, 4-7,000ft.

2.5 Post-ACP departures from Runway 24 up to 4,000ft

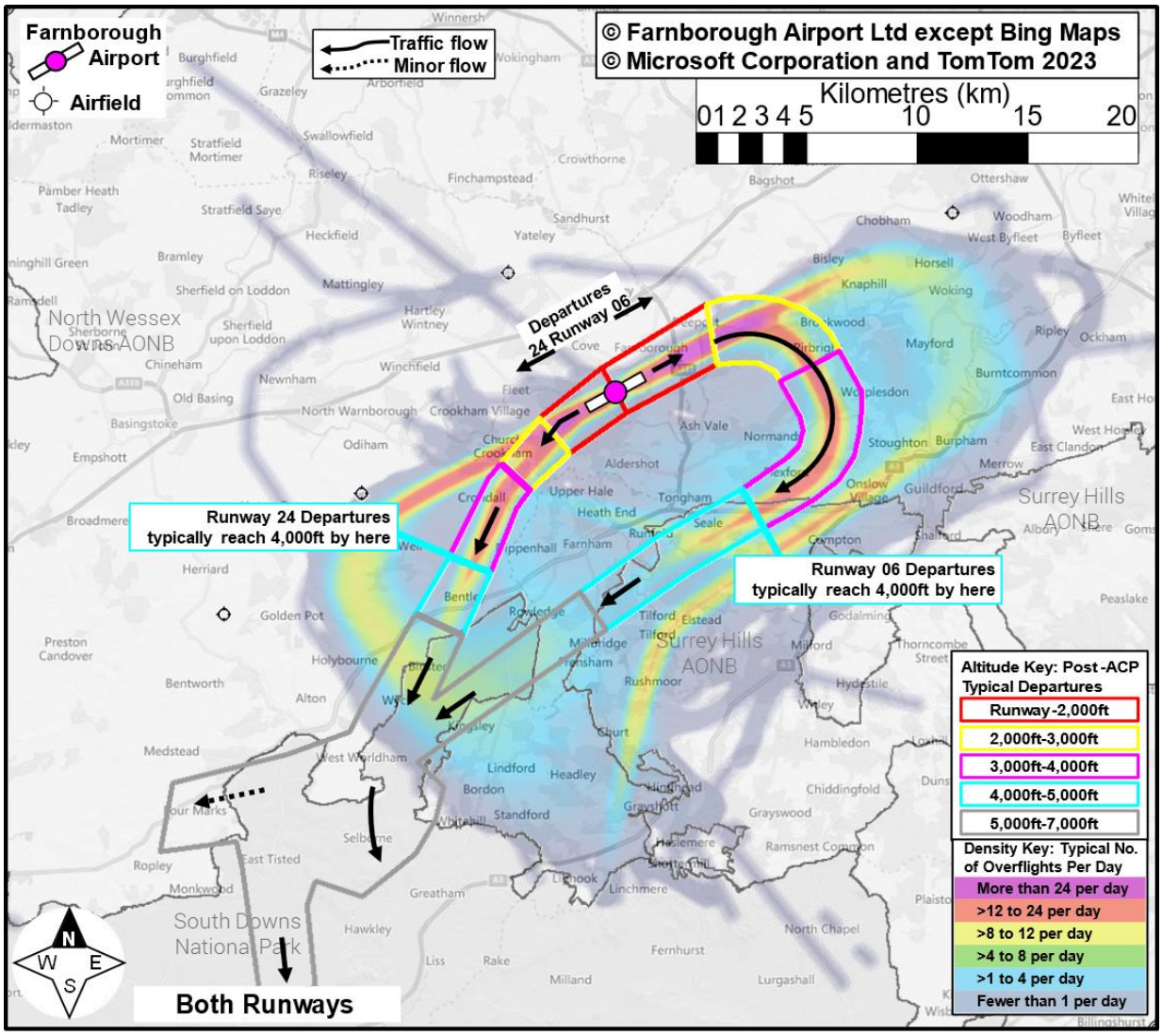

Figure 5 Density Plot and Flow Diagram: Aug 2022 Post-ACP Departures to 4,000ft from Westerly Runway 24

2.5.1 Flights reach 4,000ft much more quickly than pre-ACP. This diagram illustrates radar data up to 4,000ft but the swathes show the climb to 7,000ft fits within the same area as the 4,000ft climb pre-ACP. Also, the tracks to 4,000ft are so short that departures from both runways can be shown on the same diagram.

2.5.2 Post-ACP departures from Runway 24 turn left immediately to avoid Church Crookham as much as possible compared with pre-ACP, and climb through 2,000ft by the Bourley Road, c.3.5km sooner than pre-ACP.

2.5.3 Typically all departures closely follow the same defined route, continuing their climb above 2,000ft, reaching 3,000ft around Ewshot and the A287.

2.5.4 Around Ewshot and Crondall there is a slight left turn. The climb continues southwest towards Bentley and the A31, at which point flights are typically at or above 4,000ft as shown by the end of the pink swathe.

2.5.5 As expected, this is c.1-2,000ft higher than pre-ACP. Runway 24 departures overfly neither the South Downs National Park nor the Surrey Hills AONB below 4,000ft. Also as expected, the spread of flights is narrower, closely following the programmed route.

2.5.6 This is all consistent with Feedback Report B's prediction following the original consultation (link to Feedback Report B, see Figure 5 on page B19).

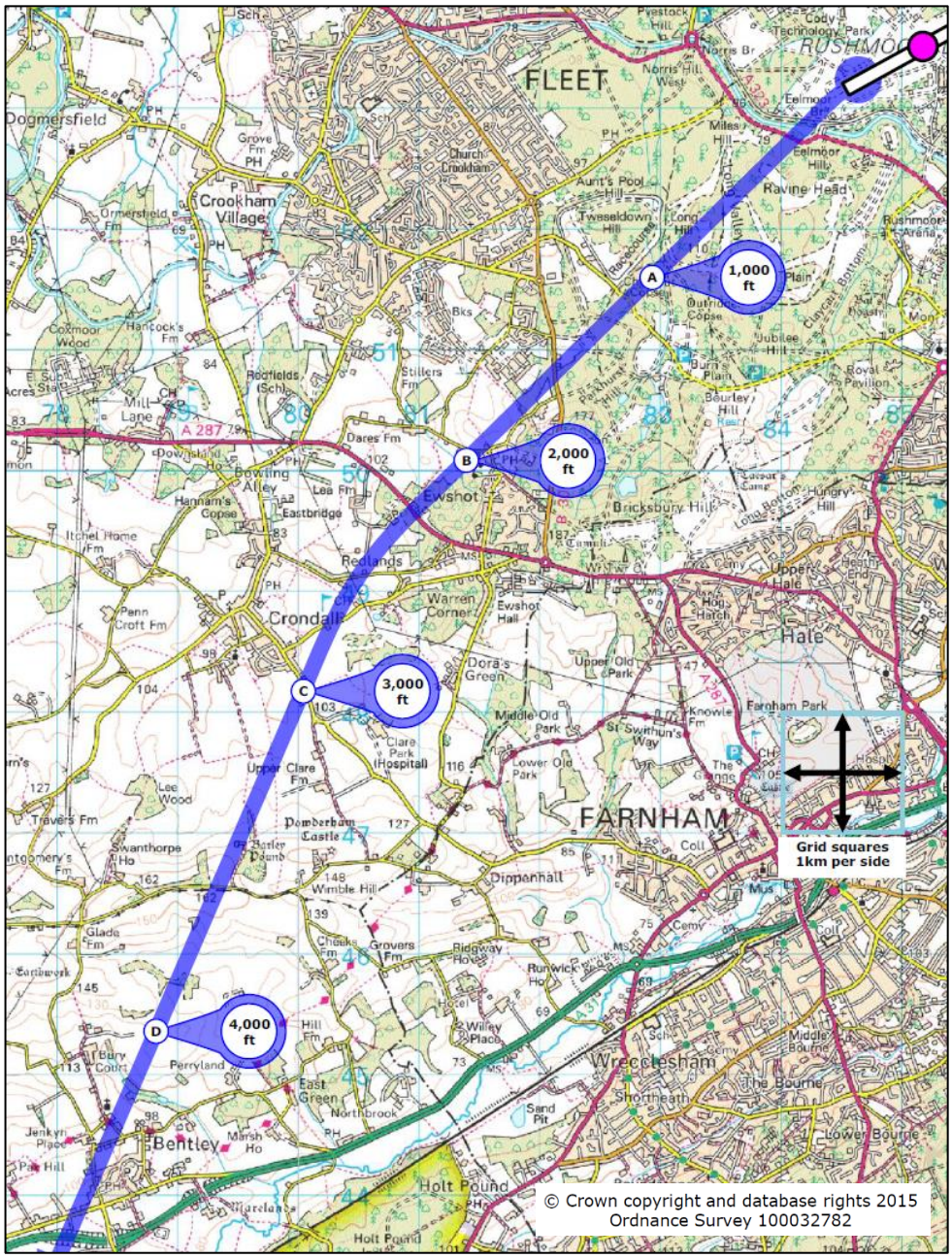

Figure 6 Extract from original material, illustrating the same region

2.5.7 See section 2.8 on page 13 for Post-ACP departures from both runways, 4-7,000ft.

2.6 Pre-ACP departures from Runway 06, 4-7,000ft

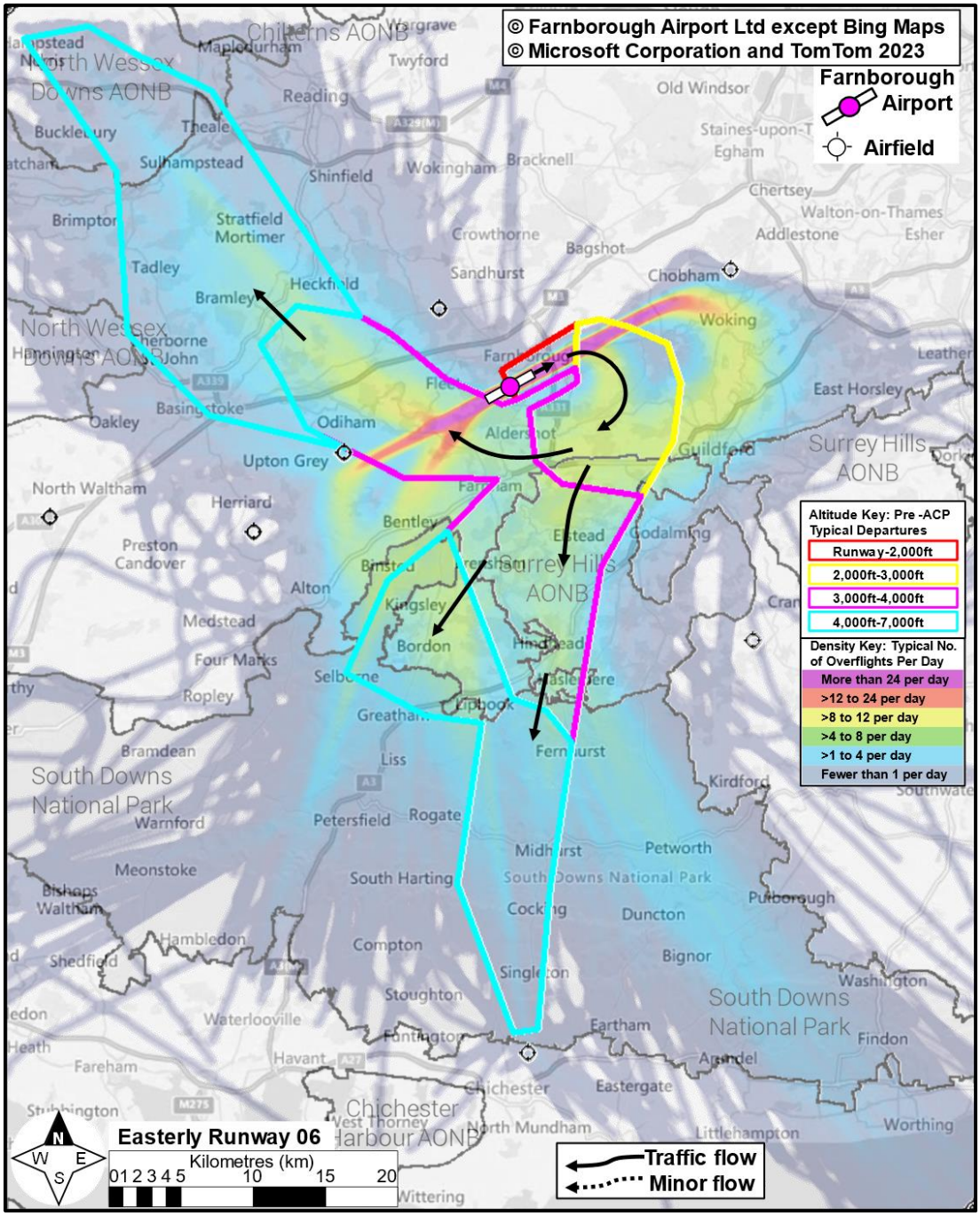

Figure 7 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Departures 4-7,000ft from Runway 06

2.6.1 See section 2.2 on page 5 for Pre-ACP departures from Runway 06 up to 4,000ft.

2.6.2 Pre-ACP departures from Runway 06 between 4-7,000ft are shown by the cyan swathes. The sheer variability of where departures climbed made it impractical to identify and define consistent intermediate swathes to where they join the air route network.

2.6.3 The swathe to the south extends over the South Downs National Park from 4-7,000ft towards Goodwood. The swathe to the southwest overflies the South Downs National Park from 4-7,000ft towards Selborne and Greatham. Traffic to the northwest overflies the North Wessex Downs AONB at the higher end of the 4-7,000ft cyan swathe and onwards to join the air route network.

2.6.4 This is consistent with, but slightly higher than, the flightpaths illustrated in the original consultation material (link to 2014 consultation material, see Part C Figure C6 on page C33).

2.7 Pre-ACP departures from Runway 24, 4-7,000ft

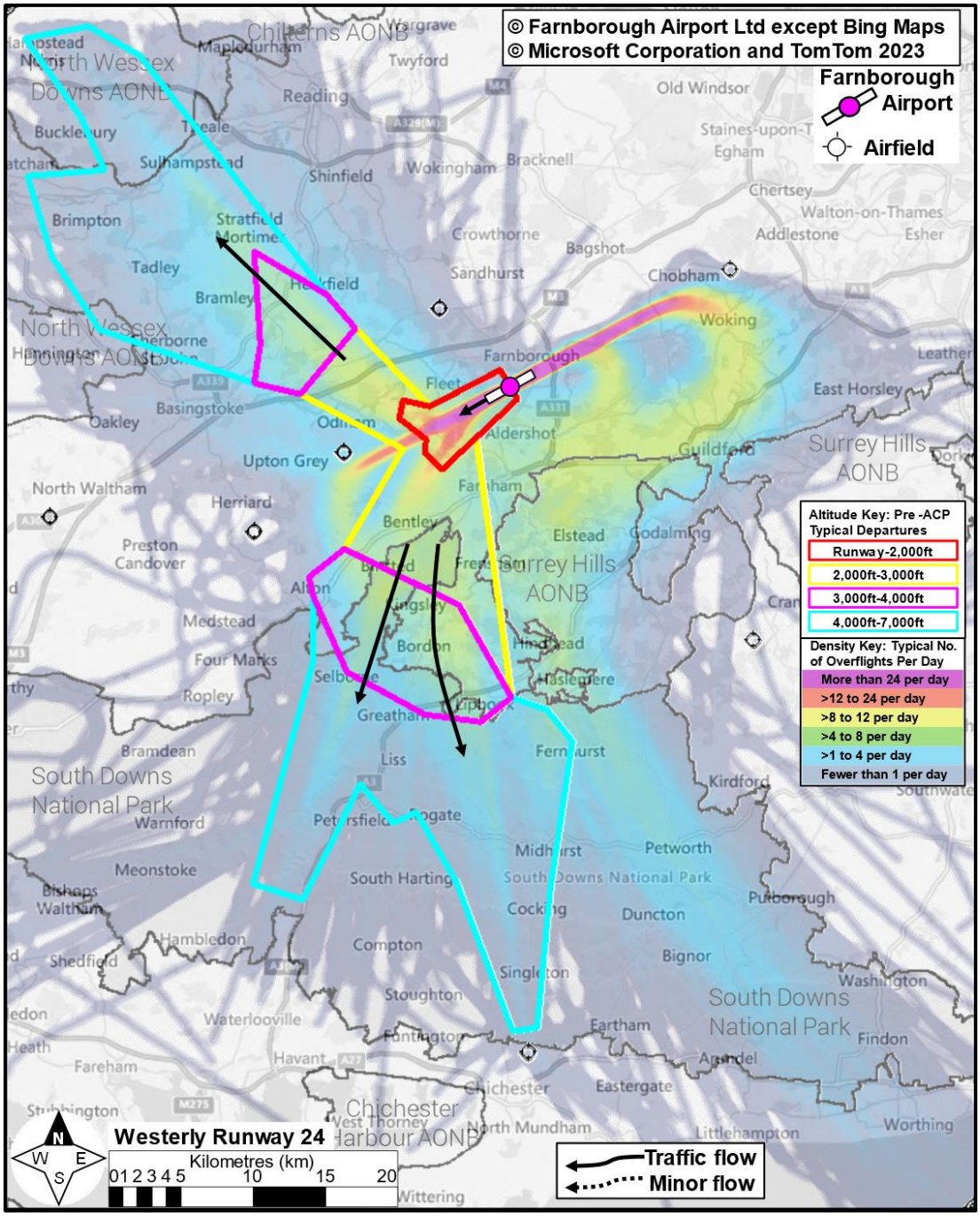

Figure 8 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Departures 4-7,000ft from Runway 24

2.7.1 See section 2.4 on page 8 for Pre-ACP departures from Runway 24 up to 4,000ft.

2.7.2 Pre-ACP departures from Runway 24 between 4-7,000ft are shown by the cyan swathes. The sheer variability of where departures climbed made it impractical to identify and define consistent intermediate swathes to where they join the air route network.

2.7.3 The swathe to the south extends over the South Downs National Park from below 4,000ft-7,000ft towards Goodwood. The swathe to the southwest overflies the South Downs National Park from below 4,000ft-7,000ft towards Petersfield and Clanfield on the A3. Traffic to the northwest overflies the North Wessex Downs AONB at the higher end of the 4-7,000ft cyan swathe to join the air route network.

2.7.4 This is consistent with, but slightly higher than, the flightpaths illustrated in the original consultation material (link to 2014 consultation material, see Part C Figure C6 on page C33).

2.8 Post-ACP departures from both runways, 4-7,000ft

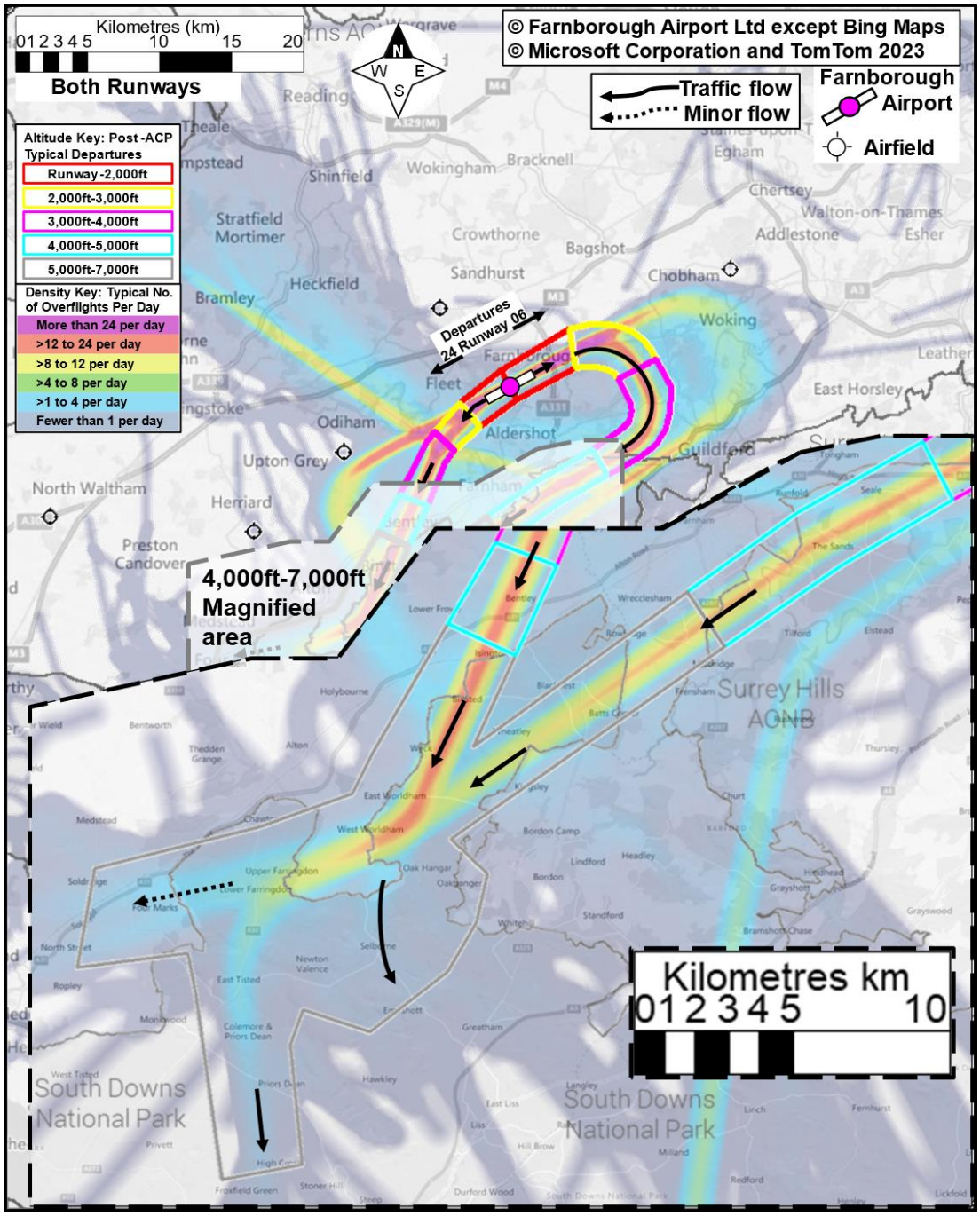

Figure 9 Density Plot and Flow Diagram: Aug 2022 Post-ACP Departures 4-7,000ft from both runways

2.8.1 See section 2.3 on page 6 for Post-ACP departures from Runway 06 up to 4,000ft, and section 2.5 on page 9 for Post-ACP departures from Runway 24 up to 4,000ft. Both diagrams are the same, due to the compactness of the post-ACP departure routes.

2.8.2 Departures from Runway 06 typically climb from 4-5,000ft following the programmed route over the northwestern edge of the Surrey Hills AONB as illustrated by the longer cyan swathe. North of Frensham the Runway 06 departure flow typically reaches or exceeds 5,000ft, entering the grey swathe and climbing from 5-7,000ft as discussed below.

2.8.3 Departures from Runway 24 typically climb from 4-5,000ft following the programmed route in the vicinity of Bentley, and over the northern edge of the South Downs National Park as illustrated by the shorter cyan swathe. By Isington and Binsted the

Runway 24 departure flow typically reaches or exceeds 5,000ft, entering the grey swathe and climbing from 5-7,000ft as discussed below.

2.8.4 The Runway 06 and Runway 24 departure flows converge[1] in the grey swathe from 5-7,000ft near West Worldham. After West Worldham the traffic from either runway behaves in the same way. Most flights reach or exceed 7,000ft in the vicinity of the Farringdons at the end of the red and yellow density area, then onwards to the air route network. The remaining flights with destinations north, northwest or northeast continue to head west and typically reach or exceed 7,000ft by the A31 at Four Marks. Here they enter and immediately exit a small bulge in the South Downs National Park generally between 6-7,000ft, then onwards to the air route network.

2.8.5 The remaining flights with destinations south, southwest or southeast make a left turn south over the Farringdons. Typically they reach or exceed 7,000ft and join the air route network by High Cross or Froxfield Green, overflying the South Downs National Park for a much shorter distance and smaller area than pre-ACP. Some flights are turned left earlier, towards Selborne hence the slight bulge in the grey swathe.

2.8.6 As expected, this is significantly higher than pre-ACP. Also as expected, the spread of flights is narrower, closely following the programmed routes.

2.8.7 This is consistent with Feedback Report C's updated climb prediction following the second consultation (link to Feedback Report C, see the right panel of Figure 4 on page C14). Flights are typically higher sooner than expected, leading to fewer sub-7,000ft departures east of the A325 near Bordon.

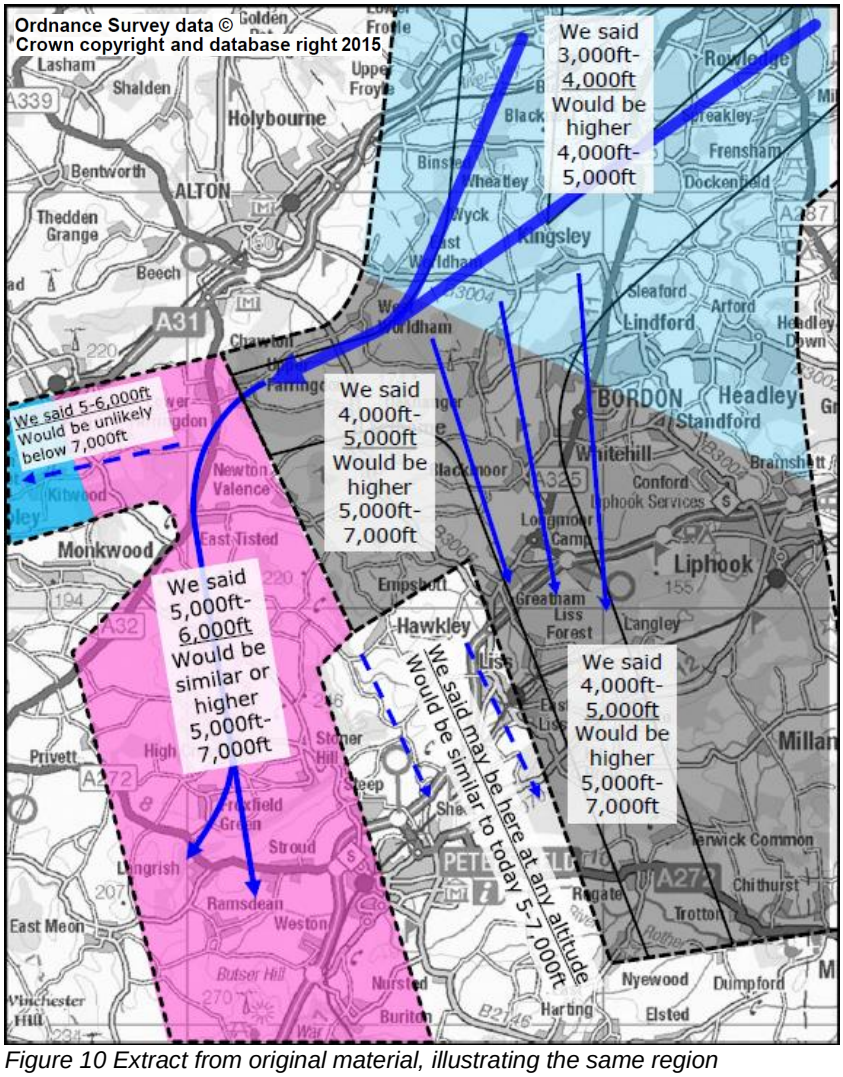

Figure 10 Extract from original material, illustrating the same region

[1] Only one runway can be in use at once therefore the flows are safely mutually exclusive.

2.9 Departures Summary and Conclusion

2.9.1 The post-ACP departures are consistent with the original material and are behaving in line with expectations.

2.9.2 The overflight areas are shorter, smaller areas are overflown with less natural dispersal, and in many cases the climb profile is better than expected.

2.9.3 As per the original material, where practical the routes aimed to minimise overflight of populated areas. Smaller areas overflown by predictable, consistent flightpaths by similar numbers of flights means fewer people would be impacted by more frequent aircraft noise events.

2.9.4 Also as per the original material, avoiding overflight of one area inevitably means flights over neighbouring areas instead. The route position/design was limited by aircraft manoeuvrability, adjacent airspace infrastructure such as RAF Odiham, Heathrow and Gatwick, and international flight procedure design standards.

2.9.5 National Parks and AONBs are valued by some for their tranquillity. Overflight of National Parks and AONBs below 7,000ft is not prohibited and would be impractical, given the relative geography involved and the general Government guidance in effect at the time to minimise populated areas being overflown at low altitudes (see ANG2014). However, we have demonstrated that overflight of National Parks and AONBs below 4,000ft and below 7,000ft have both been significantly reduced. A consequence of this is that the frequency of overflight has increased in those areas where overflight does occur. This could be either a benefit or an impact on tranquillity and also visual intrusion, depending on the observer's point of view and specific location. This is as expected and is consistent with the original materials.

3 Arrivals: 7,000ft-4,000ft, and 4,000ft to the runway

3.1.1 The diagrams on the following pages illustrate the combined arrival flows to both runways as they descend from 7,000ft-4,000ft before and after the airspace change, Runway 06 arrivals before and after the airspace change descending from 4,000ft to the runway, followed by Runway 24 arrivals likewise.

3.2 Pre-ACP arrivals to both runways, 7,000ft-4,000ft

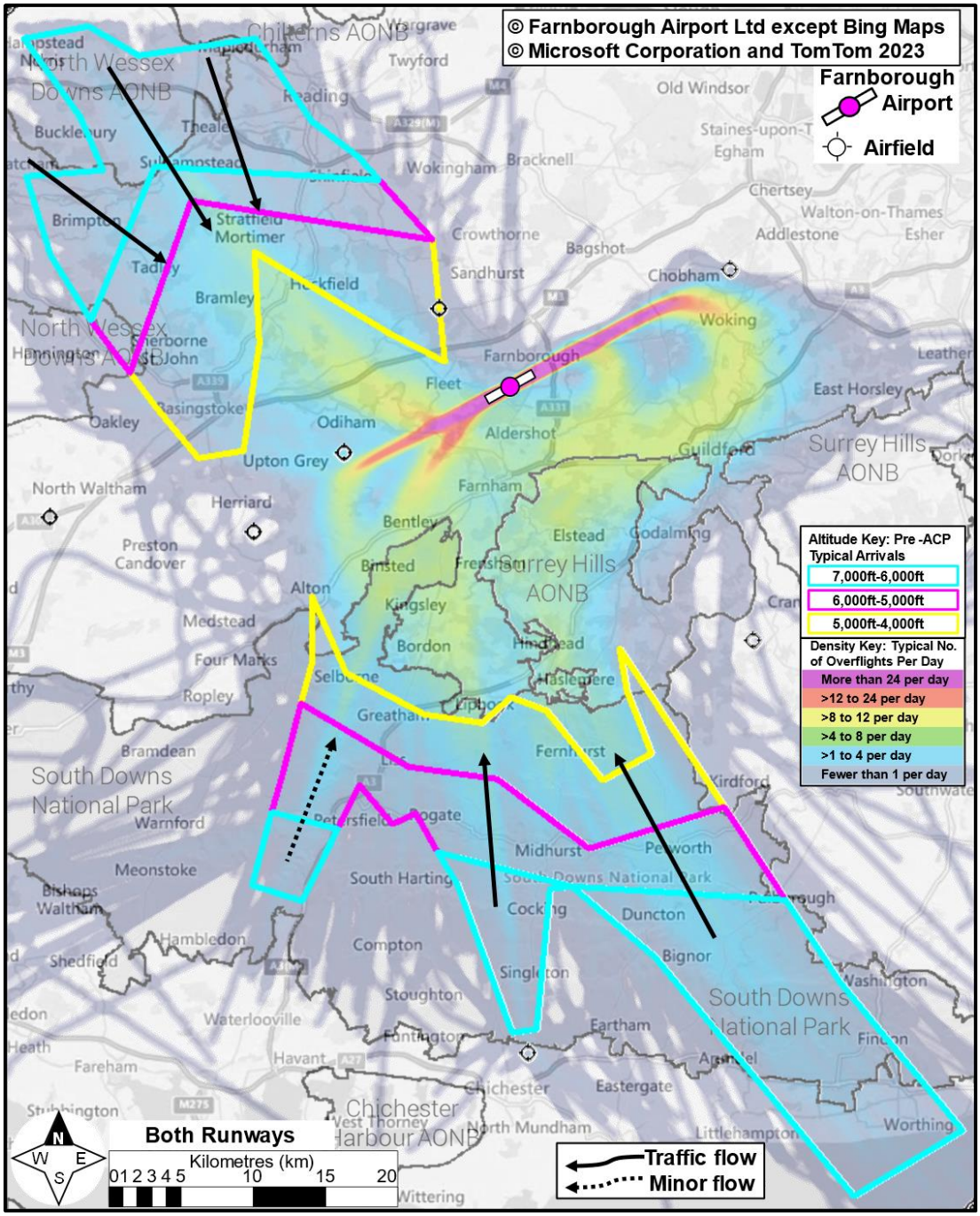

Figure 11 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Arrivals 7,000ft-4,000ft to both runways

3.2.1 See section 3.4 on page 21 for Pre-ACP arrivals from 4,000ft to Runway 06
See section 3.6 on page 24 for Pre-ACP arrivals from 4,000ft to Runway 24.

3.2.2 Pre-ACP arrivals to both runways from 7-4,000ft are shown by the swathes in the diagram above. All arrivals from the south overfly the South Downs National Park from 7-4,000ft. Most northern arrivals overfly the North Wessex AONB from 7-6,000ft.

3.2.3 Arrivals from the southeast descended from the Worthing area, passed 6,000ft in the vicinity of Duncton, 5,000ft north of Petworth and 4,000ft in the vicinity of Fernhurst.

3.2.4 Arrivals from the south descended from the Goodwood area, passed 6,000ft in the vicinity of Cocking, 5,000ft north of Midhurst near Milland, and 4,000ft at Liphook.

3.2.5 A less prominent flow from the southwest approximated the A3 road from Clanfield. They descended through 6,000ft at Petersfield, 5,000ft at Liss, 4,000ft at Selborne.

3.2.6 From the north, arrivals crossed 6,000ft near Sulhampstead, 5,000ft around Tadley, and 4,000ft approximately at the A33 north of Basingstoke.

3.2.7 This is consistent with, but slightly higher than, the flightpaths illustrated in the original consultation material (link to 2014 consultation material, see Part C Figure C7 on page C34).

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3.3 Post-ACP arrivals to both runways, 7,000ft-4,000ft

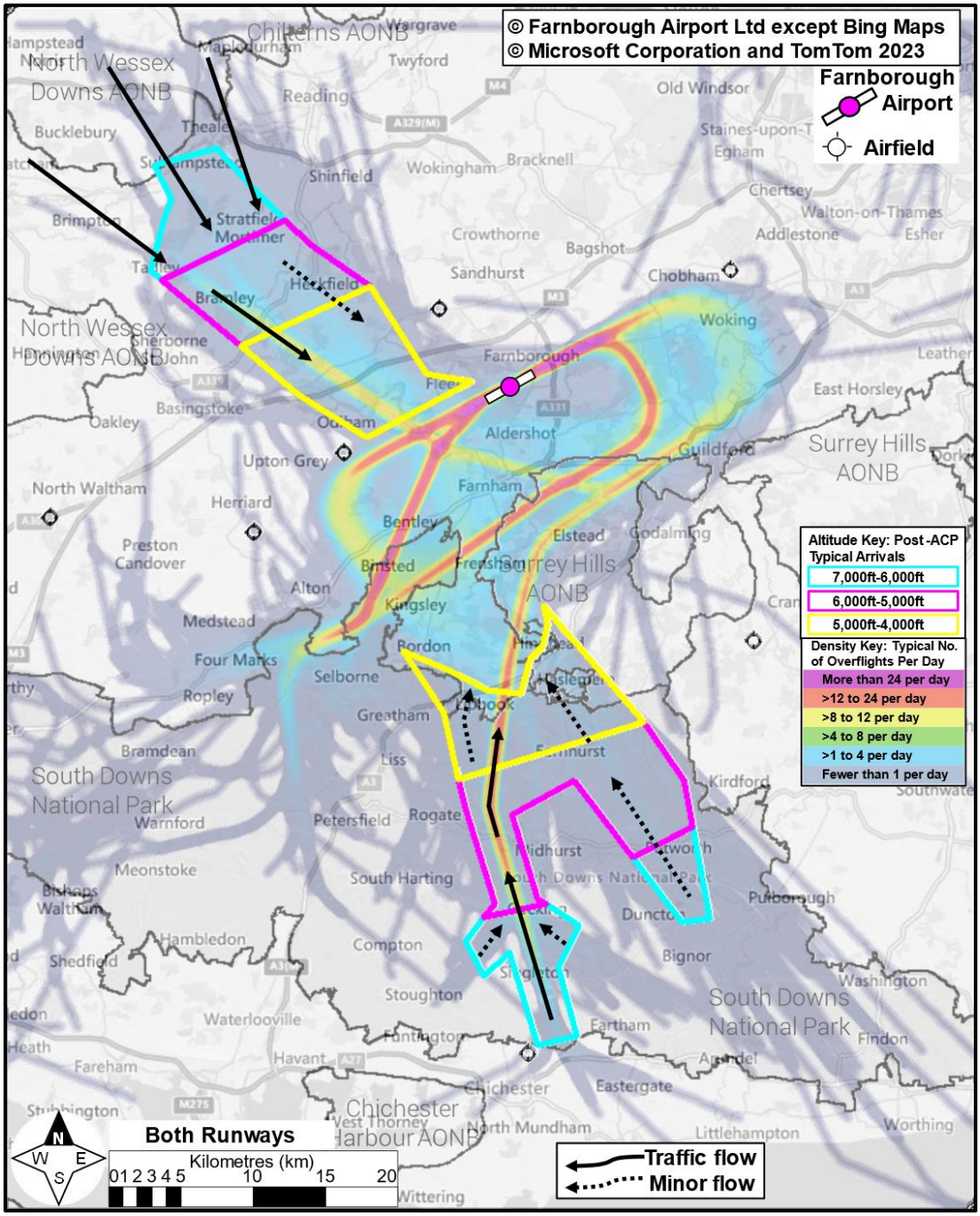


Figure 12 Density Plot and Flow Diagram: Aug 2022 Post-ACP Arrivals 7,000ft-4,000ft to both runways

3.3.1 See section 3.5 on page 22 for Post-ACP arrivals from 4,000ft to Runway 06.
See section 3.7 on page 25 for Post-ACP arrivals from 4,000ft to Runway 24.

3.3.2 Post-ACP arrivals to both runways from 7-4,000ft are shown by the swathes in the diagram above. All arrivals from the south overfly the South Downs National Park from 7-4,000ft in a much narrower primary swathe than pre-ACP.

3.3.3 From the southwest, south and southeast most arrivals typically converge above 7,000ft near Goodwood, following the narrower primary swathe where two less prominent shortcut-flows converge in the vicinity of Cocking c.6,000ft, which is higher than pre-ACP. After crossing Cocking they cross the A272 and the primary flow turns right to descend through 5,000ft near Milland at the Fernhurst road, then towards Liphook and the A3 where 4,000ft is reached. At most places along this flow the aircraft are several hundred feet to a thousand feet higher than pre-ACP, and in a narrower northbound flow.

3.3.4 Another less prominent flow shortcuts northwards from the southeast via Duncton and Petworth, passing 5,000ft around Black Down in the South Downs National Park, and 4,000ft north of the A3 around Hindhead. This is also several hundred feet to a thousand feet higher than pre-ACP.

3.3.5 Northern arrivals are also higher at all places along the arrival flow compared with the pre-ACP swathes, and now do not overfly the North Wessex AONB below 7,000ft.

3.3.6 This is broadly consistent with the predicted flightpath arrangement described in the second consultation material, with some differences in the southern arrival flows to be addressed (link to 2016 consultation material, see Figure 3 on page 9).

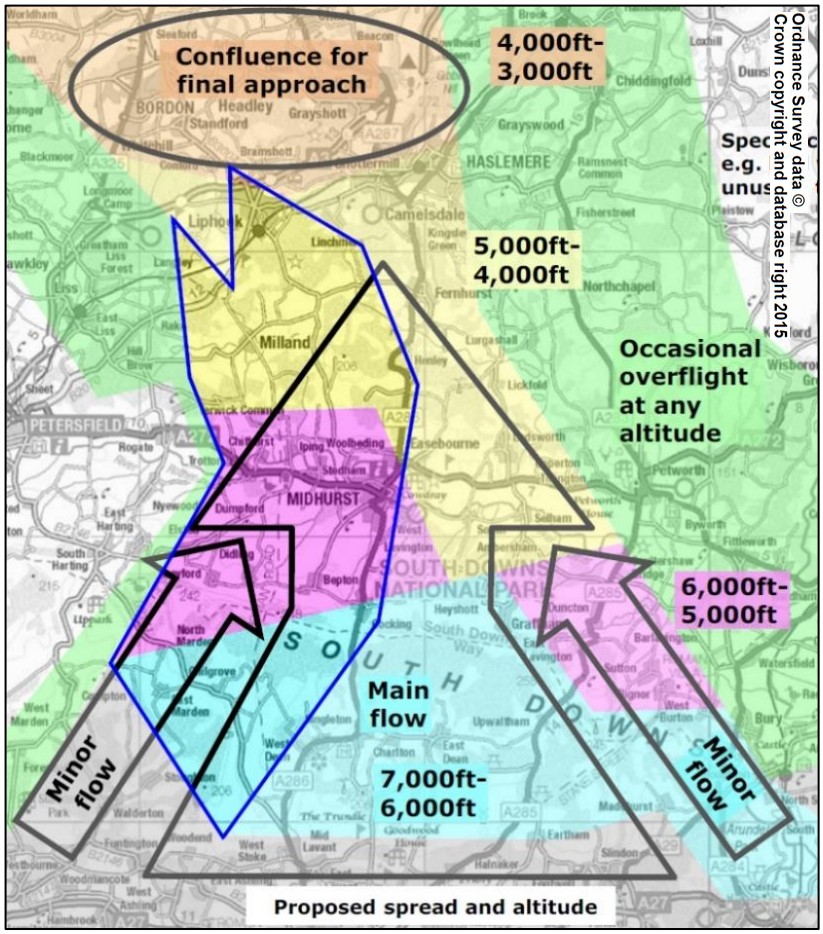


Figure 13 Extract from original material, illustrating the same region

3.3.7 The density plot in Figure 12 on the previous page shows a concentration of arrivals along the primary route to the west.

3.3.8 We originally stated that the main convergence would happen further south, forming one main flow with two minor flows positioned further west, the overall flow width narrower than today. This has occurred, with the westernmost minor flow generally joining the west of Cocking rather than remaining distinct.

3.3.9 However we also expected there to be somewhat of a spread of arrivals away from the main flow, towards the east[2].

3.3.10 The main flow width is narrower than originally predicted, with fewer flights positioned to the east. Broadly the overall arrangement remains similar, including the descending arrival altitudes which are as predicted or typically slightly higher, and the confluence for final approach below 4,000ft is, as stated, in the region of Bordon to Hindhead (see later for runway-specific arrival arrangements below 4,000ft).

[2] Paraphrased from the second consultation document (link) page 7 para 3.8-3.11.

3.3.11 We identified a contributory factor for this narrowing. During the PIR period, departures from Gatwick heading west (via Southampton) were less frequent than had been experienced prior to the COVID-19 pandemic.

3.3.12 Therefore, as there were fewer flightpath interactions requiring controller intervention, a higher-than-expected density of traffic could remain on the programmed arrival route.

3.3.13 There was less controller need to shortcut the flights from waypoints 12-24km offshore over the English Channel south of Worthing (known as NOTGI and EVEXU) to waypoints closer to the airport (known as LUXIV near Liphook and EVATA near Churt); this is the less prominent flow to the east described in paragraph 3.3.4 above. These shortcuts were originally regularly expected, and would have increased dispersal in the region. Should Gatwick departures towards Southampton return to their previous frequency, that dispersal to the east may manifest, and the secondary cyan swathe may widen and extend further south.

3.3.14 Farnborough's overall arrival operation remains broadly comparable with the original material, and this specific consequence of changes to Gatwick's departure proportions could not have been predicted at the time of writing.

3.3.15 Finally there is an update to a small region of potential overflight at Arundel. In Feedback Report C (link, Figure 3 page C13) we predicted flights in this area had potential to descend from 7-6,000ft as part of the less-prominent shortcut flow described in paragraph 3.3.4 above.

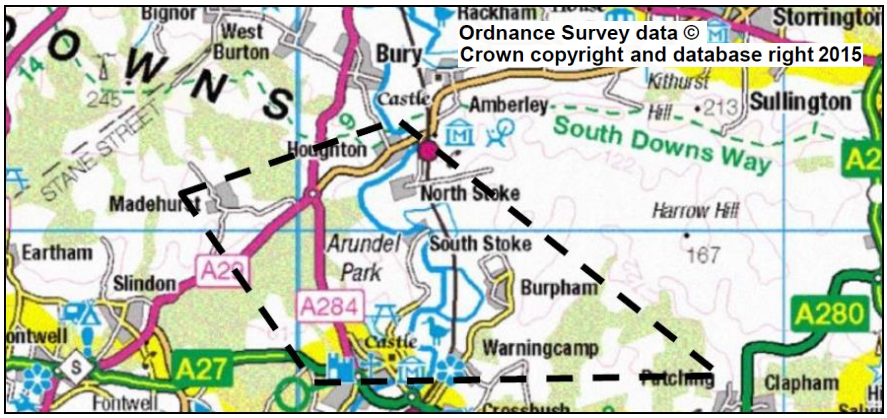


Figure 14 Extract from original material regarding Arundel

3.3.16 The density plot in Figure 12 on page 18 indicates typically fewer than one flight per day in this region. As per paragraph 3.3.13 above, should Gatwick departures via Southampton return to their pre-COVID-19 frequency, the secondary cyan swathe may widen and extend further south towards Arundel.

3.3.17 It is likely that the Arundel region will continue to not be regularly overflown by Farnborough arrivals below 7,000ft, however the possibility remains. If it manifests, we expect it would be consistent with the updated description in Feedback Report C.

3.4 Pre-ACP arrivals from 4,000ft to Runway 06

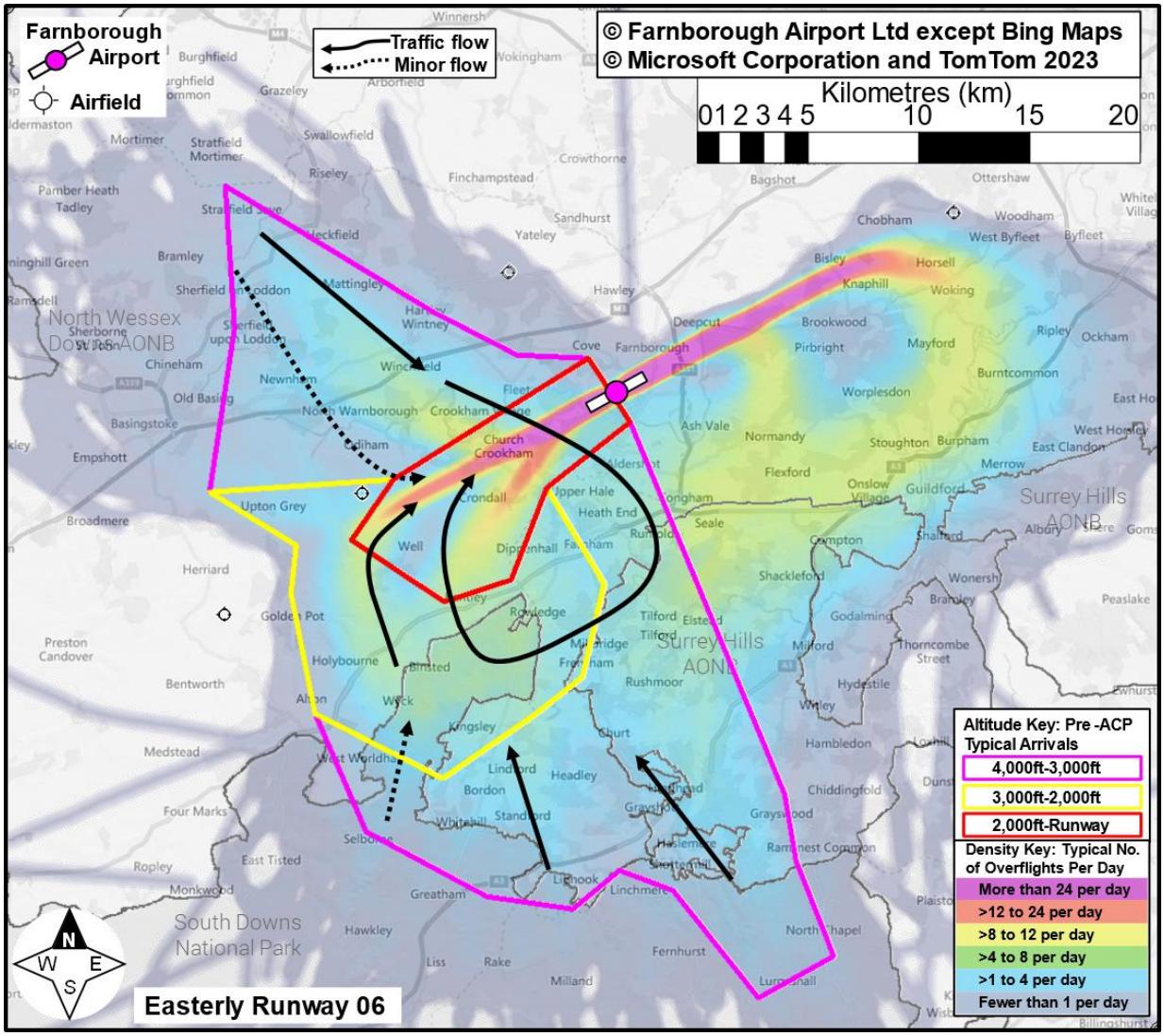


Figure 15 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Arrivals 4,000ft to Easterly Runway 06

3.4.1 See section 3.2 on page 16 for Pre-ACP arrivals to both runways, 7,000ft-4,000ft.

3.4.2 All arrivals from the south overflew the South Downs National Park from 4-3,000ft and 3-2,000ft, the easternmost arrivals also overflew the Surrey Hills AONB. Some northern arrivals overflew both at similar altitudes.

3.4.3 From the southeast arrivals typically descended from Lurgashall, Haslemere, Grayshott and Churt between 4-3,000ft. On passing Frensham they descended through 3-2,000ft , crossed the A31 between Bentley and Binsted, joining a standard arrival pattern to final approach from 2,000ft to land.

3.4.4 From the south arrivals overflew Liphook 4-3,000ft then Kingsley 3-2,000ft to join a standard arrival pattern to land. A less prominent flow arrived from the southwest and followed a similar pattern via Binsted.

3.4.5 From the north, most arrivals crossed over the final approach track between 4-3,000ft then turned right, over or south of the A31, to join a standard arrival pattern from the south, as described above. Some arrivals from the north were given a faster descent and were directed to join final approach from the north, near RAF Odiham.

3.4.6 This is consistent with the original consultation material (link to 2014 consultation material, see Part B Figure B7 on page B39).

3.5 Post-ACP arrivals from 4,000ft to Runway 06

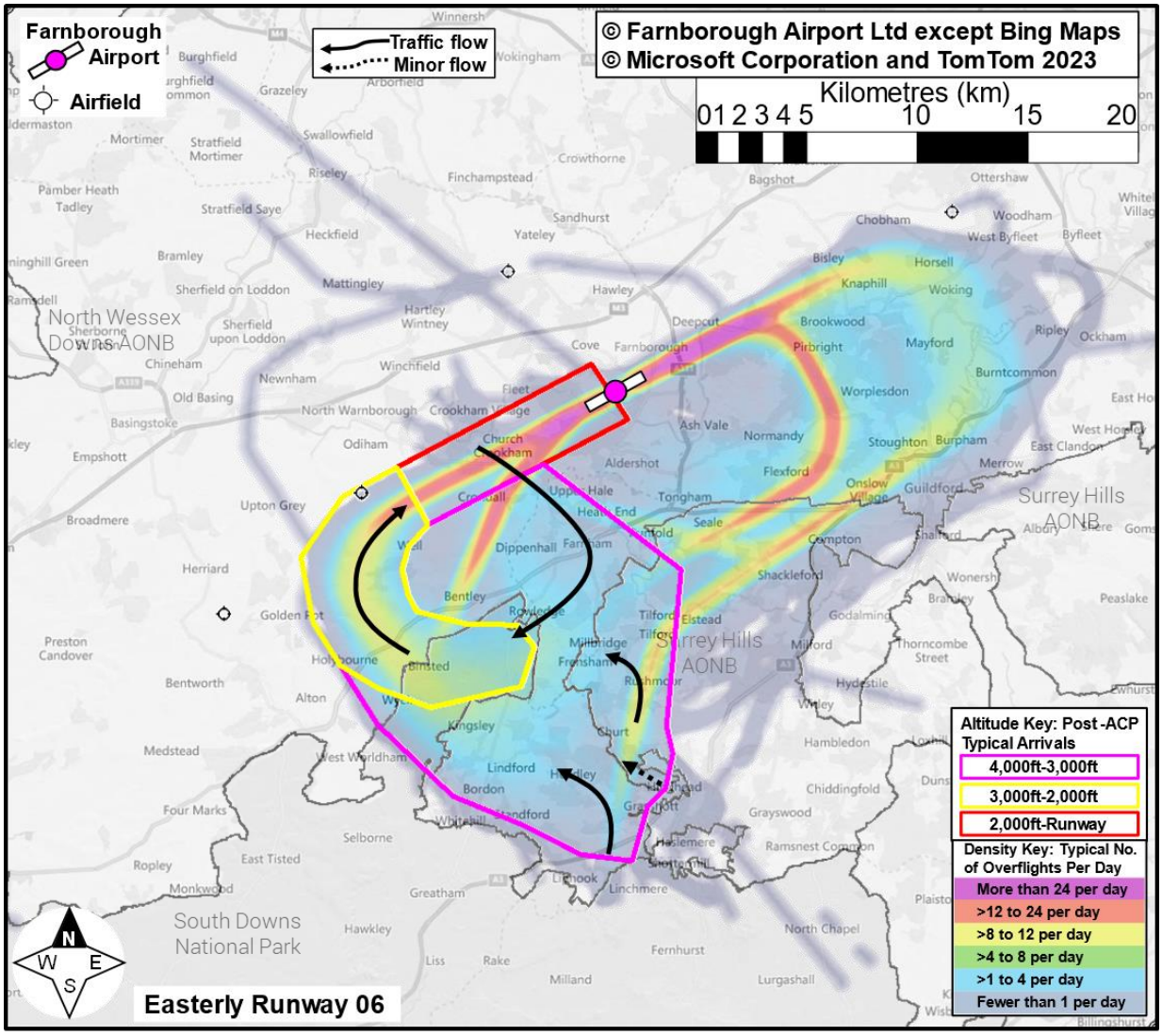


Figure 16 Density Plot and Flow Diagram: Aug 2022 Post-ACP Arrivals 4,000ft to Easterly Runway 06

3.5.1 See section 3.3 on page 18 for Post-ACP arrivals to both runways, 7,000ft-4,000ft.

3.5.2 Some arrivals from the south overfly the South Downs National Park from 4-3,000ft and 3-2,000ft, the easternmost arrivals also overfly the Surrey Hills AONB but over a much smaller area.

3.5.3 From the south arrivals typically descend from the main arrival flow east of Liphook to Tilford, from 4-3,000ft, they remain slightly higher for longer. A less prominent flow from the southeast joins this flow near Hindhead.

3.5.4 Between Liphook and Tilford the arrivals are typically turned left towards Kingsley or Rowledge. From here they descend from 3-2,000ft to join a standard arrival pattern to land. The standard pattern altitudes are consistent and match the pre-ACP arrangement, however the region below 3,000ft is considerably smaller post-ACP, and the region below 2,000ft also smaller meaning aircraft are slightly higher for longer than pre-ACP.

3.5.5 From the north, most arrivals cross over the final approach track between 4-3,000ft then turn right, over or south of the A31, to join a standard arrival pattern from the south, as described above. Arrivals from the north no longer join the arrival pattern from the north; they all must cross over and join from the south.

3.5.6 This is all consistent with Feedback Report B's prediction following the original consultation, with some minor differences to address (link to Feedback Report B, see Figure 9 on page B27).

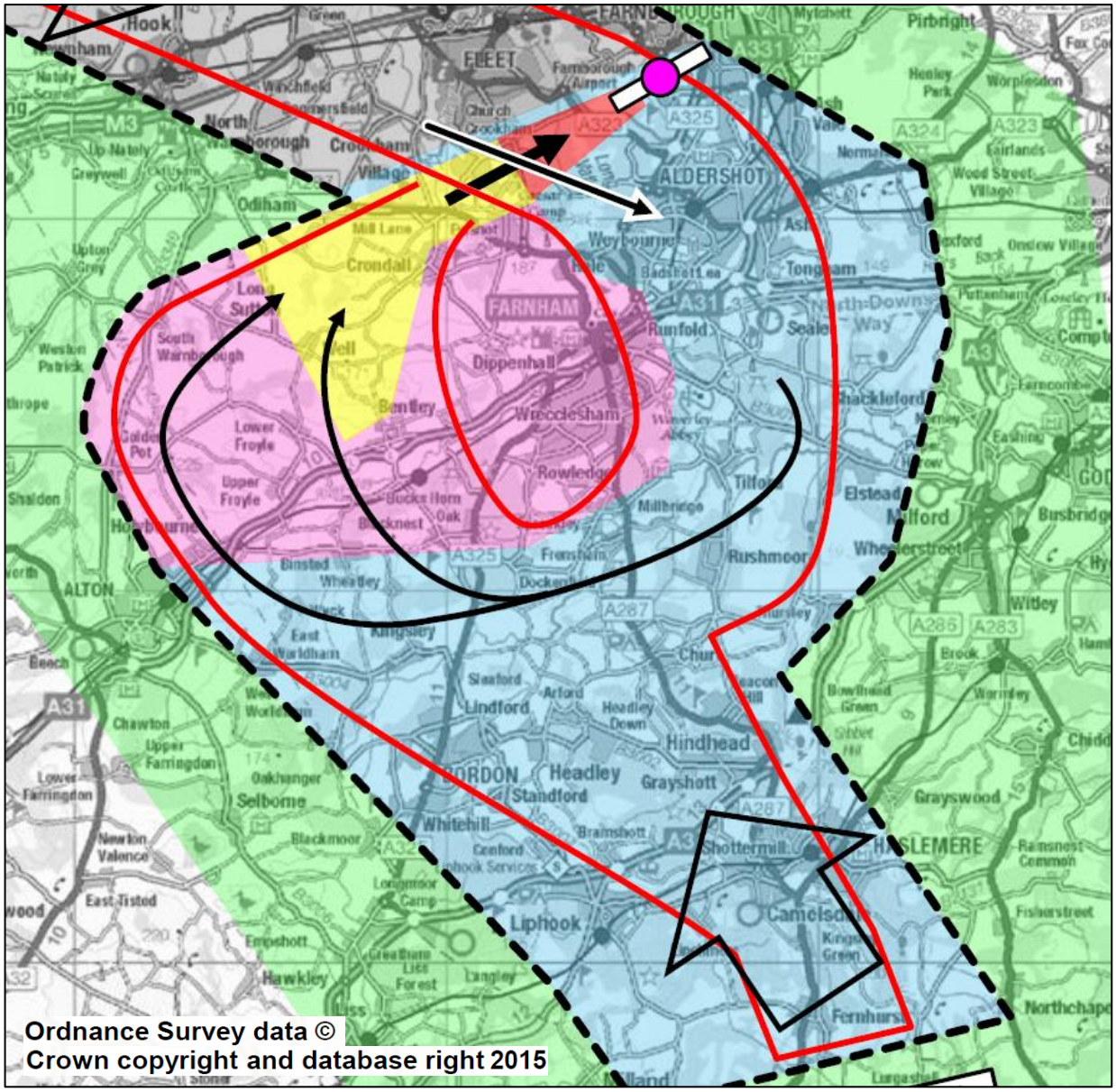


Figure 17 Extract from original material, illustrating the same region

3.5.7 The main arrival flow from the south is higher for longer, typically remaining above 4,000ft until crossing the A3.

3.5.8 It is positioned slightly further west towards Liphook and is oriented in a northeasterly direction for the reasons described in Section 3.3 on page 19. The flow remains within the region we predicted would usually be overflown.

3.5.9 The arrival flow from the north generally does not go as far east as Aldershot, it typically turns right earlier than depicted in this diagram.

3.6 Pre-ACP arrivals from 4,000ft to Runway 24

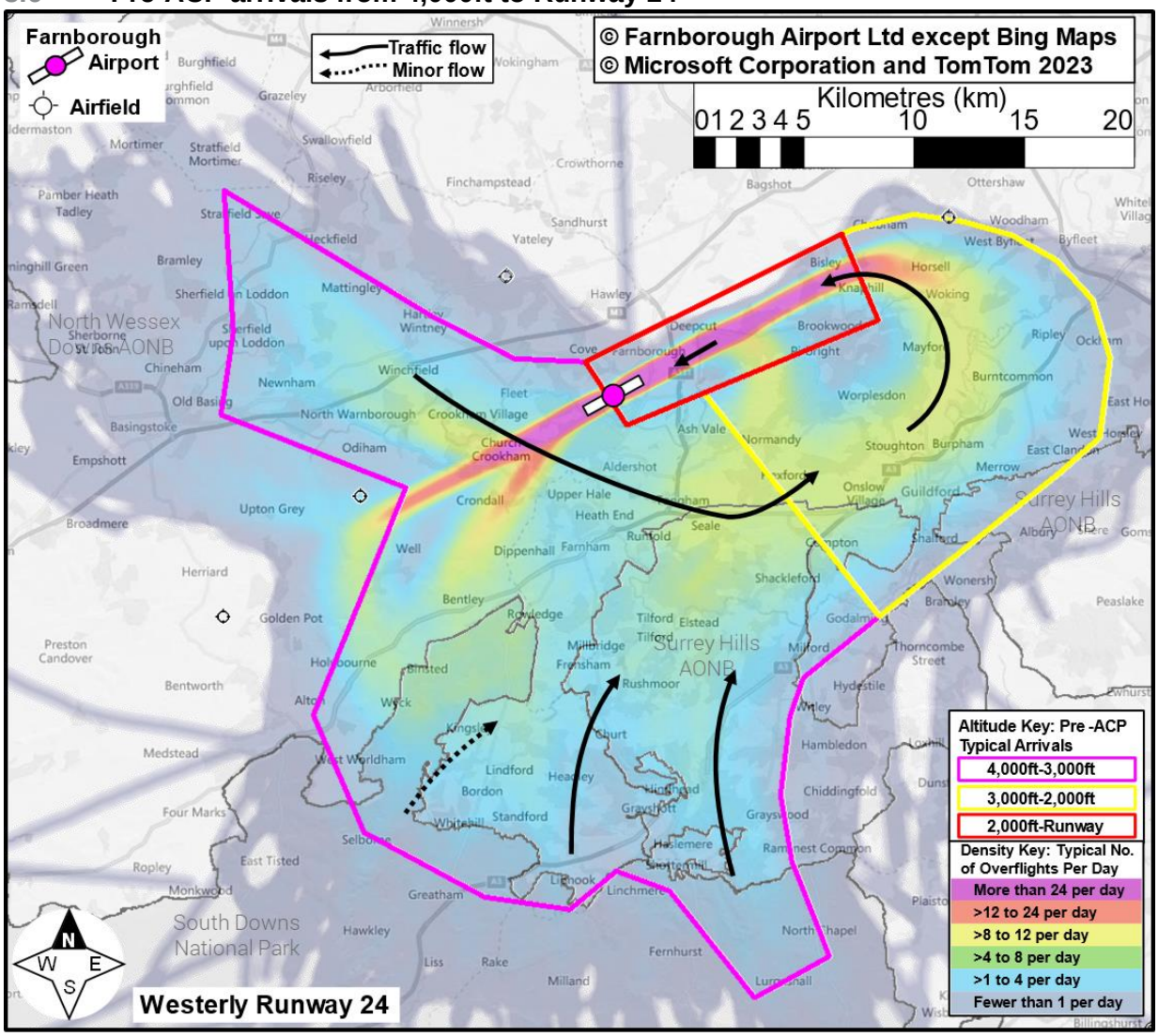


Figure 18 Density Plot and Flow Diagram: Jun 2019 Pre-ACP Arrivals 4,000ft to Westerly Runway 24

3.6.1 See Section 3.2 on page 16 for Pre-ACP arrivals to both runways, 7,000ft-4,000ft.

3.6.2 All arrivals from the south overflew the South Downs National Park from 4-3,000ft and most overflew the Surrey Hills AONB at the same altitudes. Some also overflew the northern Surrey Hills AONB 3-2,000ft if their track was further south. Northern arrivals sometimes overflew both at similar altitudes.

3.6.3 From the southeast arrivals typically descended from Lurgashall, Haslemere, the A3 between 4-3,000ft towards Compton and Flexford after which they descended from 3-2,000ft. Arrivals then typically followed a standard arrival pattern, usually parallel to and slightly north of the A3 heading northeast between 3-2,000ft, turned left onto final approach around Woking. At Knaphill on final approach they descended below 2,000ft to land.

3.6.4 From the south, the track taken was similar, starting nearer Liphook, towards Churt and Rushmoor 4-3,000ft then towards Compton, Flexford and the arrival pattern described above.

3.6.5 From the southwest a less prominent flow left the Selborne and Kingsley area between 4-3,000ft and headed towards Frensham, Churt and Rushmoor and the arrival pattern described above.

3.6.6 From the north, most arrivals crossed over Church Crookham between 4-3,000ft then turned left in the vicinity of Tongham A31/A331 towards Flexford and the arrival pattern described above.

3.6.7 This is consistent with the original consultation material (link to 2014 consultation material, see Part B Figure B7 on page B39).

3.7 Post-ACP arrivals from 4,000ft to Runway 24

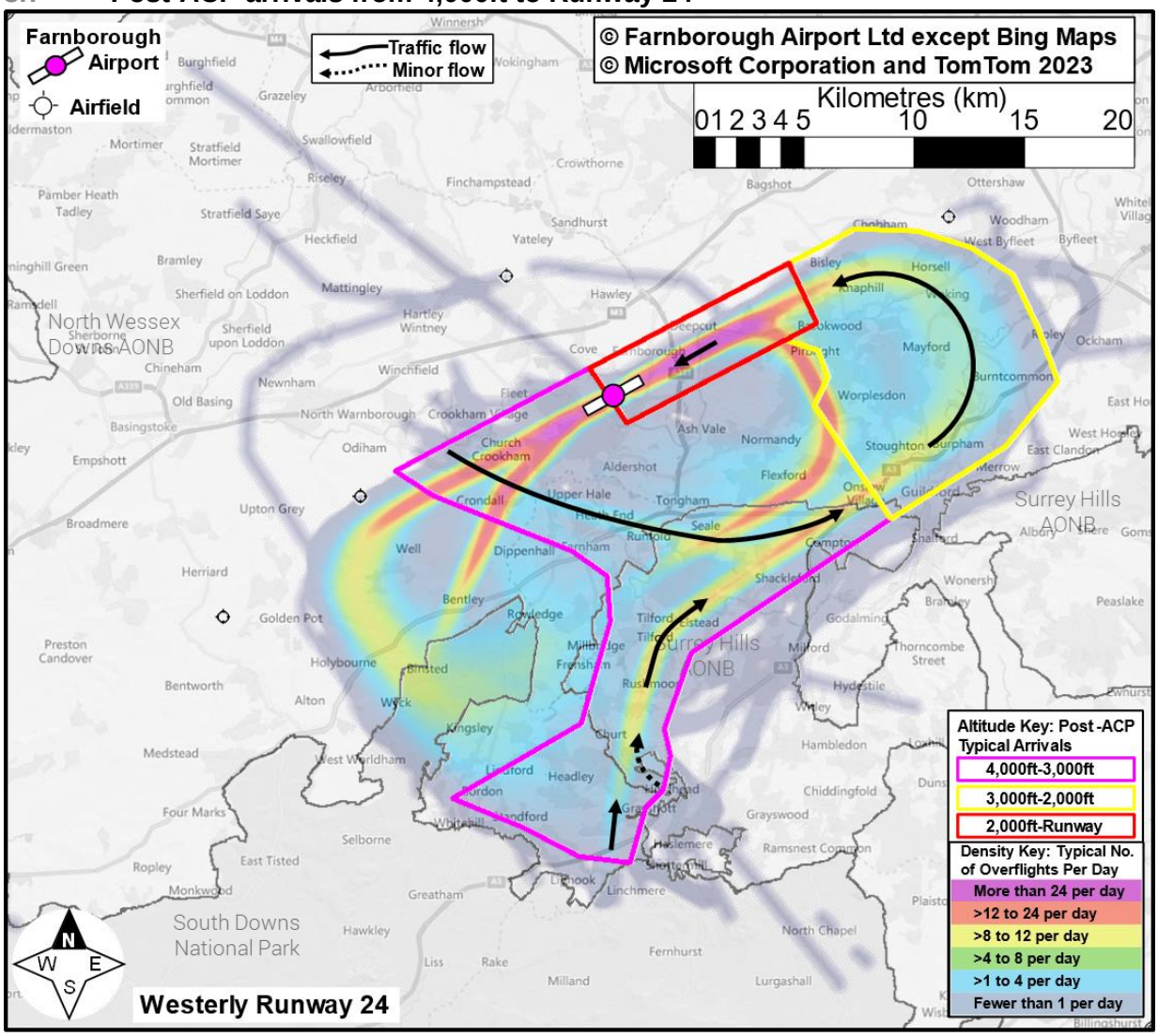


Figure 19 Density Plot and Flow Diagram: Aug 2020 Post-ACP Arrivals 4,000ft to Westerly Runway 24

3.7.1 See Section 3.2 on page 16 for Pre-ACP arrivals to both runways, 7,000ft-4,000ft.

3.7.2 All arrivals overfly the Surrey Hills AONB from 4-3,000ft. The South Downs National Park is typically not overflown below 4,000ft by post-ACP Runway 24 arrivals.

3.7.3 From the south arrivals typically descend from the main arrival flow east of Liphook to Tilford, from 4-3,000ft, they remain slightly higher for longer than pre-ACP. A less prominent flow from the southeast joins this flow near Hindhead.

3.7.4 In the vicinity of Onslow Village arrivals descend from 3-2,000ft. Arrivals then typically followed a standard arrival pattern, parallel to and slightly north of the A3 heading northeast between 3-2,000ft, then turn left onto final approach around Woking. After Knaphill on final approach they descend below 2,000ft to land, this keeps arrivals slightly higher for longer in the final approach phase than pre-ACP.

3.7.5 From the north, most arrivals cross Church Crookham between 4-3,000ft then turn left in the vicinity of Tongham A31/A331 towards Onslow Village and the arrival pattern described above.

3.7.6 This is all consistent with Feedback Report B's prediction following the original consultation, with some minor differences to address (link to Feedback Report B, see Figure 10 on page B28).

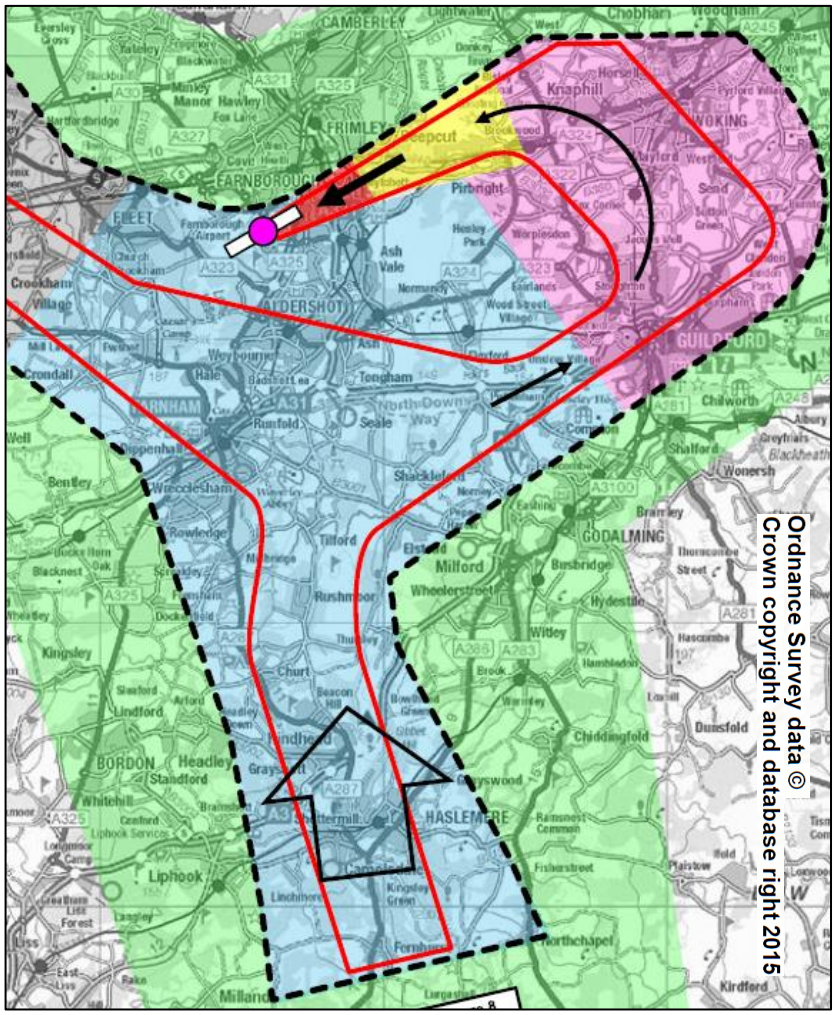


Figure 20 Extract from original material, illustrating the same region

3.7.7 The main arrival flow from the south is higher for longer, typically remaining above 4,000ft until crossing the A3.

3.7.8 It is positioned slightly further west closer to Liphook and is oriented in a northeasterly direction for the reasons described in Section 3.3 on page 19. The flow remains within the region we predicted would usually be overflown.

3.7.9 The airport's Instrument Landing System (ILS) for Runway 24 was undergoing replacement and calibration during August 2022. This led to an increase in the number of visual approaches to land at Farnborough. Visual approaches are a standard arrival method used regularly for landing at Farnborough and would not cause a noticeable change in arrival flightpaths.

3.8 Arrivals Summary and Conclusion

3.8.1 The post-ACP arrivals are generally consistent with the original material and are behaving in line with expectations.

3.8.2 There is one slight difference between our predicted arrival concentration from the south, and the actual arrival flow. We have highlighted where this occurs, and have explained why. We contend this was not predictable at the time of writing the original ACP. Overall it remains broadly consistent with our predictions of anticipated impacts detailed in the original material, which was created with reference to CAP725 and ANG2014.

3.8.3 The overflight areas are shorter, smaller areas are overflown with less natural dispersal, and in many cases the descent profile keeps arrivals higher for longer, more often than expected.

3.8.4 As per the original material, where practical the routes aimed to minimise overflight of populated areas. Smaller areas overflown by predictable, consistent flightpaths by similar numbers of flights means fewer people would be impacted by more frequent aircraft noise events.

3.8.5 Also as per the original material, avoiding overflight of one area inevitably means flights over neighbouring areas instead. The route position/design was limited by aircraft manoeuvrability, adjacent airspace infrastructure such as RAF Odiham, Heathrow and Gatwick, and international flight procedure design standards.

3.8.6 National Parks and AONBs are valued by some for their tranquillity. Overflight of National Parks and AONBs below 7,000ft is not prohibited and would be impractical, given the relative geography involved and the general Government guidance in effect at the time to minimise populated areas being overflown at low altitudes (see ANG2014). However, we have demonstrated that overflight of National Parks and AONBs below 4,000ft and below 7,000ft have both been significantly reduced. A consequence of this is that the frequency of overflight has increased in those areas where overflight does occur. This could be either a benefit or an impact on tranquillity and also visual intrusion, depending on the observer's point of view and specific location. This is as expected and is consistent with the original materials.

3.9 Arrivals: Addendum with specific analysis of GU10 (Churt area)

3.9.1 This addendum was written because we identified the GU10 postcode, and the village of Churt specifically, as originators of the vast majority of complaints (see separate document 'Annex D Stakeholder Feedback and Complaints', section 3.5 on page 7 for details of complaints by location).

3.9.2 Annex D is a separate document that should be read alongside this Overflight document, and also the Main PIR document.

3.9.3 This addendum is particularly related to the pre and post ACP arrival overflight diagrams detailed in section 3 starting on page 15. In most of the diagrams Churt is either clearly marked, or its position easily inferred as midway between the main A3 road at Haslemere along the A287 to the Frensham Ponds.

3.9.4 The GU10 postcode area was within the original consultation area, and was within an area that we predicted would be overflown from the south more narrowly than pre-ACP. This can be inferred from the overflight diagrams and subsequent narrative.

3.9.5 Churt is situated under the arrival procedure, and is close to one of the waypoints of the arrival procedure from the south when either runway is in use at Farnborough[3].

3.9.6 Often, complaints/complainants from Churt state that they were not overflown before this change. Due to the amount of complaints activity from Churt, this was specifically investigated.

3.9.7 The following is analysis of both overflight (traffic in the area that is not arriving at Farnborough, see footnote 3 below) and, separately, Farnborough arrivals.

3.9.8 To do this a gate was positioned in our ANOMS[4] system across the centre of Churt aligned in the direction of the arrival flow. The gate is 14km wide and 'looks south' with the arrivals heading north. Figure 21 shows the gate and a representation of the arrival procedure from the south. Note that the results in the following diagrams illustrate height, but the aircraft will be at an altitude (above mean sea level).

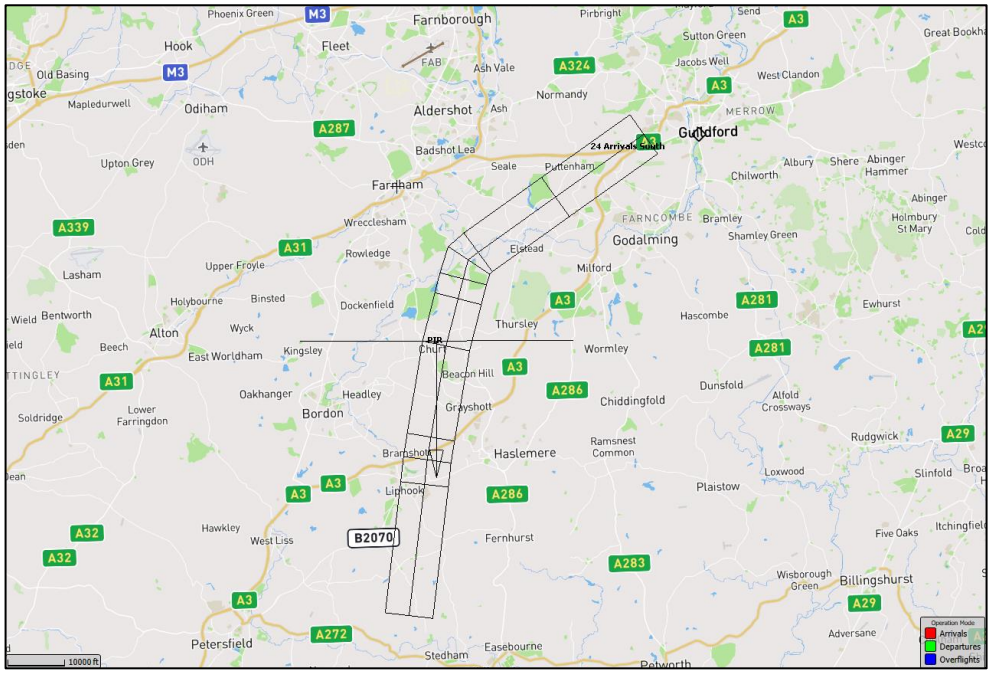


Figure 21 Analysis gate 7km either side of Churt Map background © Open Street Map 2023

[3] Arrivals from the air route network to other local aerodromes also use the Farnborough arrival routes. These are known as the Wessex Group and includes RAF Odiham, Lasham, Blackbushe, Fairoaks and Dunsfold.

[4] Our noise and track keeping system.

3.9.9 See Figure 22 below. The upper image shows overflight of Churt for the 12-month period starting on 1st April 2018 ending on 31st March 2019. The lower image shows the same period for the PIR 2022/23.

3.9.10 In each image below it can be seen that Churt is overflown. Both images also show concentrations that primarily relate to Heathrow and Gatwick traffic and also General Aviation traffic around 2,000ft with differences in the images that could be partially attributed to the introduction of the controlled airspace volume known as CTA4. There are c.3,000 fewer overflights during the PIR period than in the pre-ACP period in 2018/2019. There appear to be fewer GA flights operating at or below 3,500ft post-ACP than pre-ACP; please see separate document 'Annex E General Aviation and Glider Study' for more details.

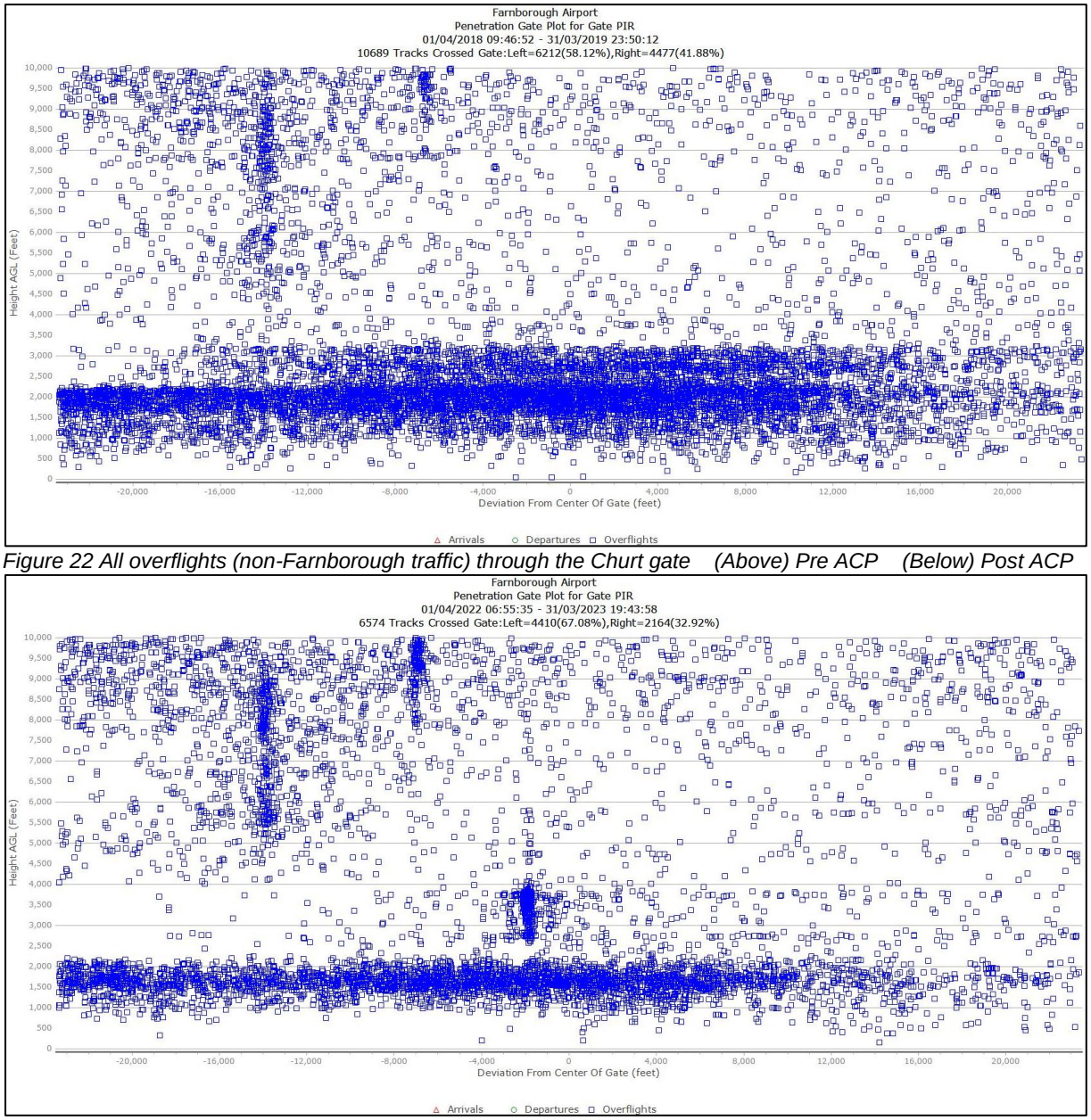


Figure 22 All overflights (non-Farnborough traffic) through the Churt gate (Above) Pre ACP (Below) Post ACP

3.9.11 The next pair of images are showing only Farnborough arrivals for pre and post ACP.

3.9.12 As per the original material, where practical the routes aimed to minimise overflight of populated areas. Smaller areas overflown by predictable, consistent flightpaths by similar numbers of flights means fewer people would be impacted by more frequent aircraft noise events.

3.9.13 Also as per the original material, avoiding overflight of one area inevitably means flights over neighbouring areas instead. The route position/design was limited by aircraft manoeuvrability, adjacent airspace infrastructure such as RAF Odiham, Heathrow and Gatwick, and international flight procedure design standards.

3.9.14 The impact of this ACP can be clearly seen. This is consistent with the consultation material, which is discussed in paragraph 3.5.6 and Figure 17 on page 23 (easterly Runway 06 arrivals), and paragraphs 3.7.6-3.7.8 and Figure 20 on page 26 (westerly Runway 24 arrivals).

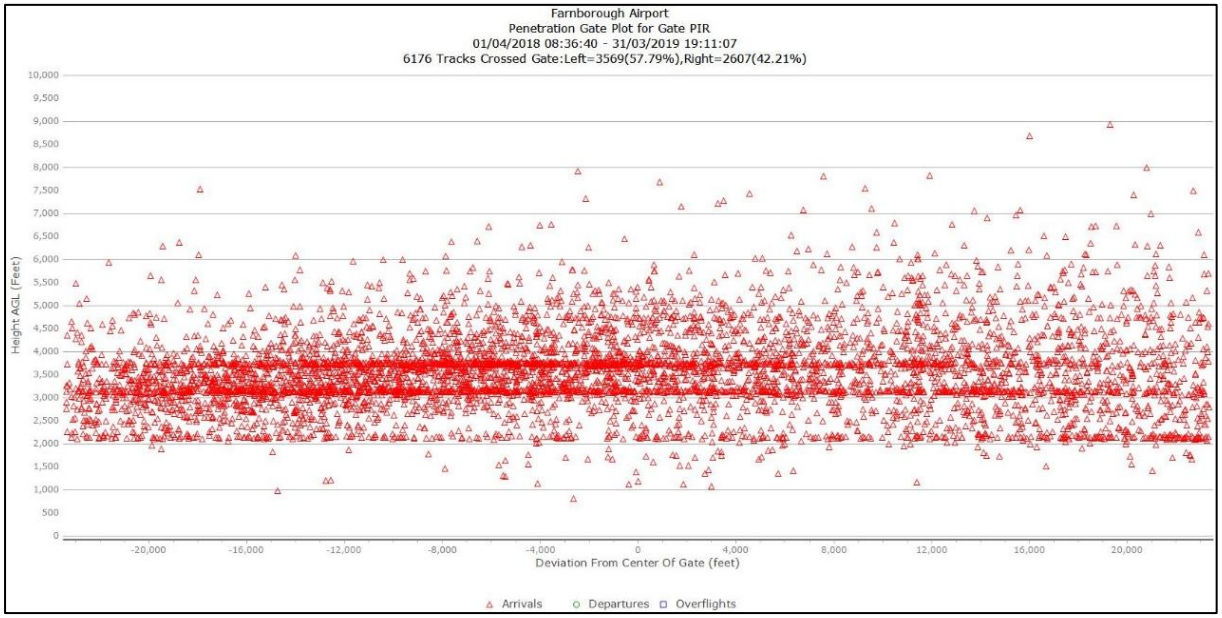
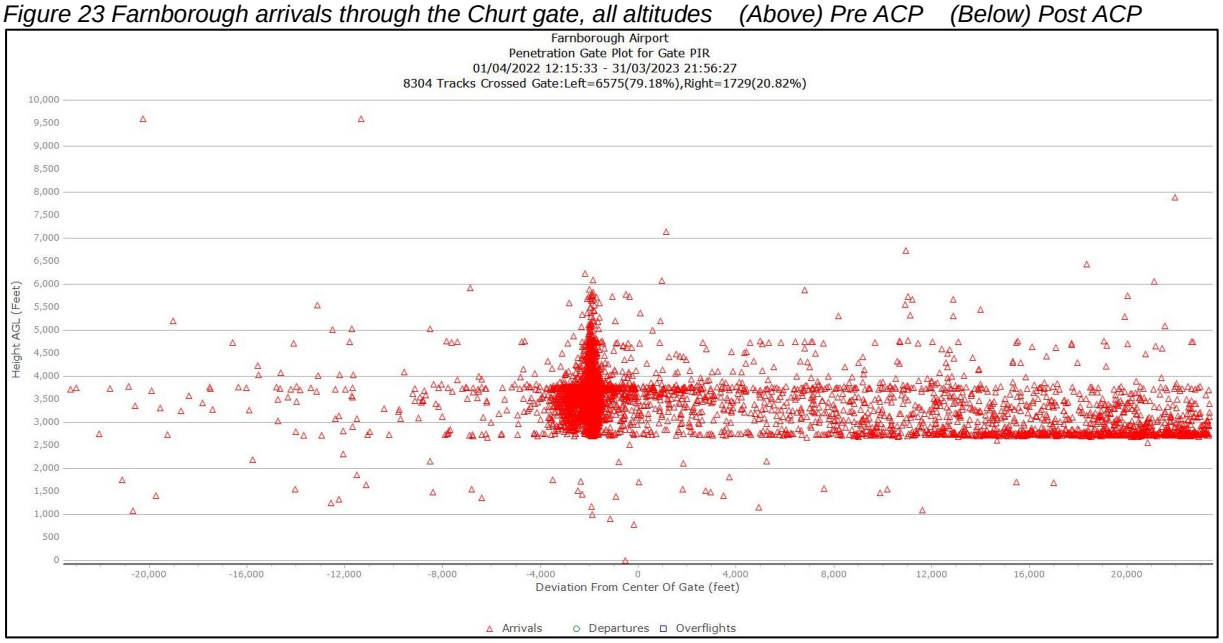


Figure 23 Farnborough arrivals through the Churt gate, all altitudes (Above) Pre ACP (Below) Post ACP



3.9.15 In the upper diagram of Figure 23 dispersion is evident and Churt was overflown by traffic arriving at Farnborough. In the second image, a narrowing of the arrival flow due to the implementation of PBN routes is visible and there is an obvious change with a much smaller element of vectoring dispersion. This was outlined in the appropriate documents before the change as summarised in paragraph 3.9.14 above.

3.9.16 There are more tracks in the lower diagram of Figure 23, 8,304 compared to 6,176, but there are far fewer aircraft below 3,500ft.

3.9.17 In Figure 24 below, the images are zoomed in to show only Farnborough arrivals at and below 4,000ft. Pre -ACP (upper diagram) Farnborough arrivals were regularly between 3,000ft-2,000ft.

3.9.18 In the lower diagram (post ACP) there are more arrivals but they are almost all between 4,000ft-3000ft altitude, as expected by the airspace and PBN route.

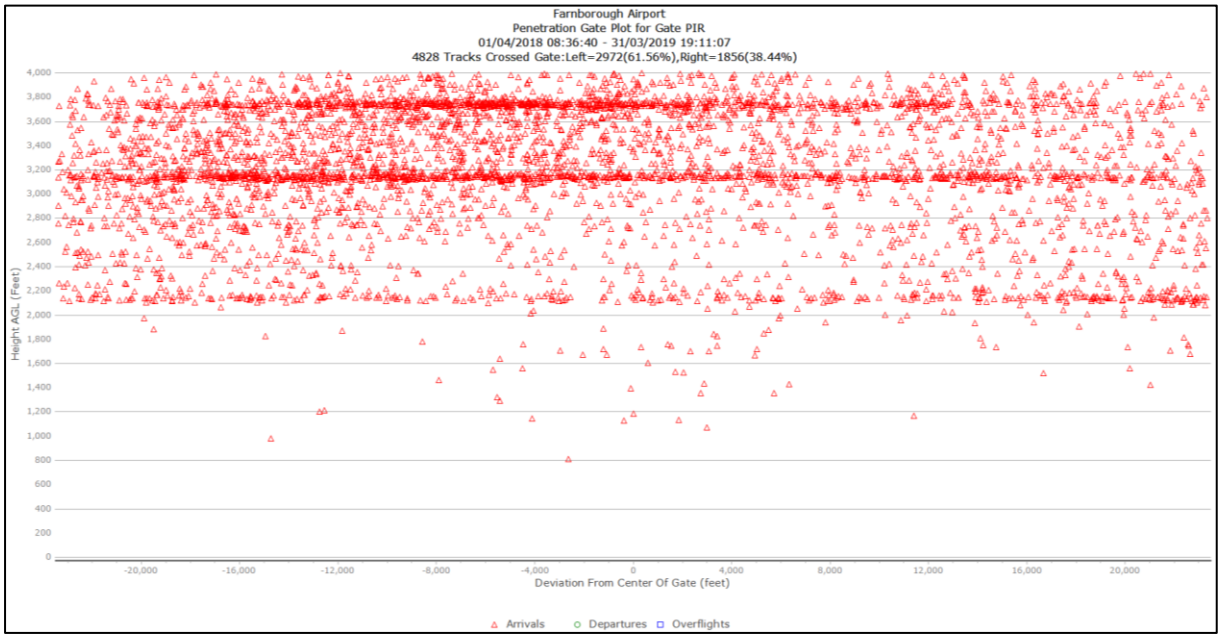
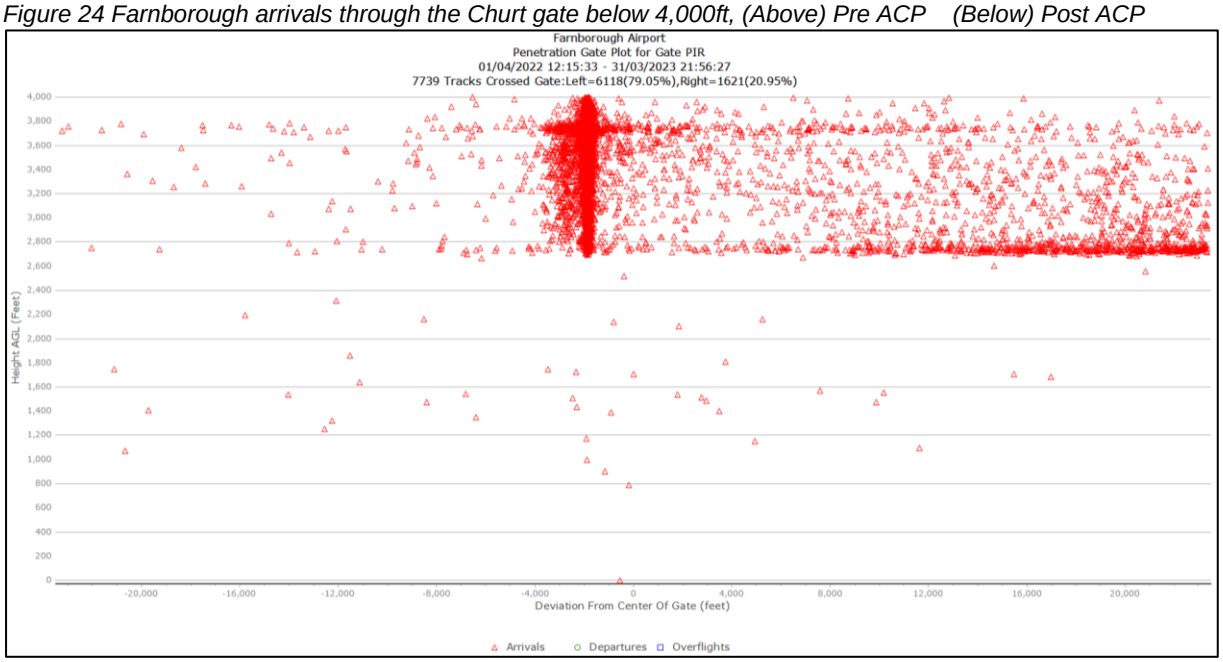


Figure 24 Farnborough arrivals through the Churt gate below 4,000ft, (Above) Pre ACP (Below) Post ACP



3.9.19 This change is also reflected when looking at the overflights (non-Farnborough traffic) when zoomed in to 4,000ft and below.

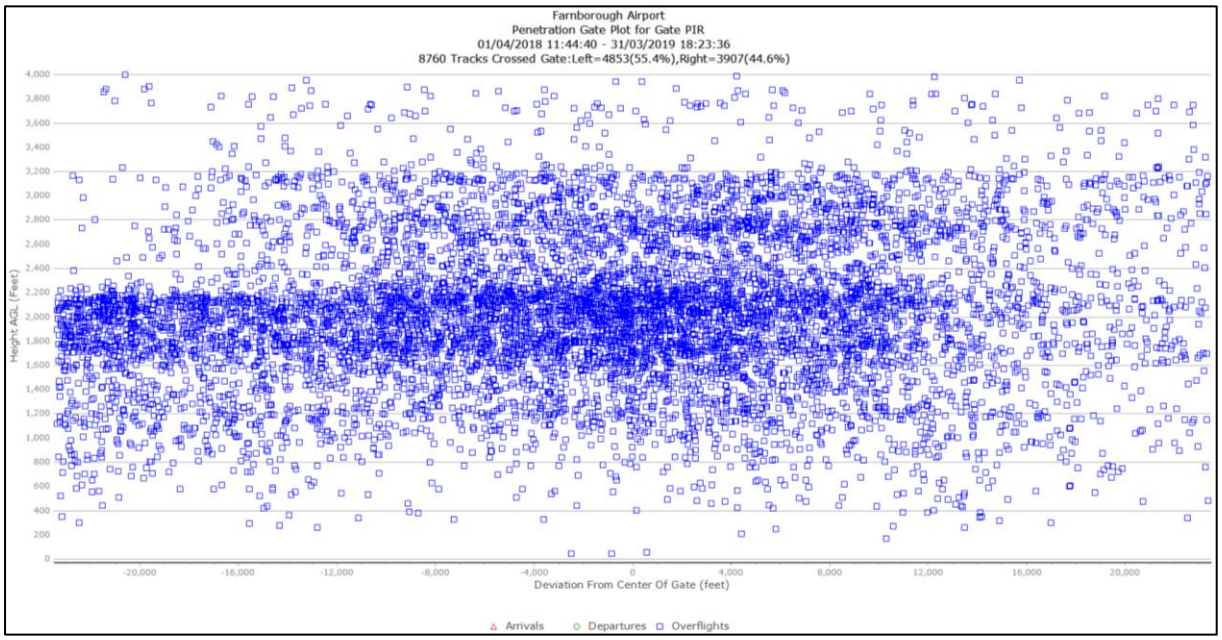
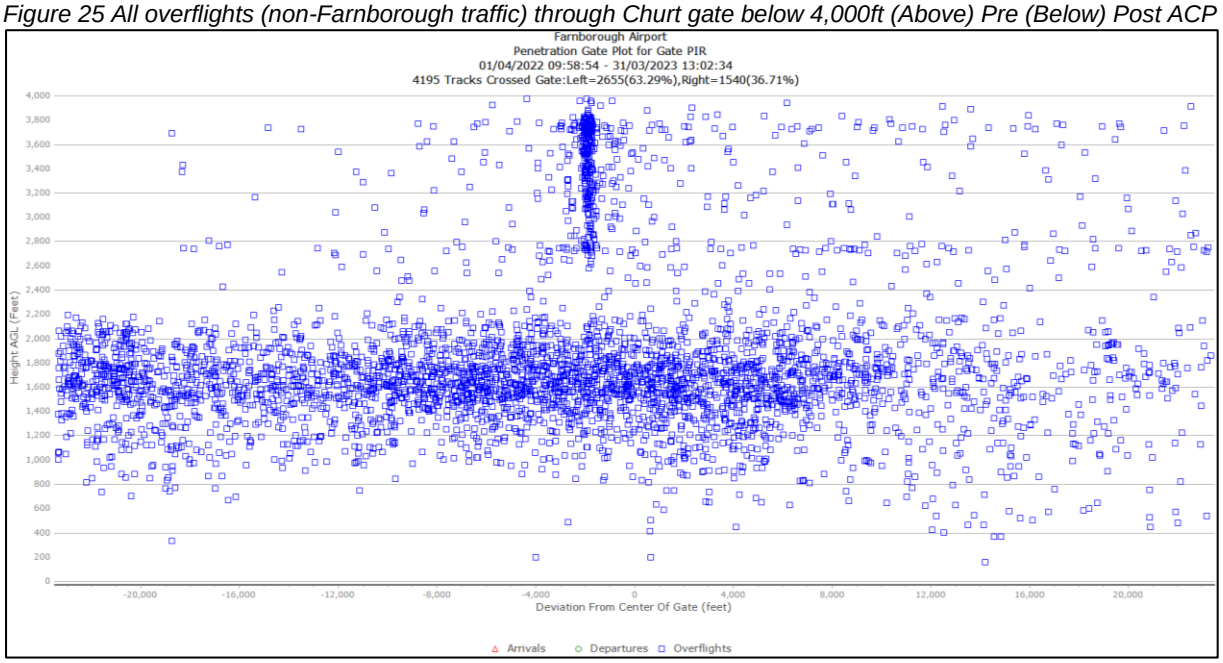


Figure 25 All overflights (non-Farnborough traffic) through Churt gate below 4,000ft (Above) Pre (Below) Post ACP



3.9.20 This concludes the Churt addendum. The data shows that Churt was overflown pre-ACP typically at lower altitudes in an unpredictably dispersed manner. Post-ACP Churt is overflown at higher altitudes with a more predictable narrower dispersion. This is consistent with the original consultation and ACP material.

4 Population overflown: Original method

4.1 Using the Original ACP Method

4.1.1 For the original consultation and ACP submission, flight density plots were created. An approximate outline was drawn around areas of density where the colour blue indicated overflight of 1-3 flights per day.

4.1.2 These geographical polygons were used to identify and analyse the postcodes inside. The population of each postcode was provided by CACI[5], a supplier of such data, using September 2012 radar information. This was used to count the total number of people overflown from 0-4,000ft, from 4-7,000ft, and combined from 0-7,000ft.

4.1.3 We then created ACP polygons to indicate where we predicted overflight would occur at least 1-3 times per day, and compared the difference.

4.1.4 The original ACP submission to the CAA stated the following:

Flight band	Actual Pre-ACP population overflown	Predicted ACP population overflown	Predicted change (net reduction in population)	Predicted % change (net reduction)
0-4,000ft	577,046	377,885	199,161	34.5%
4-7,000ft	493,308	437,487	55,821	11.3%
Total 0-7,000ft	**1,070,354**	**815,372**	**25,4982**	**23.8%**

Table 1 Populations overflown – Predictions before and after, for the original ACP

4.2 Results of pre-ACP and post-ACP population counts

4.2.1 This exercise was repeated using the actual pre and post ACP flight density plots from earlier in this document. The combined shapes are illustrated below:

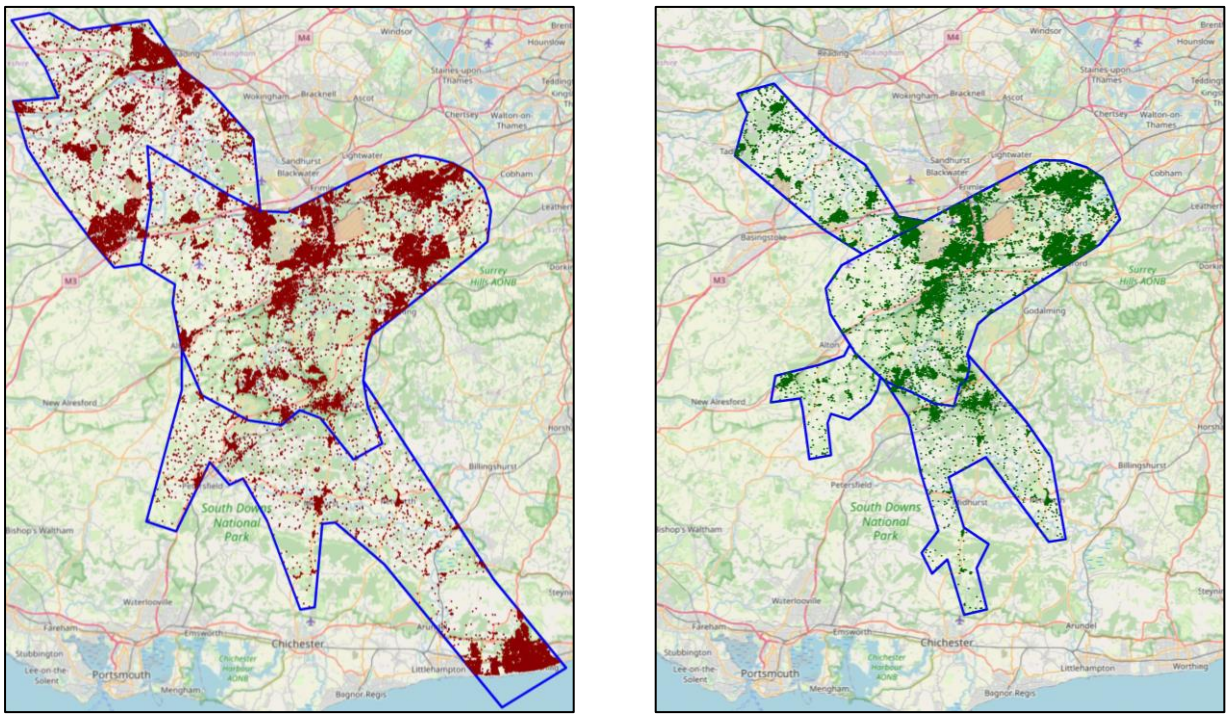


Figure 26 Regions overflown 0-4,000ft (centre), 4-7,000ft (outer). Each dot is a postcode. L: Pre-ACP, R: Post-ACP

Flight band	Actual Pre-ACP population overflown	Actual ACP population overflown	Actual change (net reduction in population)	Actual % change (net reduction)
0-4,000ft	518,418	364,549	153,869	29.7%
4-7,000ft	448,023	105,848	342,175	76.4%
Total 0-7,000ft	**966,441**	**470,397**	**496,044**	**51.3%**

Table 2 Populations overflown – Actual before and after

[5] Population data ©2023 CACI Limited. This report shall be used solely for academic, personal and/ or non-commercial purposes.

4.3 Successful outcome

4.3.1 The original pre-ACP population overflown up to 7,000ft was calculated using September 2012 radar data, where places were overflown at least 1-3 times per day.

4.3.2 The actual pre-ACP population overflown up to 7,000ft was calculated using June 2019 radar data, where places were overflown at least 1-4 times per day

4.3.3 The total populations overflown up to 7,000ft were comparable, c.1m as per Table 1 and Table 2 above.

4.3.4 The actual post-ACP population overflown up to 7,000ft was calculated using August 2022 radar data, where places were overflown at least 1-4 times per day.

4.3.5 Comparing pre-ACP and post-ACP populations overflown at least 1-4 times per day, there is a large overall net reduction in population overflown, by half a million people, halving the overflown population below 7,000ft, as per Table 2 above and illustrated by Figure 26 above.

4.3.6 The biggest difference is between 4-7,000ft. This can be seen in the main content of this document, where the coloured swathes between 4-7,000ft are significantly smaller, and Table 2's middle row.

4.4 Conclusion

4.4.1 The results are consistent with the original ACP methodology, and even fewer people are overflown than expected (at least 1-4 times per day up to 7,000ft).

4.4.2 The results are worthwhile but only give a limited illustration of the potential impacts of being overflown, such as aircraft noise.

5 Population overflown: CAP1498 method

5.1 Using the CAP1498 method

5.1.1 The CAA's document CAP1498 (link) is technical material that defines overflight more effectively than the original method above. It can more accurately highlight where areas are subject to increased or reduced overflight, which means the reader can better understand how much noise they may observe.

5.1.2 The basic premise of the method is to imagine an aircraft projecting a cone of noise downwards as it flies.

- Where that cone touches the ground, it becomes a circle.
- The cone's angle is fixed, so as an aircraft takes off, a small circle appears directly beneath. It leaves behind a linear shadow trail, the width of the circle's diameter.
- Using right-angled triangle geometry, the circle's diameter is proportionate to the height above the ground.
- As it climbs, the circle's diameter increases, the trail widens. As it descends, the diameter reduces, the trail narrows.
- The higher the aircraft, the bigger the circle (larger area overflown, more people impacted by noise), but also the lesser the noise itself (the higher the aircraft, the quieter it seems from the ground).
- Crucially, 'overflight' does not relate to being directly overflown by the aircraft itself. The width of the circle increases size as height increases, so the observer only has to be within the shadow trail to be included in the calculation, rather than directly beneath the centre of the aircraft.

5.1.3 NATS provided an excellent explanation of how the CAP1498 method works in a short animation for another airspace change – the concept is identical and applies to Farnborough. Please click here to access it.

5.1.4 We have applied this method to actual radar data from 16 June-15 September 2019 (a specifically-defined summer period used for aviation noise calculations), and to radar data from the same 92-day period in 2022 for this PIR.

5.1.5 This allows us to not only indicate how often an area was overflown, before the ACP and after, within the PIR period, but also allows us to show exactly where change has occurred, and by how much.

5.2 Results Pre ACP 0-4,000ft

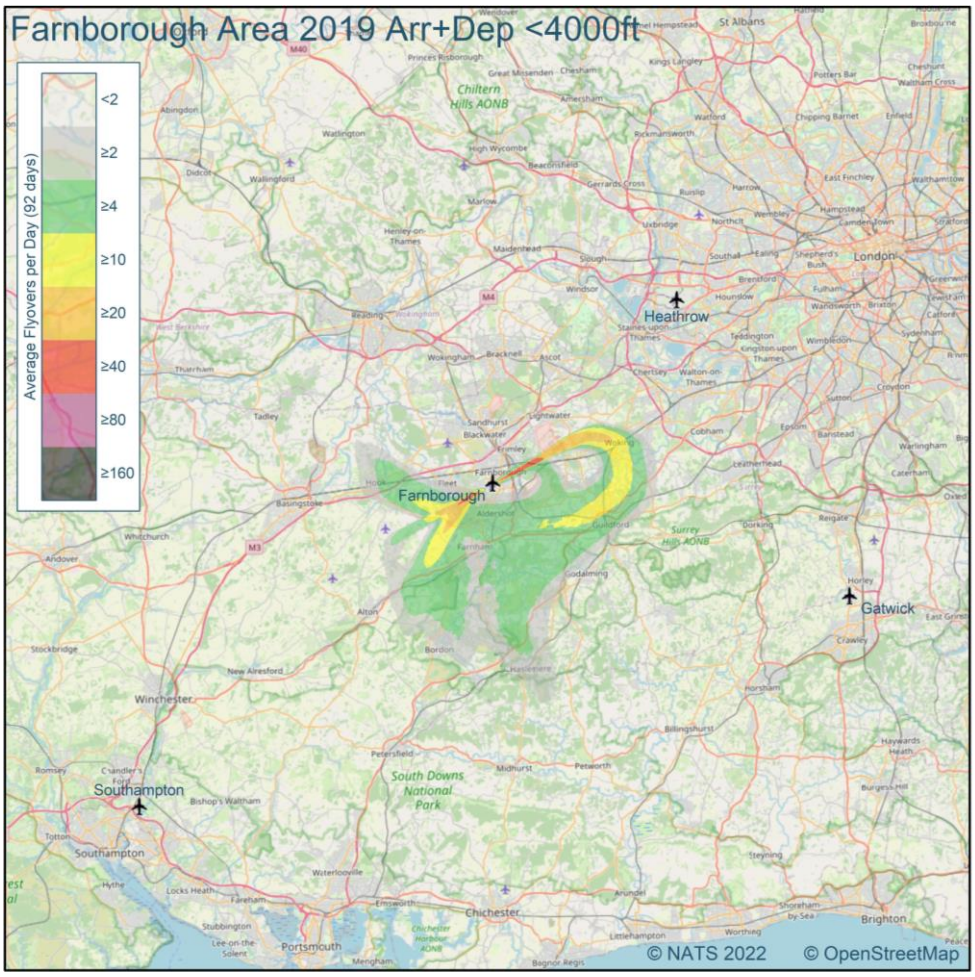


Figure 27:

Colour	Daily Overflights	Population Impacted
Grey	≥2 <4	105,114
Green	≥4 <10	177,112
Yellow	≥10 <20	83,411
Orange	≥20 <40	16,688
Red	≥40 <80	2,668
Total	≥2 <80	384,993

Table 3: *Population impact frequency, pre-ACP, below 4,000ft*

5.2.1 The table above indicates how many people were overflown, and how frequently.

5.2.2 The narrow red area close to the airport indicates places where overflights happened 40-80 times per day, spreading into a wider orange, yellow then green areas at 4-10 per day, finally a much wider grey at 2-4 per day.

5.2.3 Pre-ACP, c.385,000 people were overflown at least twice per day up to 4,000ft.

5.3 Results Post ACP 0-4,000ft

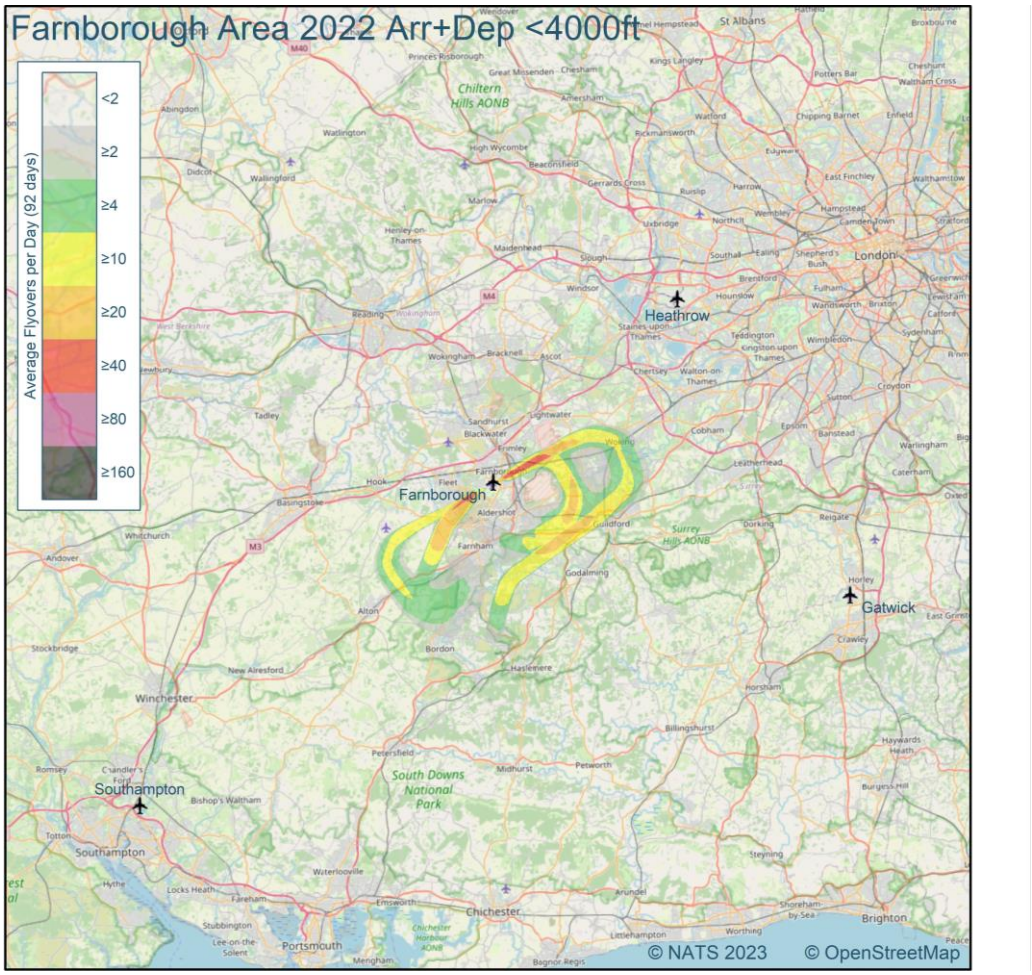


Figure 28:

Colour	Daily Overflights	Population Impacted
Grey	≥2 <4	50,034
Green	≥4 <10	74,392
Yellow	≥10 <20	68,663
Orange	≥20 <40	11,002
Red	≥40 <80	4,221
Total	≥2 <80	208,312

Table 4: *Population impact frequency, post-ACP, below 4,000ft*

5.3.1 The table above indicates how many people were overflown, and how frequently.

5.3.2 The narrow red area close to the airport is longer than pre-ACP. The orange and yellow areas are well defined and do not spread. There is some spread in green, but far less than pre-ACP. There is little obvious grey.

5.3.3 The places overflown regularly by the ACP routes are clearly defined due to their predictable, systemised nature. The swathes are shorter and narrower.

5.3.4 Post-ACP, c.208,000 people were overflown at least twice per day up to 4,000ft; this is 177,000 fewer people overflown than pre-ACP.

5.4 Difference between pre and post ACP, 0-4,000ft

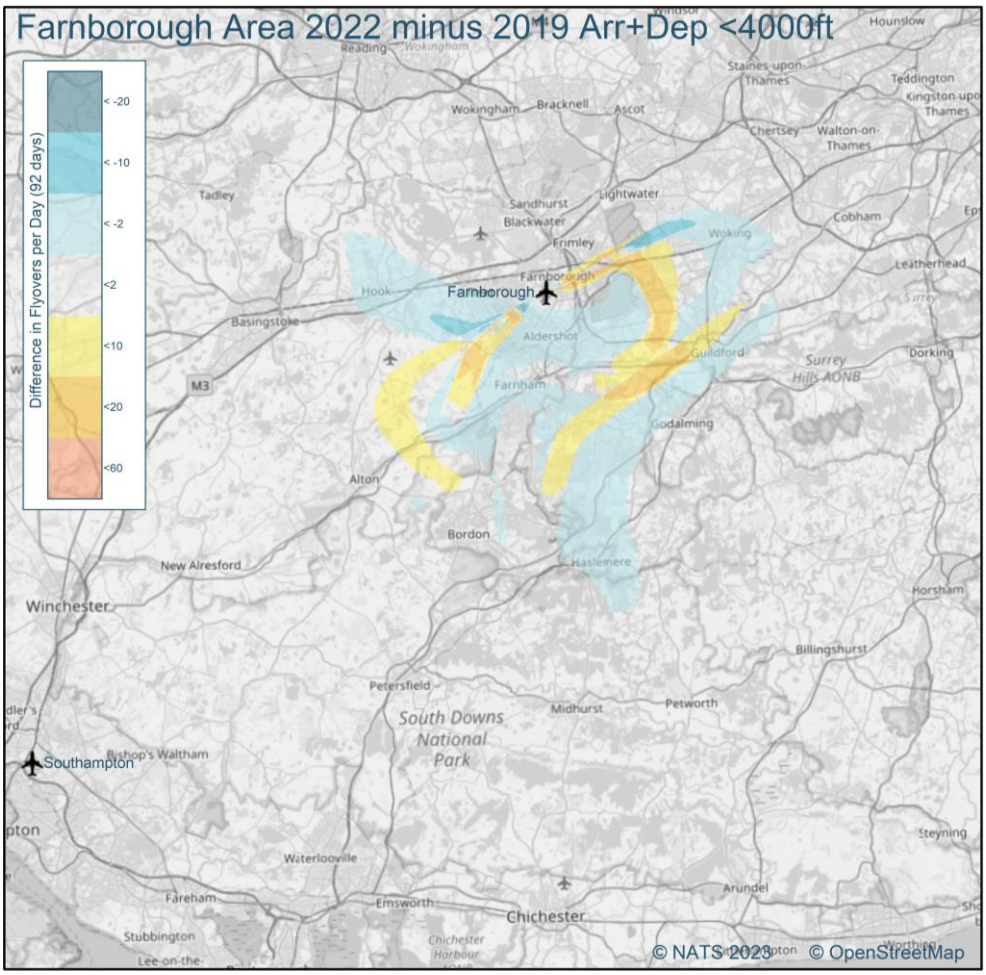


Figure 29:

Change	Daily Overflight Change	Population Impacted	Totals
Reduction	≥ -20 < -10	7,262	267,547
	≥ -10 < -2	260,285	
Increase	≥ 2 < 10	39,268	52,118
	≥ 10 < 20	11,179	
	≥ 20 < 60	1,671	

Table 5:

Population with a significant change in impact frequency due to the ACP, below 4,000ft

5.4.1 Figure 29 shows the difference between Figure 27 and Figure 28, for populations where overflight has changed by 2 per day or more below 4,000ft.

5.4.2 The upper part of Table 5 shows how many people were overflown less frequently and by how many times per day. The lower part shows how many were overflown more frequently and by how many.

5.4.3 More than five times as many people benefitted from reduced overflight than were disbenefitted by increased overflight, below 4,000ft.

5.4.4 The main areas of increased frequency (darker orange) are:

- The downwind arrival leg from north of Shackleford to the west of Guildford
- The first turns of Runway 06 departures
- Where the arrival route from the northwest crosses the Runway 24 departure route in the vicinity of Crondall.

5.4.5 This is as predicted by the original consultation material and illustrated by the overflight diagrams in this document.

5.5 Results Pre ACP 0-7,000ft

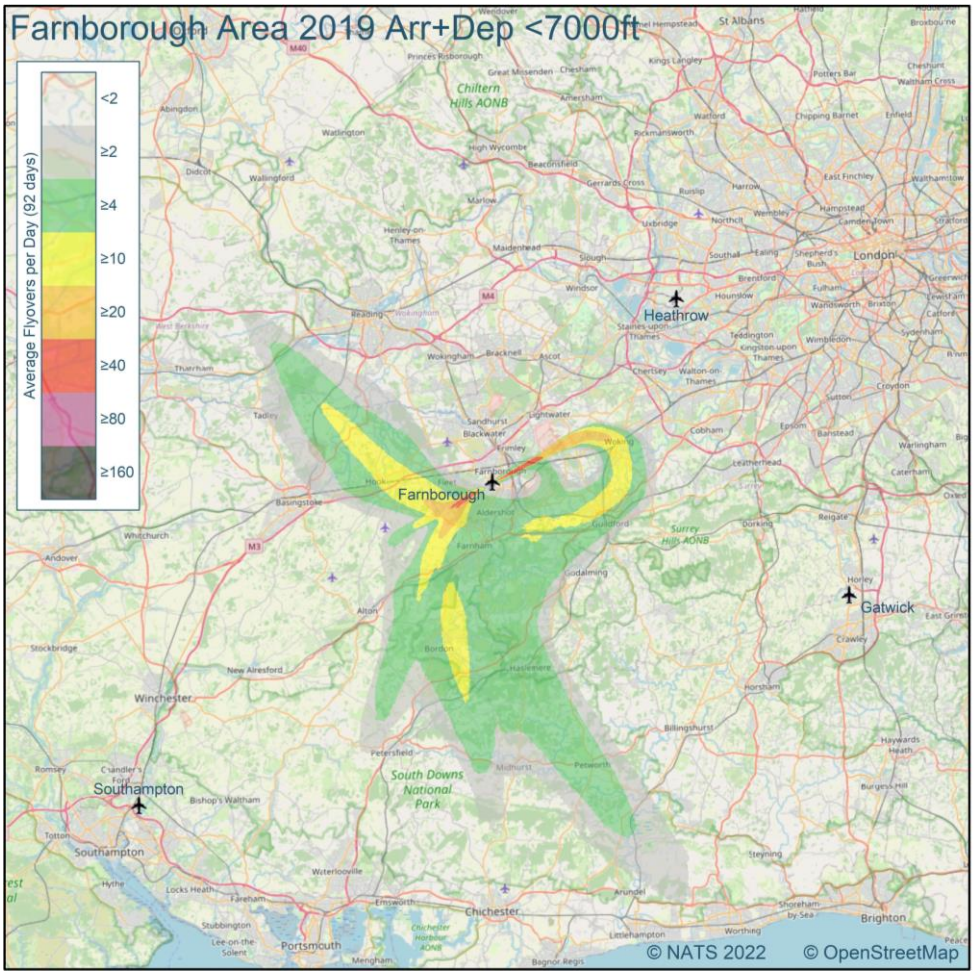


Figure 30:

Colour	Daily Overflights	Population Impacted
Grey	≥2 <4	103,255
Green	≥4 <10	281,317
Yellow	≥10 <20	107,179
Orange	≥20 <40	19,280
Red	≥40 <80	3,215
Total	≥2 <80	514,246

Table 6:

Population impact frequency, pre-ACP, below 7,000ft

5.5.1 The table above indicates how many people were overflown, and how frequently.

5.5.2 It is cumulative to 7,000ft with the data from section 5.2 on page 36, Results Pre ACP 0-4,000ft.

5.5.3 The narrow red area close to the airport indicates places where overflights happened 40-80 times per day, spreading into a wider orange, yellow then very wide green areas at 4-10 per day, finally grey at 2-4 per day.

5.5.4 Pre-ACP, c.514,000 people were overflown at least twice per day up to 7,000ft.

5.6 Results Post ACP 0-7,000ft

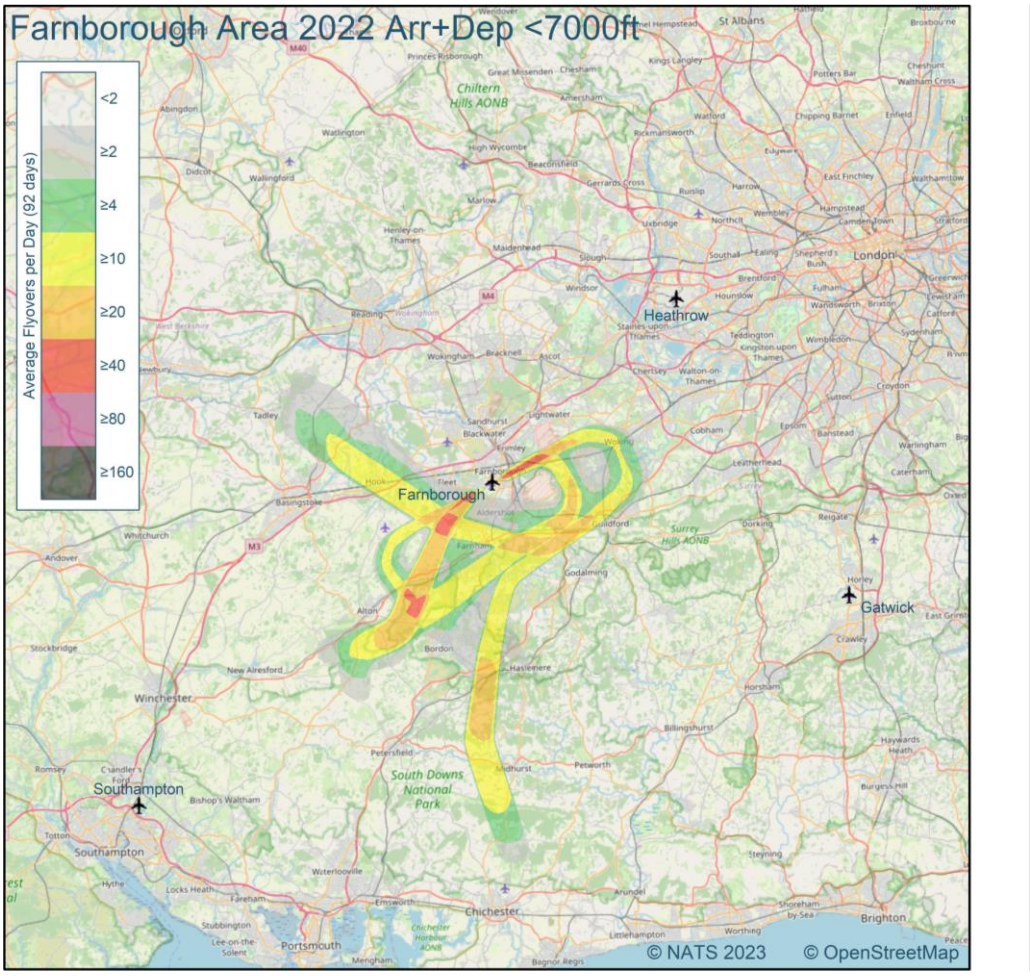


Figure 31:

Colour	Daily Overflights	Population Impacted
Grey	≥2 <4	120,382
Green	≥4 <10	114,507
Yellow	≥10 <20	108,248
Orange	≥20 <40	20,473
Red	≥40 <80	5,516
Total	≥2 <80	369,126

Table 7:

Population impact frequency, post-ACP, below 7,000ft

5.6.1 The table above indicates how many people were overflown, and how frequently.

5.6.2 It is cumulative to 7,000ft with the data from section 5.3 on page 37, Results Post ACP 0-4,000ft.

5.6.3 The narrow red area close to the airport is longer than pre-ACP. The orange and yellow areas are well defined and do not spread. There is minor spread in green, and the grey areas do not extend far from the green.

5.6.4 The places overflown regularly by the ACP routes are clearly defined due to their predictable, systemised nature. The swathes are shorter and narrower.

5.6.5 Where routes cross each other, the impacts increase and the colour reddens at the confluence.

5.6.6 Post-ACP, c.369,000 people were overflown at least twice per day up to 7,000ft; this is 145,000 fewer people overflown than pre-ACP.

5.7 Difference between pre and post ACP, 0-7,000ft

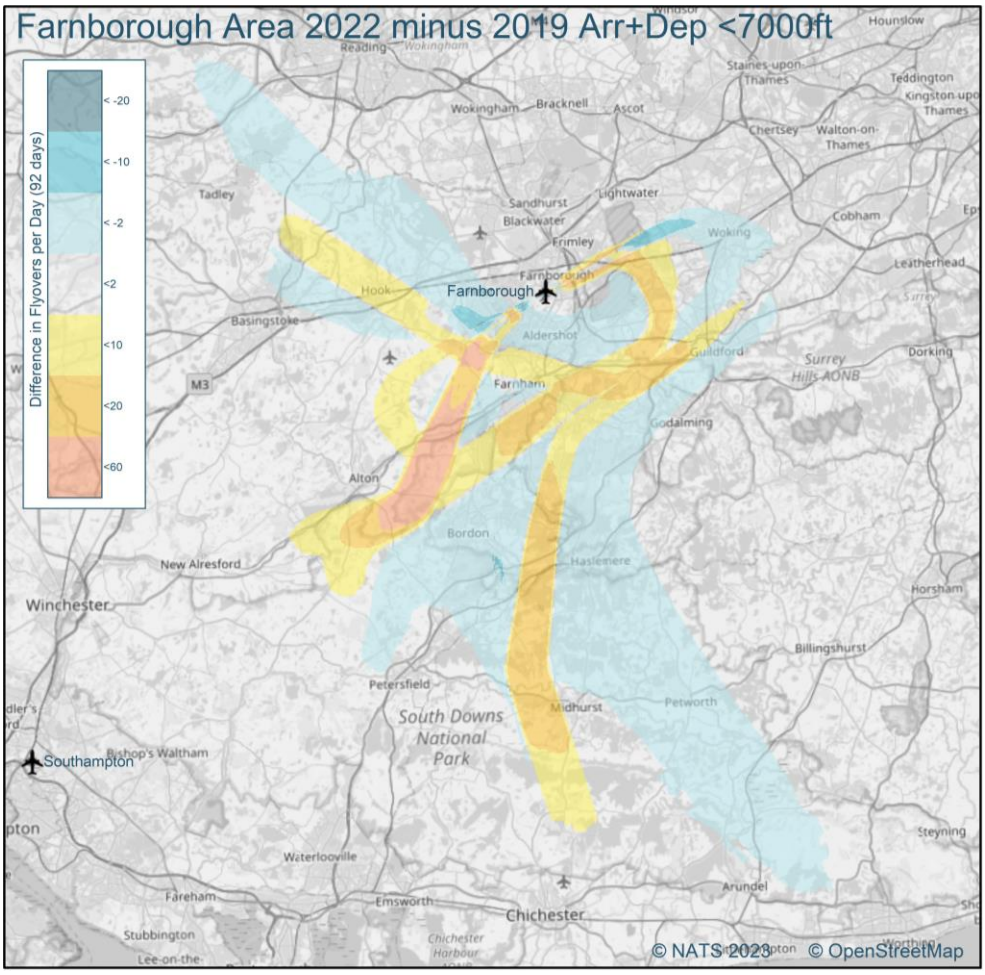


Figure 32:

Change	Daily Overflight Change	Population Impacted	Totals
Reduction	≥ -60 < -20	137	330,071
	≥ -20 < -10	12,636	
	≥ -10 < -2	317,298	
Increase	≥ 2 < 10	79,824	113,737
	≥ 10 < 20	28,543	
	≥ 20 < 60	5,370	

Table 8:

Population with a significant change in impact frequency due to the ACP, below 7,000ft

5.7.1 Figure 29 shows the difference between Figure 27 and Figure 28, for populations where overflight has changed by 2 per day or more below 7,000ft. This is cumulative, i.e. includes the population overflown below 4,000ft as per section 5.4 above.

5.7.2 The upper part of Table 5 shows how many people were overflown less frequently and by how many times per day. The lower part shows how many were overflown more frequently and by how many.

5.7.3 Almost three times as many people benefitted from reduced overflight than were disbenefitted by increased overflight, below 7,000ft.

5.7.4 The main areas of increased frequency (light pink) are:

- Where the arrival route from the northwest crosses the Runway 24 departure route in the vicinity of Crondall.
- Where Runway 24 departures cross the A31 near Bentley, heading southwest.

5.7.5 This is as predicted by the original consultation material and illustrated by the overflight diagrams in this document.

6 Conclusion

6.1.1 This document illustrates how and where the overflight of Farnborough arrivals and departures has changed, and compares the changes to the original 2014/2016 consultation and feedback material.

6.1.2 In most scenarios the change is very consistent with the original material.

- Arrivals remain higher for longer and fly over fewer people.
- Departures climb higher more quickly and also fly over fewer people.
- There was a corresponding reduction in the area of overflight of AONBs, Surrey Hills in particular, and the South Downs National Park.

6.1.3 Section 3.3 from page 18 describes some differences in expected arrival flow dispersion from the south. Broadly the results are consistent with the original material and arrival concept, however there is a reduction in eastward dispersion compared with the original prediction. We have described the difference, investigated reasons, and identified the changed proportions of Gatwick departures to the southwest as a significant contributory factor. This could not have been predicted at the time of writing the original proposal, and the arrival operation from the south remains broadly comparable with the original material.

6.1.4 Less dispersion means fewer people get overflown, but those that do get overflown are overflown more frequently. This is described in detail in Section 5 from page 35.

- More than five times as many people benefitted from reduced overflight than were disbenefitted by increased overflight, below 4,000ft.
- Almost three times as many people benefitted from reduced overflight than were disbenefitted by increased overflight, below 7,000ft (including those below 4,000ft).

6.1.5 The pre-ACP, post-ACP and original material was compared. This evidence supports our conclusion that the impacts presented in the approved ACP are as anticipated, and that the original conclusions remain unchanged.

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