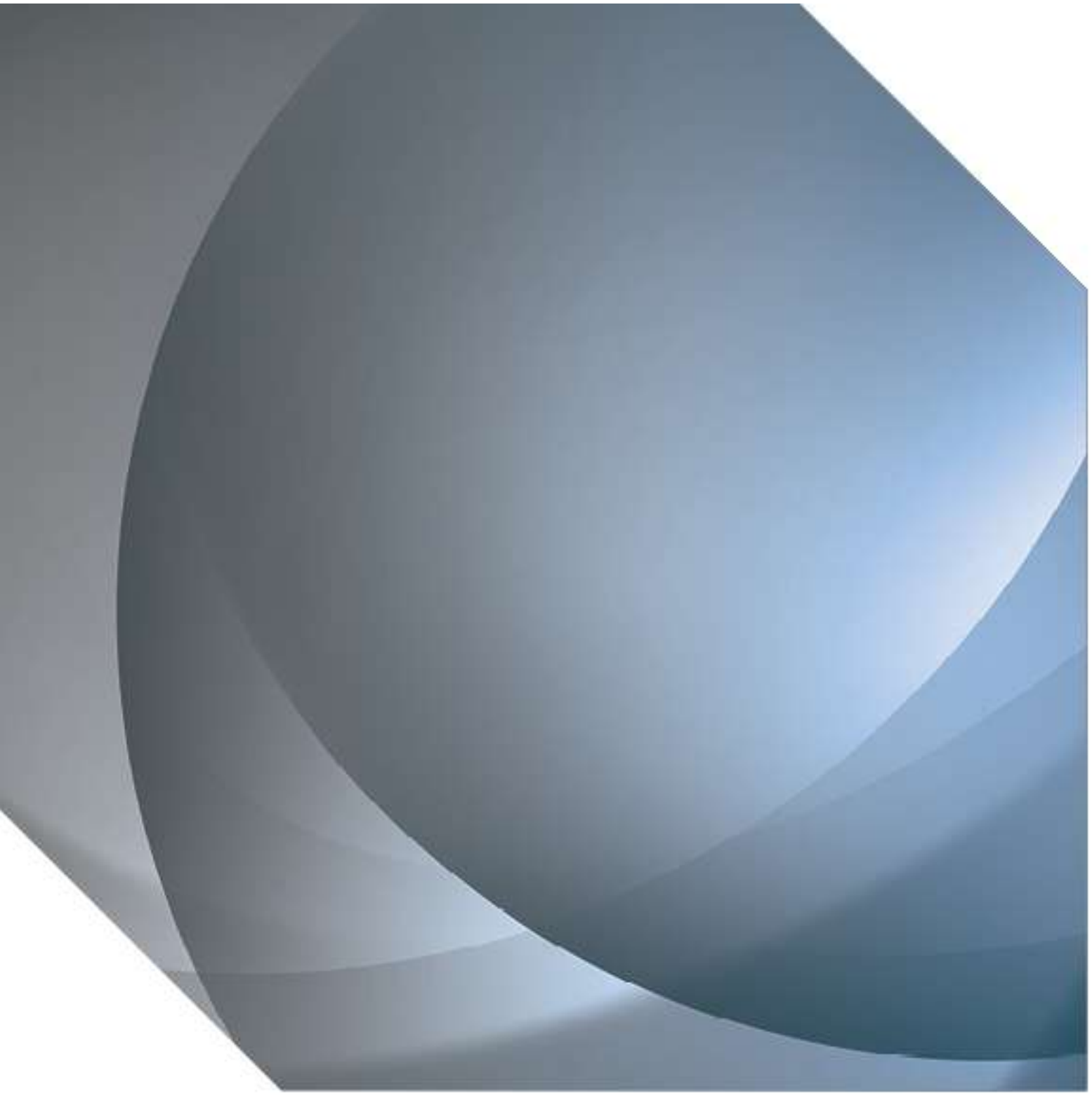
Report of the CAA's Post Implementation Review of the implementation of RNAV-1 Standard Instrument Departures at Gatwick Airport

Annex 2: PIR Environmental Analysis report

Annex 2 to CAP 1346



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Acronyms

2014 Guidance	The Secretary of State's Guidance to the CAA on Environmental Objectives Relating to the Exercise of its Air Navigation Functions published in 2014
AMSL	Above Mean Sea Level
AONB	Area of Outstanding Natural Beauty
CO_2	Carbon Dioxide
dB	Decibel units
dBA	Decibel units measured on an A-weighted scale
ERCD	Environmental Research and Consultancy Department
Gatwick	Gatwick Airport Limited
L_{max}	Maximum sound level
LAQ	Local Air Quality
L_{eq}	Equivalent continuous sound level
PIR	Post Implementation Review
PRNAV	Precision Area Navigation
RNAV-1	Area Navigation
SEL	Sound Exposure Level
SID	Standard Instrument Departure

PIR Environmental Analysis report

1. Our original environmental assessment of the proposed airspace change taken into account in the CAA's decision in 2013 only assessed the anticipated impacts up to 4000ft AMSL as this is the height at which aircraft departing Gatwick Airport are typically able to be tactically vectored from their SID by air traffic control. Neither Gatwick nor the CAA anticipated a change to the vectoring practices after the change was implemented and therefore did not anticipate any change in impacts arising from traffic between 4000ft AMSL and 7000ft AMSL. In the first instance, our Post Implementation Review (PIR) of the environmental impact of the airspace change that is the subject of this PIR will assess the actual impacts of aircraft up to 4000ft AMSL.

2. Since making our decision in 2013, the Secretary of State has issued a further version of his Guidance to the CAA on Environmental Objectives Relating to the Exercise of its Air Navigation Functions (2014 Guidance). The 2014 Guidance clarified that the impact of aviation noise should still be considered for aircraft up to 7000ft AMSL. Specifically the 2014 Guidance says:

> *…in the airspace from 4,000 feet (amsl) to 7,000 feet (amsl), the focus should continue to be minimising the impact of aviation noise on densely populated areas, but the CAA may also balance this requirement by taking into account the need for an efficient and expeditious flow of traffic that minimises emissions.*

3. In addition, it is apparent from feedback received from some groups and residents in the vicinity of Gatwick Airport that they feel affected by a change in noise levels from aircraft that are between 4000ft AMSL and 7000ft AMSL.

4. In this report, we will also review the noise impacts due to any changes from aircraft between 4000ft and 7000ft AMSL whilst noting that any such impacts were not part of the original decision.

Key points from the ERCD Annex E Report to the CAA Director of Airspace who made the airspace change decision in November 2013

5. ERCD submitted a report dated 30 May 2012 to be taken into account in the CAA's decision-making process for the original proposal from Gatwick. Key points from that report are as follows:

5.1 An overall environmental benefit could not be demonstrated. Standard noise metrics required under CAP 725 (L_{eq} contours, 90dBA SEL footprint) would be unlikely to show any change as a result of this proposal. Equally, any impact on CO_2 emissions would in all likelihood be negligible, and it was likely that there would not be any impact upon Local Air Quality (LAQ).

5.2 In line with Government guidance at that time (i.e. Guidance to the CAA on Environmental Objectives Relating to the Exercise of it Air Navigation Functions issued in 2002 (the 2002 Guidance)), the introduction of the RNAV-1 SIDs was expected generally to result in fewer people being overflown, assuming all other things being equal. Of the four trialled SIDs, the distribution (below 4000ft AMSL) on Routes 1 and 3 showed that traffic was concentrated along a path similar to that of traffic on the conventional SID. On Routes 2 and 4, the portrayed distribution (below 4000ft AMSL) of traffic on the RNAV-1 SID was notably different to the traffic on the conventional SID. Specifically:

i) **Route 2** – conventional traffic was shown to be on a wider dispersion that was concentrated to the west of the NPR centreline whilst the RNAV-1 traffic was shown to be more concentrated and on a path to the east of the NPR centreline.

ii) **Route 4** – conventional traffic had a wider dispersion, mostly to the west of the NPR centreline after the right-hand turn but largely within the NPR compliance monitoring swathe. The RNAV-1 traffic was more focused and initially had a similar path to the conventional traffic, but 1%-5% of traffic was shown to exceed the limit of the NPR compliance monitoring swathe below 4000ft AMSL.

5.3 Gatwick proposed a Management Oversight Process that included quarterly reports to its Noise and Track Monitoring Advisory Group containing a list of specific data on the impact of the RNAV-1 SIDs. It was recommended that copies of these reports should be requested as part of the post implementation review.

5.4 Evidence from the trialled SIDs was used as fair representations of the expected traffic dispersions that would occur on the SIDs that had not been trialled.

Environmental Analysis by ERCD to be taken into account by the CAA in the Post Implementation Review

Population overflown

Anticipated effect

6. Generally the proposed change was expected to result in some people experiencing an increase in overflights due to the nature of RNAV-1 and its improved track keeping (i.e. concentration), and others that were beneath the wider pre-implementation dispersion experiencing less overflights.

7. However, on two of the routes (Routes 2 and 4) there was expected to be a likely shift in the mean track that was not entirely due to traffic becoming more concentrated around the existing traffic pattern.

8. Gatwick's proposal explained that:

> *The improved track-keeping ability of PRNAV will result in less dispersal of flights across the NPR compliance monitoring swathes. Thus the noise impact of the over-flying aircraft will affect less people. However those who are directly beneath the flight path will experience a greater number of over-flights.*

9. This was acknowledged by ERCD as true up to a point, but may not necessarily be true in all circumstances. The statement assumed that the reduced dispersal remained along the current route. If the route is actually moving because the SID cannot be replicated exactly, it would not necessarily be true that less people would be affected.

10. The proposal advised that:

> *Above 4,000ft aircraft would be tactically vectored exactly as they are today, therefore there will be no change to the environmental performance from aircraft above 4,000ft.*

11. Whilst aircraft are still able to be vectored after implementation, this statement is only true if aircraft are vectored from similar points as occurred before implementation. If the new SIDs resulted in aircraft being at a different location when they achieve 4000ft AMSL then there could be a change in the environmental impact. For example, the diagrams that illustrated Route 2 in the consultation and the airspace change proposal submitted to the CAA showed that the distribution up to 4000ft AMSL was expected to be noticeably different for traffic on the conventional SID and traffic on the RNAV-1 SID.

Actual effect

12. Noting that there is no accepted definition of "overflown", we assessed the population "overflown" and the results are detailed in the tables in Appendix A (together with more information about how the results were derived), and summarised in the table below.

Table 1: Summary of the change (increase or decrease) in the number of people overflown

	Route							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Total number of people overflown below 4000ft AMSL	+50	-50	-2,000	-500	-1,300	0	0	0
Total number of people overflown below 7000ft AMSL	+150	-850	-1,550	+6,600	-900	-2,050	-1,100	0
Overflown below 4000ft AMSL by more than ten flights per day	0	+700	+450	-300	0	-50	0	0
Overflown below 7000ft AMSL by more than ten flights per day	+100	+950	+200	+2,500	+350	-50	-50	0

13. Table 1 shows that aircraft on most of the routes overfly fewer people but notably Route 4 shows an increase in the number of people overflown between 4000ft AMSL and 7000ft AMSL. (Note that this does not necessarily mean that this increase represents "newly overflown" people – especially as some of this increase may include people that are already overflown by Route 3).

Consideration of noise impact – L_{eq} Contours and SEL Footprints

Anticipated effect

14. Neither L_{eq} contours nor SEL footprints were required from Gatwick as part of the proposal as the SID replications were not expected to have any impact upon these metrics. As part of the PIR we have undertaken noise modelling to see if the new SIDs have in fact had any impact upon either the contours or footprints.

Actual effect

L_{eq} contours

15. We have remodelled the Gatwick 2013 actual summer day L_{eq} contours with the 2014 (RNAV-1) departure mean tracks and compared the results of the two sets of contours. These two sets of contours are portrayed in the diagram at Appendix B. There are some very slight differences in the 57dBA contour, mainly to the west of the airport. This is caused by the positioning of the 26LAM track (Route 4), which was further to the west in 2014 and this shift in Route 4 was an anticipated result of the airspace change.

16. The areas, populations and households are summarised in Tables 2 to 4 below. The population and household counts have been rounded to the nearest 50. The 57dBA contour shows a very small reduction in people affected with the RNAV-1 routes in place.

Table 2

2013 average summer day - 2013 routes			
L_{eq}	Area (km^2)	Population	Households
57	40.9	3,250	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	<50	<50
72	1.9	<50	<50

Table 3

2013 average summer day with 2014 (RNAV-1) routes			
L_{eq}	Area (km^2)	Population	Households
57	40.9	3,200	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	<50	<50
72	1.9	<50	<50

Table 4

Change (difference between Table 2 & Table 3)			
L_{eq}	Area (km^2)	Population	Households
57	0.0	-50	0
60	0.0	0	0
63	0.0	0	0
66	0.0	0	0
69	0.0	0	0
72	0.0	0	0

17. L_{eq} contours are a means of portraying long-term average noise exposure, and as such they take account of both the noise level of each aircraft, its duration and the number of aircraft noise events. The 57dBA L_{eq} contour remains the accepted limit for defining the onset of significant community annoyance due to aircraft noise, namely it is the indicator that is used to portray the point at which a proportion of the community would consider itself to be significantly annoyed by aviation noise. This does not mean that no one living beyond a 57dBA L_{eq} contour will be annoyed by aviation noise – the experience of annoyance due to aviation noise is a personal experience and is influenced by a number of

subjective factors. Equally, and for the same reason, it does not mean that everyone living within a 57dBA L_{eq} contour will be annoyed by aviation noise.

18. Any effect that concentration has upon the 57dBA L_{eq} contour is reflected in the diagram at Appendix B. So whilst it is true that some residents and communities may be experiencing an increase in overflights as a result of concentration due to RNAV-1, and therefore also experiencing an increase in noise impact, that impact would not be deemed to be significant if they are beyond the 57dBA L_{eq} contour.

SEL footprints

19. We have generated 90dBA departure SEL footprints for the noisiest type of aircraft operating at night in 2013 (Airbus A330), and the most frequent type (Airbus A320 with CFM engines). In selecting the noisiest type, we only considered aircraft types with at least one movement per summer night on average.

20. The 90dBA SEL footprints for the above two aircraft types and for each of the Gatwick SIDs (pre- and post-RNAV-1) were compared. The 26WIZ SID (Route 9) was omitted as this is not available at night. As expected, the introduction of RNAV-1 SIDs has minimal effect on the 90dBA SEL footprints. Footprint areas, populations and households are unchanged by the RNAV-1 SIDs and this is shown in Tables 5 and 6 below. All figures have been rounded to the nearest 50.

Table 5

A330 90dBA SEL footprints – results for both the 2013 conventional routes and the 2014 RNAV-1 routes			
SID	**Area (km^2)**	**Population**	**Households**
08CLN	8.1	400	150
08DTY	8.1	400	150
08KEN	8.1	400	150
08SFD	8.1	400	150
26BOG	8.3	150	50
26LAM	8.3	150	50
26SAM	8.3	150	50
26SFD	8.3	150	50

Table 6

A320 90dBA SEL footprints – results for both the conventional 2013 routes and the 2014 RNAV-1 routes			
SID	**Area (km^2)**	**Population**	**Households**
08CLN	3.3	<50	<50
08DTY	3.3	<50	<50
08KEN	3.3	<50	<50
08SFD	3.3	<50	<50
26BOG	3.3	<50	<50
26LAM	3.3	<50	<50
26SAM	3.3	<50	<50
26SFD	3.3	<50	<50

Noise Preferential Route (NPR) compliance

21. One of the pieces of evidence submitted with the original airspace change proposal were “heat maps” – diagrams that illustrate actual traffic patterns, and portrayed the density of traffic using a colour key with each colour representing a percentage of the total number of flights. As part of the PIR, we asked Gatwick to provide equivalent diagrams to illustrate post-implementation traffic patterns and densities, using the same percentage scale. These diagrams would enable us to gauge the actual impact, notably on Route 4, of both concentration and mean track.

22. As a result of changing the supplier for their Noise & Track-Keeping system, Gatwick advised that it is not able to provide diagrams that use the same scale for the purposes of the PIR. Instead of a scale that shows densities as a percentage, the diagrams provided for the PIR show densities as a number of flights. Therefore, in the absence of being able to provide equivalent post-implementation diagrams, we sought an alternative means of comparing NPR compliance in order to gauge the impact.

23. In order to make this comparison, Gatwick has provided this summary (below) of NPR compliance. It shows the percentage of flights on each route that remain within their respective NPR compliance monitoring swathe below the height at which they can be tactically vectored, i.e. “on track”. The table illustrates periods both before and after the implementation of the RNAV-1 SIDs.

Table 7

		Pre-implementation (1 Sept 2013 – 1 Nov 2013)			Post-Implementation (1 Jan 2015 – 1 Mar 2015)		
Route no.	**Vectoring height (feet amsl)**	**Total flights**	**Outside NPR swathe**	**On track (% within NPR swathe)**	**Total flights**	**Outside NPR swathe**	**On track (% within NPR swathe)**
1	3,000	4,572	22	99.5%	4,166	10	99.8%
2	4,000	1,850	15	99.2%	1,045	4	99.6%
3	3,000	1,780	12	99.3%	1,161	2	99.8%
4	4,000	7,192	478	93.4%	5,488	800	85.4%
5	3,000	743	6	99.2%	396	1	99.7%
6	3,000	2,023	4	99.8%	1,180	2	99.8%
7	4,000	4,503	39	99.1%	3,913	7	99.8%
8	3,000	110	0	100.0%	14	0	100.0%
9	3,000	18	0	100.0%	1	0	100.0%

24. As Table 7 shows, the only route with a notable change in compliance rate is Route 4 which has worsened, from 93% to 85%. (Based upon the evidence submitted with the airspace change proposal and the case made by Gatwick the CAA had expected that the proportion of traffic that would exceed the NPR compliance monitoring swathe below 4000ft AMSL on Route 4 post-implementation would be 1%-5%.)

Illustrative noise levels by height

Table 8: Departure L_{max} levels by aircraft height

Height (ft)	125-180 seat single-aisle 2-eng jet (dBA Lmax)	250 seat twin-aisle 2-eng jet (dBA Lmax)
1000	85	92
2000	75	83
3000	70	77
4000	66	73
5000	63	69
6000	60	66
7000	59	64

25. The above noise levels are for illustrative purposes. They are modelled average values, based upon actual monitored noise data. The two aircraft types portrayed are the predominant types in use at Gatwick Airport.

Table 9: Aircraft groupings

Aircraft grouping	Specific types
125-180 seat single-aisle 2-eng jet	Airbus A318/319/320/321, Boeing 737-600/700/800/900
250 seat twin-aisle 2-eng jet	Airbus A330, Boeing 767-300/400

Review of each route since RNAV-1 SIDs implemented on 14 November 2013

26. Appendix C is a copy of the table that was included in the environmental report prepared by ERCD to support the 2013 decision. It summarises the expected impacts below 4000ft AMSL based upon the proposal submitted by Gatwick.

27. Using the evidence provided by Gatwick as part of the PIR, each route is considered in turn below and key observations summarised.

Route 1

28. **Expectation based on proposal:** A concentration of traffic along the existing flight path.

29. **Observation up to 4000ft AMSL:** The expected concentration along the existing flight path is evident.

30. **Observation between 4000ft AMSL and 7000ft AMSL:** Whilst the post-implementation spread of traffic due to vectoring is similar to the pre-implementation spread, there does appear to be a notable concentration of traffic remaining on the RNAV-1 SID in comparison to the conventional SID, between Ellens Green and Plaistow.

Route 2

31. **Expectation based on proposal:** The pre-implementation traffic using the conventional SID appeared to be concentrated to the west of the NPR centreline (yet within the NPR compliance monitoring swathe) on the initial right-hand turn. In addition to a general concentration of traffic as a result of RNAV-1, there was an expectation that there would be a shift in dispersion such that traffic would be concentrated to the east of the NPR centreline (yet still within the NPR compliance monitoring swathe) on the same turn. In terms of impact, this would mean that below 4000ft AMSL the population within the NPR compliance monitoring swathe to the west of the NPR centreline would be overflown less

whilst the population within the NPR compliance monitoring swathe to the east of the NPR centreline would be overflown more frequently.

32. **Observation up to 4000ft AMSL:** Firstly it is noted that there is a change in dispersion and concentration of the conventional SID traffic in the samples provided for the PIR compared with that shown in consultation and proposal – namely that the assumed concentration of traffic to the west of the right-hand turn is not evident. This means that the pre- and post-implementation flight paths appear to be much closer matched than was expected based upon the proposal.

33. Secondly there is a clear increase in concentration due to RNAV-1, even around the right-hand turn.

34. **Observation between 4000ft AMSL and 7000ft AMSL:** A large number of aircraft are above 4000ft AMSL as they complete the right-hand turn; this is the case for both conventional and RNAV-1 traffic. However the dispersion of traffic at that turn is much wider for the conventional SID, which therefore takes a greater number of aircraft over the western side of East Grinstead than the equivalent RNAV-1 SID. Whilst tactical vectoring patterns are generally similar between conventional SID and RNAV-1 SID, the volume of traffic that remains on the SID is greater for RNAV-1 than conventional, as revealed by an apparently greater concentration on the RNAV-1 SID.

Route 3

35. **Expectation based on proposal:** A concentration of traffic along the existing flight path.

36. **Observation up to 4000ft AMSL:** The expected concentration along the existing flight path is evident, notably around the 180^{o} turn.

37. **Observation between 4000ft AMSL and 7000ft AMSL:** Whilst the post-implementation spread of traffic due to vectoring is similar to the pre-implementation spread, there does appear to be a notable concentration of traffic remaining on the RNAV-1 SID in comparison to the conventional SID between 4000ft-5000ft AMSL. Above 5000ft AMSL the dispersion and concentration of traffic on the conventional SID and the RNAV-1 SID appear similar.

Route 4

38. **Expectation based on proposal:** The proposal explained that it was not possible to come up with a design that enabled the SID to be safely contained within the NPR compliance monitoring swathe for Route 4. Traffic below 4000ft AMSL on the RNAV-1 SID trial was shown to exceed the limit of the NPR compliance monitoring swathe (to the north of the first turn) with a greater frequency (1%-5% of traffic) than the pre-implementation traffic on the

conventional SID did. This suggested that populations in that area, outside the NPR compliance monitoring swathe (such as South Holmwood), were more likely to be overflown by aircraft below 4000ft AMSL (after the change) as a result of the shift of traffic pattern but CAA analysis undertaken as part of its consideration of the proposal concluded that any increase in noise impact as a result was expected to be minor.

39. Traffic was expected to be concentrated about the RNAV-1 SID. This would mean that fewer residents would be overflown, particularly those located inside of the turn and to the right of the NPR. However, in common with the other RNAV-1 SIDs, the concentration of traffic about the SID would mean that those residents located beneath the SID would be overflown more often.

40. The expected concentration of traffic resulting from RNAV-1 meant that potentially fewer people would be overflown due to a much narrower dispersion. The heat map provided with the airspace change proposal (also published in the consultation) showed that almost all of the pre-implementation conventional traffic remained within the NPR compliance monitoring swathe below 4000ft AMSL despite having a wider dispersion, especially around the turn).

41. **Observation up to 4,000ft:** As anticipated, the spread of traffic using the RNAV-1 SID has reduced compared with the spread of traffic using the conventional SID.

42. There are significantly fewer aircraft on the eastern half of the NPR compliance monitoring swathe around the turn such that Newdigate and the adjacent areas on the right hand side (eastern side) of the turn have notably fewer overflights.

43. However, a number of aircraft are evidently outside the NPR compliance monitoring swathe on the outside of the turn. The estimated duration of this period of flight below 4000ft AMSL (the NPR vectoring altitude) was estimated during the airspace change proposal analysis as being approximately 20 seconds before aircraft would reach 4,000ft. When examining the track diagrams provided for the PIR, some flights continue along the RNAV-1 SID as far as Leigh at 4000ft AMSL– this aspect was portrayed in the proposal and was therefore expected.

44. As with all of the Routes being reviewed in this PIR, the task is made more difficult by being unable to make a direct comparison between the “heat map” density diagrams provided for the airspace change proposal and the density and track diagrams provided for the PIR. The two sets of diagrams are not directly comparable and so a degree of expert interpretation is required.

45. In particular, for Route 4, it makes definitive conclusions about any differences in traffic patterns harder to reach. However, the following is our finding for Route 4.

46. We compared the expected RNAV-1 traffic as portrayed in the airspace change proposal density diagram[1] with the actual RNAV-1 traffic as portrayed in the documents submitted in the PIR. When comparing the average mean tracks (i.e. a line that reflects the concentration of the traffic) from these two density diagrams, it can be seen, that following implementation of the RNAV-1 SIDs, each mean track in the density diagrams is very similar – namely that in general the tracks around the turn are as expected.

47. Whilst RNAV-1 traffic appears to be closely following the SID, leading to a more concentrated pattern centred on the RNAV-1 SID nominal track (i.e. the designed track of the SID) as expected, there also appears to be a greater proportion of traffic that is exceeding the NPR compliance monitoring swathe below 4000ft AMSL at the north-west point of the turn than was anticipated based on the evidence submitted for the proposal. This suggests that whilst locations in that area were expected to be overflown below 4000ft AMSL as a result of this change, the number of aircraft that are actually below 4000ft AMSL in that location is greater than was expected. More specifically, we anticipated that 1%-5% of aircraft would exceed the NPR compliance monitoring swathe below 4000ft AMSL but the figures provided for this PIR from Gatwick show that approximately 15% of aircraft are below 4000ft AMSL as they exceed the swathe (derived from Table 7 on page 13).

48. **Observation between 4000ft AMSL and 7000ft AMSL:** Tactical vectoring is apparent from Leigh and onwards to the east for both conventional and RNAV-1 SIDs. There is no significant change in the spread of vectored traffic, however, Nalderswood appears to be less often overflown by vectored traffic using the RNAV-1 SID as a result of the re-alignment and concentration of the SID track.

49. Above 4000ft AMSL even though tactical vectoring is still occurring it is also apparent that there is a proportion of departures which remain concentrated on the RNAV-1 SID. As this section of the RNAV-1 SID design is further north than the conventional SID, this concentration means that there are a greater number of aircraft that are flying north of the NPR compliance monitoring swathe than was the case with the conventional SIDs, albeit these aircraft are above 4000ft AMSL (so not in breach of the NPR).

50. Most aircraft, both conventional and RNAV-1, reach 5000ft AMSL by South Godstone.

51. Most of the tracks for RNAV-1 departures take a wider turn than aircraft that flew on the conventional SID once past Beare Green, resulting in an increase in flights over South Holmwood and Leigh. The eastbound track towards South Earlswood has moved to the north as is clearly evident from comparison

[1] The diagram used for both the consultation and the proposal submitted to the CAA.

between conventional SID and RNAV-1 track diagrams (refer to the CAA's Route Analysis report for copies of track diagrams). This northwards shift in the mean track of the RNAV-1 SID, coupled with a general concentration of aircraft on the RNAV-1 SID means that there appears to be:

- An increase in aircraft that overfly Leigh and South Earlswood;
- an increase in aircraft that are passing closer to Dovergreen and South Nuffield;
- a decrease in aircraft that pass close to Nalderswood and Salfords.

Route 5

52. **Expectation based on proposal:** The heat map of the traffic on the conventional SID showed that departing aircraft followed the NPR centreline closely – in fact, closer than it seemed to follow the conventional SID nominal track (i.e. the designed track of the SID). The conventional SID nominal track sat to the south of the NPR (a maximum distance of 453m from the NPR centreline). Gatwick anticipated that the mean track of the RNAV-1 traffic would be similar to the current mean track rather than shifting south nearer to the nominal track of the RNAV-1 SID (towards Dormansland).

53. **Observation up to 4000ft AMSL:** The majority of traffic appears to be at 4000ft AMSL or above by the time it reaches Dormansland – this was true for conventional departures as well as currently for RNAV-1 departures. Dispersion has reduced slightly, and the RNAV-1 traffic pattern shows more concentration than the conventional traffic pattern, prior to tactical vectoring becoming apparent.

54. **Observation between 4000ft AMSL and 7000ft AMSL:** Despite a similar pattern of wide dispersion due to vectoring, it appears that traffic using the Route 5 SIDs are concentrating about the SID, with the result that the mean track for RNAV-1 traffic has shifted further south. Whilst this shift southwards was a possibility, it was not expected by Gatwick or the CAA. After the A22 road the pattern of the RNAV-1 departures is noticeably different from that of the conventional departures. Based upon the heat maps provided for the PIR, the conventional departures show two distinct eastbound concentrated tracks (one over Lingfield and one to the north of Dormansland), whilst the RNAV-1 pattern shows a single concentration that has moved further south such that it is closer to/above Dormansland. This is likely to reflect a reduction in traffic over Lingfield but an increase in traffic over Dormansland.

55. It is noted that aircraft on the RNAV-1 SIDs are turning earlier compared with aircraft on the conventional SIDs, with the turn commencing before the A22 road.

Route 6

56. **Expectation based on proposal:** The charts illustrating the conventional SID traffic pattern showed that aircraft were typically not making the shallow left turn on this route. This took traffic close to the eastern edge of the NPR compliance monitoring swathe though not beyond it (below 4000ft AMSL). Gatwick expected traffic on the RNAV-1 SID to demonstrate a similar track, i.e. not making the left turn, but with some concentration due to RNAV-1.

57. **Observation up to 4000ft AMSL:** Both conventional and RNAV-1 traffic show two distinct routes, one that follows the SID towards Crookham Hill and the other that continues straight out from the runway towards Lingfield. The NPR associated with this SID ends at 3000ft AMSL and there is vectoring below 4000ft AMSL for both conventional and RNAV-1 traffic. The RNAV-1 traffic shows a clear concentration in comparison to the conventional traffic.

58. **Observation between 4000ft AMSL and 7000ft AMSL:** Whilst the overall spread of traffic due to vectoring is similar for both conventional and RNAV-1 traffic, there is an apparent concentration for RNAV-1 traffic along the two mean tracks.

Route 7

59. **Expectation based on proposal:** This route was not trialled. Gatwick's and the CAA's assumption was that the RNAV-1 traffic on this route would be a good match for the conventional traffic pattern, but with the expected concentration that results from RNAV-1.

60. **Observation up to 4000ft AMSL:** For both conventional and RNAV-1 departures, the majority of aircraft have reached 4000ft AMSL before the left turn southwards at Ellens Green. A few aircraft appear to have been given early vectoring off the RNAV-1 SID (more than is apparent in the conventional traffic charts).

61. As most of the traffic achieves 4000ft AMSL before the left turn, the initial straight-out portion of this route does not show a significant difference in concentration between conventional traffic and RNAV-1 traffic.

62. **Observation between 4000ft AMSL and 7000ft AMSL:** In most cases, aircraft that are above 4000ft AMSL have completed the left turn and are heading south.

63. For conventional traffic, the distribution through the left turn was wider than is apparent for RNAV-1 traffic. Once aircraft have steadied up on track southbound, the concentration reduces slightly, except for a wide dispersion due to vectoring which extends from Slinfold to the west as far as Alfold Crossways. There is also a distinct, separate density plot of traffic extending further west

beyond the SID turning point to the south, which means there is widespread westbound vectoring after the turn should have been initiated.

64. For RNAV-1 traffic, the distribution through the left turn is more concentrated and slightly further west within the NPR compliance monitoring swathe (and evenly spread about the NPR centreline through the turn) compared with the conventional traffic. Once the turn is completed and aircraft have steadied up and are heading south, the main spread of traffic becomes more concentrated (and is notably more concentrated than the conventional southbound traffic), though there is still widespread dispersion due to vectoring which extends from slightly east of Slinfold to the west as far as Alfold Crossways. As with the conventional traffic, there is also a distinct, separate density plot extending further west beyond the SID turning point (at Ellens Green) to the south, which means there is widespread westbound vectoring after the turn should have been initiated.

65. The greater concentration of RNAV-1 traffic on this southbound segment means that more aircraft are closer to Slinfold as they fly south than appears to be the case for conventional traffic. In addition, there appears to be a slight increase in the number of tactically vectored RNAV-1 aircraft to the east of the SID, above Slinfold.

66. To investigate this, the CAA undertook a “gate analysis” of traffic as it passed Slinfold. The position of the gate in relation to the NPR and the NPR compliance monitoring swathe is illustrated by the diagram at Appendix D. A gate analysis is a means of portraying the details of each flight (both its height and its lateral position) as it passes through the “gate”.

67. Two samples were used – one for 2013 (all aircraft between 1 June and 30 September, 5,501 aircraft in total) which illustrate traffic using the conventional SID and the other sample from 2014 (all aircraft between 1 June and 30 September, 2,644 aircraft in total). The number of aircraft using Route 7 in 2014 decreased due to some aircraft being directed to use the ADNID trial SID.[2] However, the 2014 data is representative and more than sufficient for statistical comparison. From the 2013 sample, the average height of aircraft was 7002ft AMSL and from the 2014 sample, the average height was 7291ft AMSL. Appendix E shows the two charts that illustrate the results.

68. Based upon the average heights, and the modelled noise results shown in Table 8 above, we would expect the L_{max} noise levels for the predominant aircraft types as they pass through the location of the gate to be between 59dBA and 64dBA.

69. The histogram at Appendix F is another method of portraying the lateral spread of aircraft as they pass through the gate. The diagram uses 500m bands to

[2] See PIR report for information on the ADNID trial.

show the percentage of flights above locations on the ground as they pass through the gate. It clearly illustrates the concentration due to RNAV-1 that is seen in the gate plots in Appendix E and also shows that the number of flights in the -1,000 to -1,500m band (the band that Slinfold is in) has increased from 1% to 3%.

70. Appendix G is a graph that illustrates the average L_{max} values based on the gate analysis, for both 2013 and 2014. From the graph, it can be seen that at -1,000m from the NPR (the approximate location of Slinfold), the average L_{max} has increased from 59dBA to 60dBA, a marginal increase that would not be considered significant.

71. From this gate analysis, we can conclude that on Route 7:

- More aircraft are closer to Slinfold as a result of concentration.
- The number of aircraft directly above Slinfold on Route 7 has increased from 1% of flights to 3% of flights.
- The average height of aircraft as they pass Slinfold is 7291ft AMSL, with 60% being above 7000ft AMSL. The average noise level (L_{max}) at Slinfold for a flight on Route 7 has increased marginally (<1dBA).
- Based on the two predominant aircraft types at Gatwick Airport, noise levels (L_{max}) for flights that pass over Slinfold would be between 54 and 67dBA L_{max}.

Route 8

72. **Expectation based on proposal:** The heat map provided for the proposal showed traffic not following the left-hand turn of the conventional SID. Instead, the traffic appears to head straight out from departure, with the 1%-5% of current traffic exceeding the western boundary of the NPR compliance monitoring swathe below 4000ft AMSL.

73. Gatwick explained that “traffic is routinely given a standard radar heading to run it further west on the SFD route from 26L” and that this would continue to happen once the RNAV-1 SID (which closely matched the conventional SID) was implemented. Therefore, in the instance of this route, despite the new RNAV-1 SID replicating the conventional SID and the two traffic dispersions expected to be similar, it was still expected that traffic would be directed to travel further west such that a small proportion would still exceed the NPR compliance monitoring swathe.

74. **Observation up to 4000ft AMSL:** Almost all conventional and RNAV-1 traffic achieve 4000ft AMSL before the left turn. The concentration of RNAV-1 on this straight-out section of the SID is marginally more concentrated than the conventional traffic.

75. **Observation between 4000ft AMSL and 7000ft AMSL:** RNAV-1 traffic appears to be following the SID very closely and tightly around the left turn. In comparison, conventional traffic appears to take the turn wider and to be more dispersed. However, it is not apparent if this wider dispersion is due to a greater use of tactical vectoring or due to the design of the conventional SID. The expected pattern of traffic flying "straight-out" is not apparent.

Route 9

76. **Expectation based on proposal:** There was no illustration of current traffic density or expected traffic density because the SID was used infrequently and there was very little track data to produce meaningful traffic patterns/heat maps.

77. **Observation up to 4000ft AMSL:** Very few aircraft use this route and so the sample sizes used for these observations are small. Both conventional and RNAV-1 traffic are reaching 4000ft AMSL before the turn near Rusper. Traffic is notably more concentrated for those departures following the SID design, especially through the turn. There are some aircraft being turned off the RNAV-1 SID very early.

78. **Observation between 4000ft AMSL and 7000ft:** After passing Roffrey, vectoring is evident for both conventional and RNAV-1 traffic. Other than a continuing general concentration for RNAV-1 traffic about the SID, traffic patterns reflect tactical vectoring and are similar for conventional and RNAV-1 SIDs.

Other environmental impacts

CO_2 emissions

79. **Expectation based on proposal:** Prior to consultation, the CAA considered the need for undertaking an emissions assessment. On the assumption that the RNAV-1 SIDs would replicate the existing conventional SIDs, with no changes to fleet mix, traffic volumes or vertical profiles, it was concluded that a CO_2 assessment would not be required as any increase or decrease in emissions would be minimal, and that the likelihood would be no change overall.

80. **Observation following implementation:** Accepting that generally on the routes, traffic is more concentrated about the RNAV-1 SIDs, the mean tracks of each route are comparable with the mean track of traffic on the conventional SIDs. This means that there is unlikely to be any changes in track mileage and therefore any significant changes to fuel burn and CO_2 emissions.

81. The exception is Route 4, where the new RNAV-1 SID has generally resulted in aircraft taking a wider turn before heading east. This will result in a small increase in track mileage and (all other things being equal) a small increase in fuel burn and therefore CO_2 emissions.

82. Whilst this is likely to mean a negative impact in terms of CO_2 emissions, the scale of that impact is likely to be very small.

Local air quality (LAQ)

83. **Expectation based on proposal:** Prior to consultation, the CAA considered the need for undertaking an LAQ assessment taking into account it was anticipated that the RNAV-1 SIDs would replicate the existing conventional SIDs, with no changes to fleet mix, traffic volumes or vertical profiles. It was concluded that a LAQ assessment would not be required as no impact on LAQ as a result of this proposal was anticipated.

84. **Observation following implementation:** There are no changes to traffic patterns below 1000ft AMSL, and there has been no traffic growth or change in runway usage that is attributable to the introduction of RNAV-1 SIDs. This means that it remains very unlikely that the implementation has resulted in a worsening of LAQ.

Tranquillity

85. **Expectation based on proposal:** Considering the extent of the anticipated impact and the areas overflown below 4000ft AMSL, tranquillity and visual intrusion were considered. We concluded in the ERCD Annex E report (taken into account by the CAA decision maker) that there would be no additional impact upon Areas of Outstanding Natural Beauty (AONB) or National Parks.

86. **Observation following implementation:** Based upon the proposal, it was anticipated that a proportion of RNAV-1 traffic (1%-5%) using Route 4 would exceed the NPR compliance monitoring swathe on its northern edge, in the vicinity of South Holmwood before achieving 4000ft AMSL. South Holmwood is situated just within the boundary of the Surrey Hills AONB.

87. Based upon the data presented for the post implementation review (track diagrams, and the data regarding the proportion of traffic exceeding the NPR compliance monitoring swathe below 4000ft AMSL on Route 4 (see Table 7) - approx 15% of aircraft), it is apparent that there is an increase in traffic overflying the area of South Holmwood (i.e. more than was anticipated based upon the proposal).

88. In addition, based upon track diagrams submitted for the PIR that illustrate the pattern of conventional traffic and RNAV-1 traffic, there is also an apparent increase in aircraft between 4000ft-7000ft AMSL in this area.

89. Whilst tranquillity and visual intrusion remain subjective qualities, it would be reasonable to conclude that both aspects are likely to have been affected negatively to some extent in this small area of the Surrey Hills AONB, namely around South Holmwood and the areas directly south and east of that location.

APPENDIX A

Population “overflown” – Gatwick Airport post-implementation review analysis

There is no universally defined or agreed definition of what is an overflight.

Different methods have pros and cons.

The method used for this analysis counts aircraft passing through a 400m x 400m grid square.

400m was chosen as a practical compromise, based on previous experience:

- Populations and households were rounded to the nearest 50
- No adjustment has been made for differing traffic volumes in 2013 and 2014.

Route 1 - up to 4000ft AMSL

	Conventional (2013)			**RNAV-1 (2014)**			**Difference**		
Average Daily Overflights	**Area (km^2)**	**Population**	**Households**	**Area (km^2)**	**Population**	**Households**	**Area**	**Population**	**Households**
> 1	16.4	400	150	15.7	450	200	-4%	+13%	+33%
> 2	14.3	350	150	13.9	350	150	-3%	**+0%**	**+0%**
> 5	11.6	250	100	11.5	300	150	-1%	**+20%**	**+50%**
> 10	9.2	200	100	9.4	200	100	+1%	**+0%**	**+0%**

Route 1 - 4000ft AMSL to 7000 AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	34.6	1,800	700	29.0	1,900	700	-16%	+6%	+0%
> 2	21.6	1,300	450	18.1	850	250	-16%	-35%	-44%
> 5	12.0	450	150	10.3	550	150	-14%	+22%	+0%
> 10	7.8	250	100	7.9	350	150	+1%	+40%	+50%

Route 1 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	51.0	2,200	850	44.7	2,350	900	-12%	+7%	+6%
> 2	35.9	1,650	600	32.0	1,200	400	-11%	-27%	-33%
> 5	23.6	700	250	21.8	850	300	-8%	+21%	+20%
> 10	17.0	450	200	17.3	550	250	+2%	+22%	+25%

Route 2 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	14.0	2,000	800	12.5	1,950	800	-10%	-3%	+0%
> 2	11.3	1,850	750	11.0	1,900	800	-3%	+3%	+7%
> 5	8.0	1,400	550	8.7	1,500	600	+9%	+7%	+9%
> 10	5.4	450	150	6.9	1,150	450	+28%	+156%	+200%

Route 2 – 4000ft AMSL to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	39.2	6,150	2,550	31.9	5,350	2,250	-19%	-13%	-12%
> 2	34.4	4,800	2,000	28.1	4,450	1,800	-18%	-7%	-10%
> 5	24.1	2,000	750	22.5	3,200	1,300	-7%	+60%	+73%
> 10	12.1	1,400	550	16.6	1,650	650	+37%	+18%	+18%

Route 2 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	53.2	8,150	3,350	44.4	7,300	3,050	-16%	-10%	-9%
> 2	45.7	6,650	2,750	39.1	6,350	2,600	-14%	-5%	-5%
> 5	32.1	3,400	1,300	31.2	4,700	1,900	-3%	+38%	+46%
> 10	17.5	1,850	700	23.5	2,800	1,100	+34%	+51%	+57%

Route 3 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	41.2	9,100	3,650	29.7	7,100	2,900	-28%	-22%	-21%
> 2	30.2	6,900	2,750	23.7	5,050	2,100	-22%	-27%	-24%
> 5	17.6	2,300	950	16.4	2,450	1,000	-7%	+7%	+5%
> 10	8.7	850	350	10.9	1,300	550	+25%	+53%	+57%

Route 3 – 4000ft AMSL to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	54.2	7,200	2,800	43.8	7,650	3,000	-19%	+6%	+7%
> 2	37.2	6,100	2,450	27.8	5,800	2,300	-25%	-5%	-6%
> 5	23.4	6,200	2,450	19.2	5,600	2,250	-18%	-10%	-8%
> 10	11.9	4,350	1,750	13.3	4,100	1,700	+12%	-6%	-3%

Route 3 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	95.4	16,300	6,450	73.5	14,750	5,900	-23%	-10%	-9%
> 2	67.4	13,000	5,200	51.5	10,850	4,400	-24%	-17%	-15%
> 5	41.0	8,500	3,400	35.6	8,050	3,250	-13%	-5%	-4%
> 10	20.6	5,200	2,100	24.2	5,400	2,250	+17%	+4%	+7%

Route 4 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	25.4	3,500	1,550	19.2	3,000	1,300	-24%	-14%	-16%
> 2	20.7	3,200	1,450	15.8	2,500	1,100	-24%	-22%	-24%
> 5	14.8	2,900	1,300	12.3	1,950	850	-17%	-33%	-35%
> 10	10.8	1,750	800	10.1	1,450	600	-6%	-17%	-25%

Route 4 - 4000ft AMSL to 7000 AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	88.1	17,500	6,950	80.5	24,600	9,900	-9%	+41%	+42%
> 2	60.0	10,050	,3900	50.4	13,600	5,400	-16%	+35%	+38%
> 5	33.7	5,050	1,950	25.9	7,850	3,200	-23%	+55%	+64%
> 10	20.4	2,550	1,050	15.1	5,350	2,200	-26%	+110%	+110%

Route 4 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	113.5	21,000	8,500	99.7	27,600	11,200	-12%	+31%	+32%
> 2	80.7	13,250	5,350	66.2	16,100	6,500	-18%	+22%	+21%
> 5	48.5	7,950	3,250	38.2	9,800	4,050	-21%	+23%	+25%
> 10	31.2	4,300	1,850	25.2	6,800	2,800	-19%	+58%	+51%

Route 5 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	14.2	2,950	1,150	13.0	1,650	700	-9%	-44%	-39%
> 2	12.0	2,000	850	11.2	1,500	650	-7%	-25%	-24%
> 5	9.4	1,250	550	9.2	700	300	-2%	-44%	-45%
> 10	7.0	500	200	7.4	500	250	+6%	+0%	+25%

Route 5 – 4000ft AMSL to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	27.7	3,150	1200	27.6	3,550	1,250	+0.0%	+13%	+4%
> 2	19.7	2,500	850	17.4	2,000	600	-12%	-20%	-29%
> 5	8.3	1,650	500	7.0	1,050	400	-16%	-36%	-20%
> 10	3.7	500	200	5.3	850	350	+57%	+41%	+75%

Route 5 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	41.9	6,100	2,350	40.6	5,200	1,950	-3%	-15%	-17%
> 2	31.7	4,500	1,700	28.6	3,500	1,250	-10%	-22%	-26%
> 5	17.7	2,900	1,050	16.2	1,750	700	-8%	-40%	-33%
> 10	10.7	1,000	400	12.7	1,350	600	+18%	+35%	+50%

Route 6 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	11.2	700	300	9.8	700	300	-13%	+0%	+0%
> 2	8.2	550	200	7.4	400	200	-10%	-27%	+0%
> 5	4.8	300	100	4.1	250	100	-14%	-17%	+0%
> 10	2.1	150	50	1.0	100	50	-52%	-33%	+0%

Route 6 – 4000ft AMSL to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	17.2	4,850	1,850	11.5	2,800	1,050	-33%	-42%	-43%
> 2	8.9	3,300	1,300	5.7	1,550	500	-36%	-53%	-62%
> 5	1.0	250	100	1.2	0	0	+20%	-100%	-100%
> 10	0.1	0	0	0.1	0	0	+0%	+0%	+0%

Route 6 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	28.4	5,550	2,150	21.3	3,500	1,350	-25%	-37%	-37%
> 2	17.1	3,850	1,500	13.1	1,950	700	-23%	-49%	-53%
> 5	5.8	550	200	5.3	250	100	-10%	-55%	-50%
> 10	2.2	150	50	1.1	100	50	-50%	-33%	+0%

Route 7 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	12.7	250	100	11.0	250	100	-13%	+0%	+0%
> 2	11.3	250	100	9.8	200	100	-13%	-20%	+0%
> 5	9.4	250	100	8.2	150	50	-12%	-40%	-50%
> 10	8.0	150	50	6.9	150	50	-13%	+0%	+0%

Route 7 – 4000ft AMSL to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	35.8	2,900	1,200	32.3	1,800	750	-10%	-38%	-37%
> 2	22.7	750	300	18.1	650	250	-20%	-13%	-17%
> 5	12.5	450	200	10.6	350	150	-15%	-22%	-25%
> 10	7.8	300	150	7.5	250	100	-4%	-17%	-33%

Route 7 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	Area (km^2)	Population	Households	Area (km^2)	Population	Households	Area	Population	Households
> 1	48.5	3,150	1,300	43.3	2,050	850	-11%	-35%	-35%
> 2	34.0	1,000	400	27.9	850	350	-18%	-15%	-13%
> 5	21.9	700	300	18.8	500	200	-14%	-29%	-33%
> 10	15.8	450	200	14.4	400	150	-9%	-11%	-25%

Route 8 – up to 4000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	**Area (km^2)**	**Population**	**Households**	**Area (km^2)**	**Population**	**Households**	**Area**	**Population**	**Households**
> 1	4.3	150	50	4.7	150	50	+7%	+0%	+0%
> 2	-	-	-	-	-	-	-	-	-
> 5	-	-	-	-	-	-	-	-	-
> 10	-	-	-	-	-	-	-	-	-

Route 8 – 4000ft AMSL to 7000ft AMSL

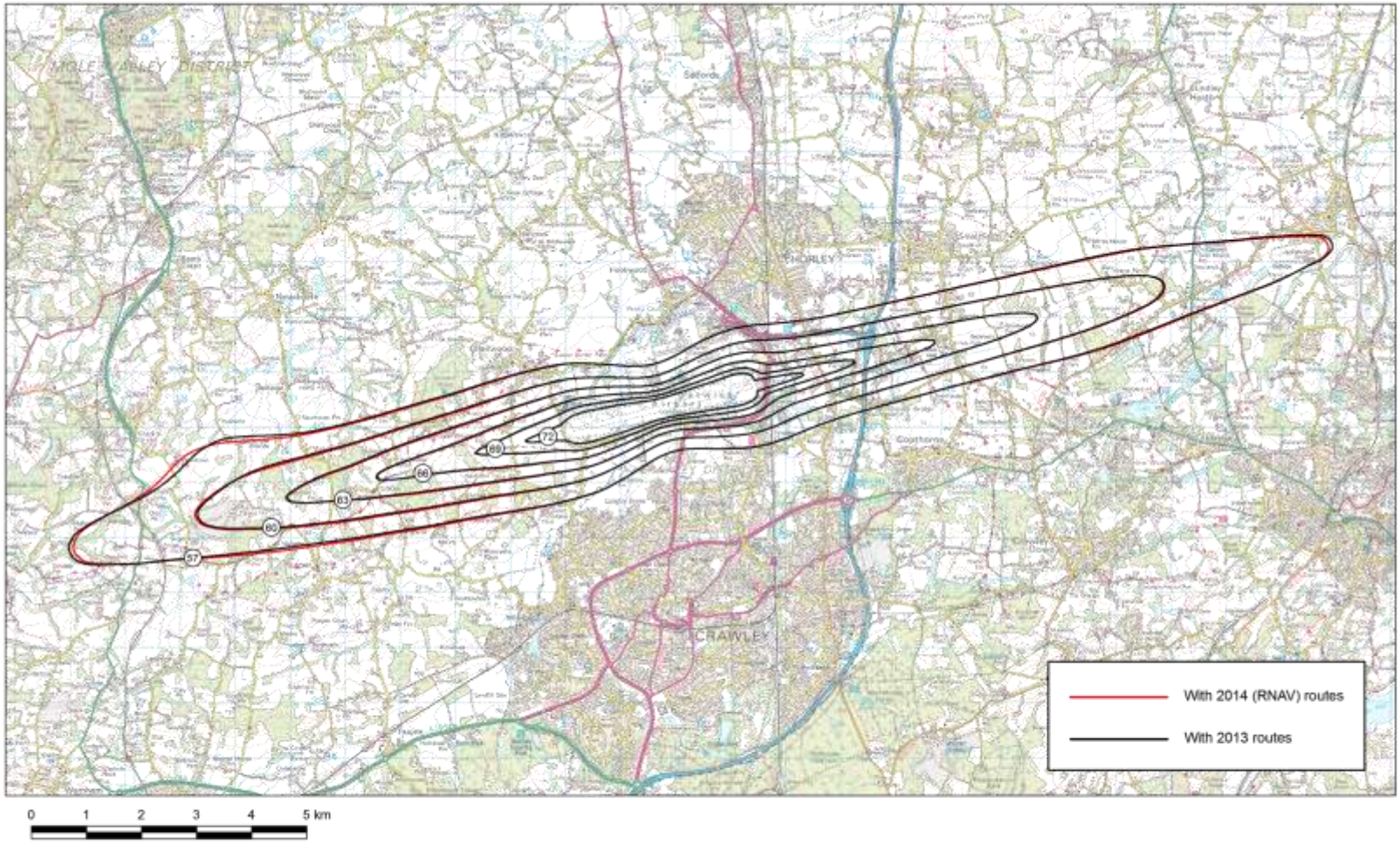
	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	**Area (km^2)**	**Population**	**Households**	**Area (km^2)**	**Population**	**Households**	**Area**	**Population**	**Households**
> 1	3.2	100	50	3.7	100	50	+16%	+0%	+0%
> 2	-	-	-	-	-	-	-	-	-
> 5	-	-	-	-	-	-	-	-	-
> 10	-	-	-	-	-	-	-	-	-

Route 8 – up to 7000ft AMSL

	Conventional (2013)			RNAV-1 (2014)			Difference		
Average Daily Overflights	**Area (km^2)**	**Population**	**Households**	**Area (km^2)**	**Population**	**Households**	**Area**	**Population**	**Households**
> 1	7.5	250	100	8.4	250	100	+12%	+0%	+0%
> 2	-	-	-	-	-	-	-	-	-
> 5	-	-	-	-	-	-	-	-	-
> 10	-	-	-	-	-	-	-	-	-

APPENDIX B

L_{eq} contours



GATWICK AIRPORT
Year 2013 average summer day Leq contours
Actual modal split (69%W / 31%E)

Table 1: 2013 average summer day noise exposure contours with conventional departure routes: Areas, populations and households (black contour)

Leq	Area	Population	Households
(-)	(km²)	(-)	(-)
57	40.9	3,250	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	0	0
72	1.9	0	0

Table 2: 2013 average summer day noise exposure contours with RNAV-1 departure routes: Areas, populations and households (red contour)

Leq	Area	Population	Households
(-)	(km²)	(-)	(-)
57	40.9	3,200	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	0	0
72	1.9	0	0

APPENDIX C

Summary of routes (from ERCD consideration of the airspace change proposal)

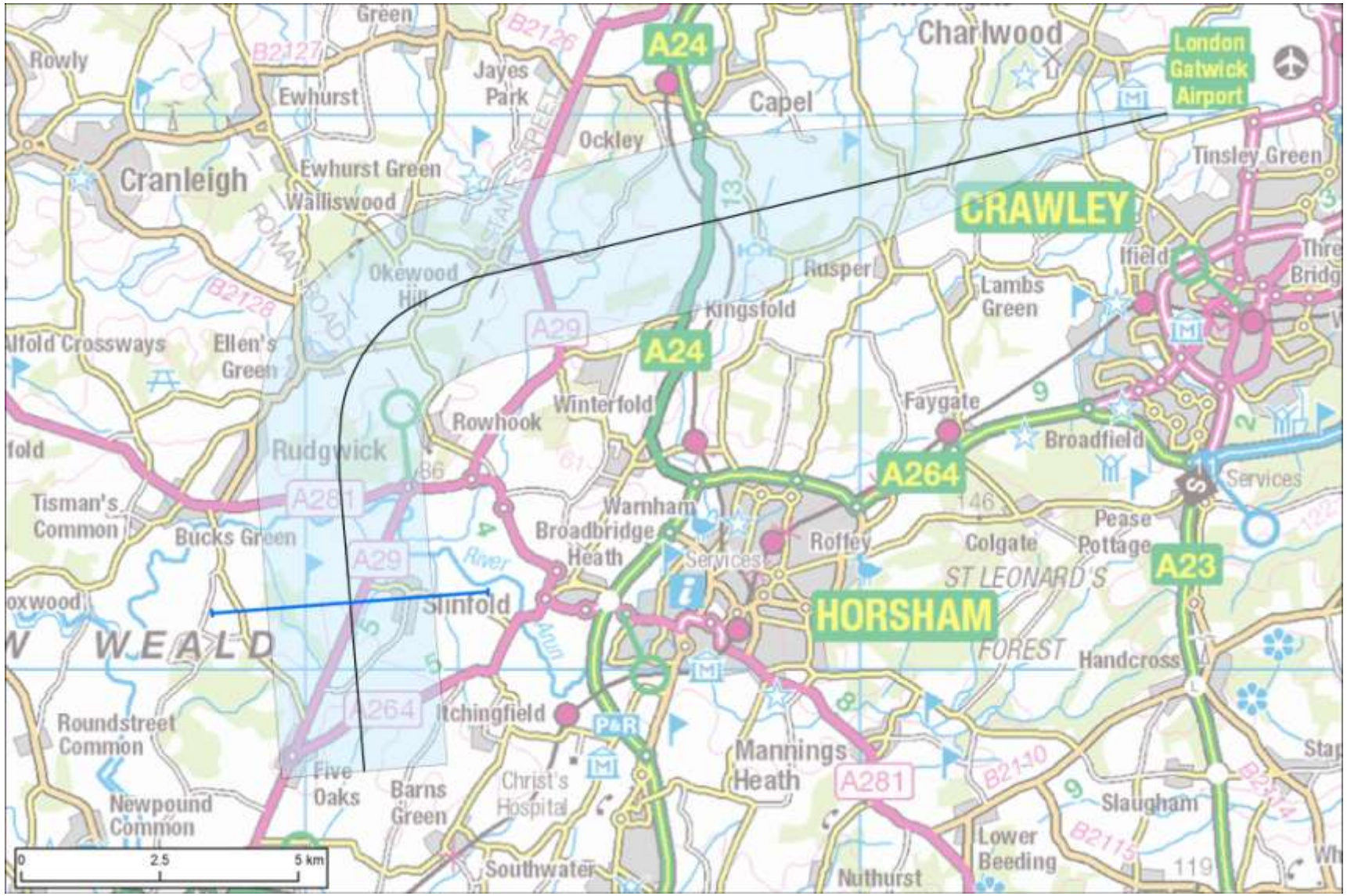
Route	Runway	SIDs	Max distance of PRNAV SID from conventional SID below 4,000ft (m)	Nature of Route (initial part of SID)	Comments	Other than concentrating traffic due to implementing PRNAV, is the expected path of traffic similar to the path of traffic using the current conventional SID?
1 - trialled	26L	KENET 2M SAM 2M	206	Straight-out	None.	Yes
2 - trialled	08R	SFD 9P	308	90 degree turn	Most of the traffic was concentrated to the west of the NPR centreline on the initial right-hand turn, so the expected shift in dispersion such that traffic will be concentrated to the east of the NPR centreline on the same turn is actually greater than the stated 370m?	No
3 - trialled	08R	KENET 3P SAM 3P	355	180 degree turn	None.	Yes

4 - trialled	26L	BIG 7 M CLN 8M DVR 8M LAM 4M	370	Tight 180 degree turn	The new PRNAV SID (like the existing conventional SID) travels outside the NPR swathe. However, whilst current conventional traffic seems to be largely contained within the NPR swathe, the trial shows that a proportion of the PRNAV traffic (1%-5%) exceeds the NPR swathe.	No
5 – not trialled, equivalent to Route 1	08R	BIG 3P CLN 5P DVR 2P	16	Straight-out	The heat plot of the existing traffic shows that it follows the NPR centreline closely – in fact closer than it seems to follow the conventional SID centreline. The conventional SID sits to the south of the NPR centreline (a max distance of 453m from the NPR). The PRNAV is a very good replication of the conventional SID. The sponsor anticipates that the PRNAV traffic will be similar to the current dispersion rather than shifting south (towards Dormansland) to better match the SID.	Unknown but assumed to be a similar path to current conventional SID traffic.
6 – not trialled, equivalent to Route 1	08R	LAM 5P	42	Straight-out	The NPR and SIDS are closely aligned, but the demonstrated conventional traffic pattern shows that aircraft are typically not making the shallow left turn on this Route.	Unknown but assumed to be a similar path to current conventional SID traffic.

					This takes traffic close to the eastern edge of the NPR swathe though not beyond it (below 4,000ft). The sponsor expects traffic on the PRNAV Sid to demonstrate a similar dispersion, i.e. not making the left turn.	
7 – not trialled, equivalent to Route 2	26L	BOGNA 1M HARDY 5 M	475	90 degree turn	None.	Unknown but assumed to be a similar path to current conventional SID traffic.
8 – not trialled, equivalent to Route 2	26L	SFD 5M	87	90+ degree turn (approx 110 degree)	The heat plot (Fig 13) appears to show traffic not following the left hand turn of the conventional SID. Instead, the traffic appears to head straight out from departure, with the 1%-5% of current traffic breaching the boundary of the NPR swathe.	Unknown but assumed to be a similar path to current conventional SID traffic.
9 – not trialled, equivalent to Route 3	26L	DAGGA 1M TIGER 3M WIZAD 4M	372	180 degree turn	There is no illustration of current traffic density or expected traffic density. This is because the SID is used infrequently and there is very little track data to produce meaningful traffic patterns/heat maps.	Unknown but assumed to be a similar path to current conventional SID traffic.

APPENDIX D

Position of gate for “gate analysis” of Route 7

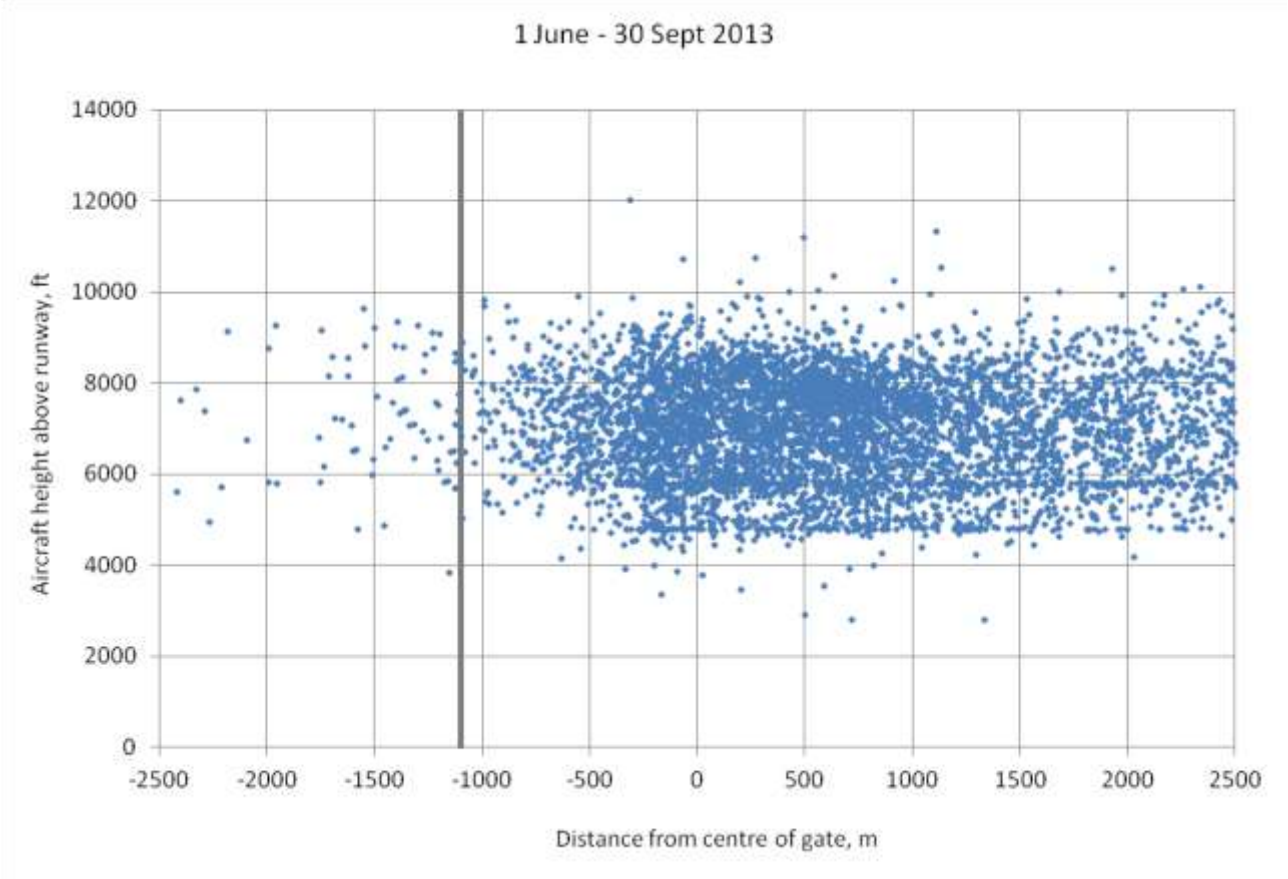


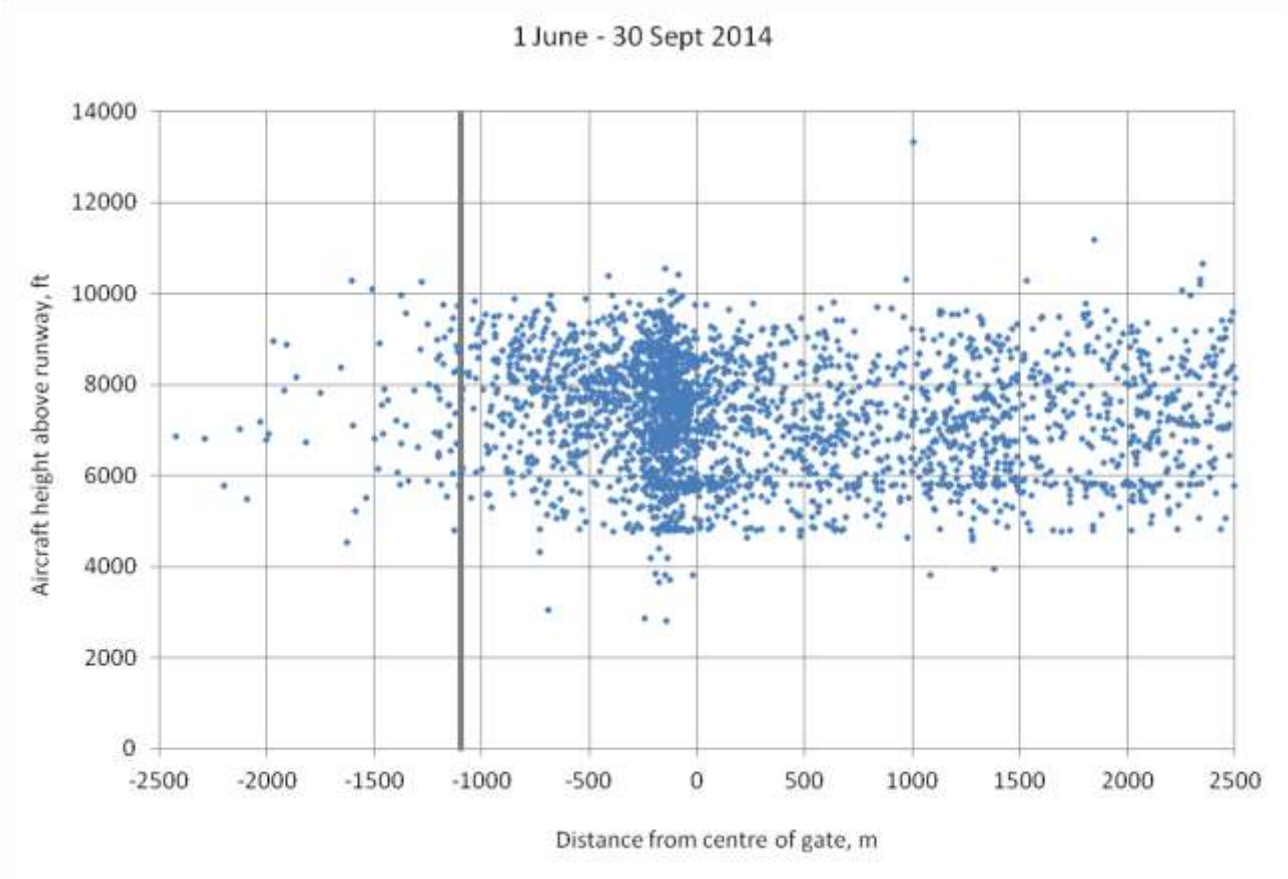
APPENDIX E

Results of gate analysis for Route 7

Notes for both charts

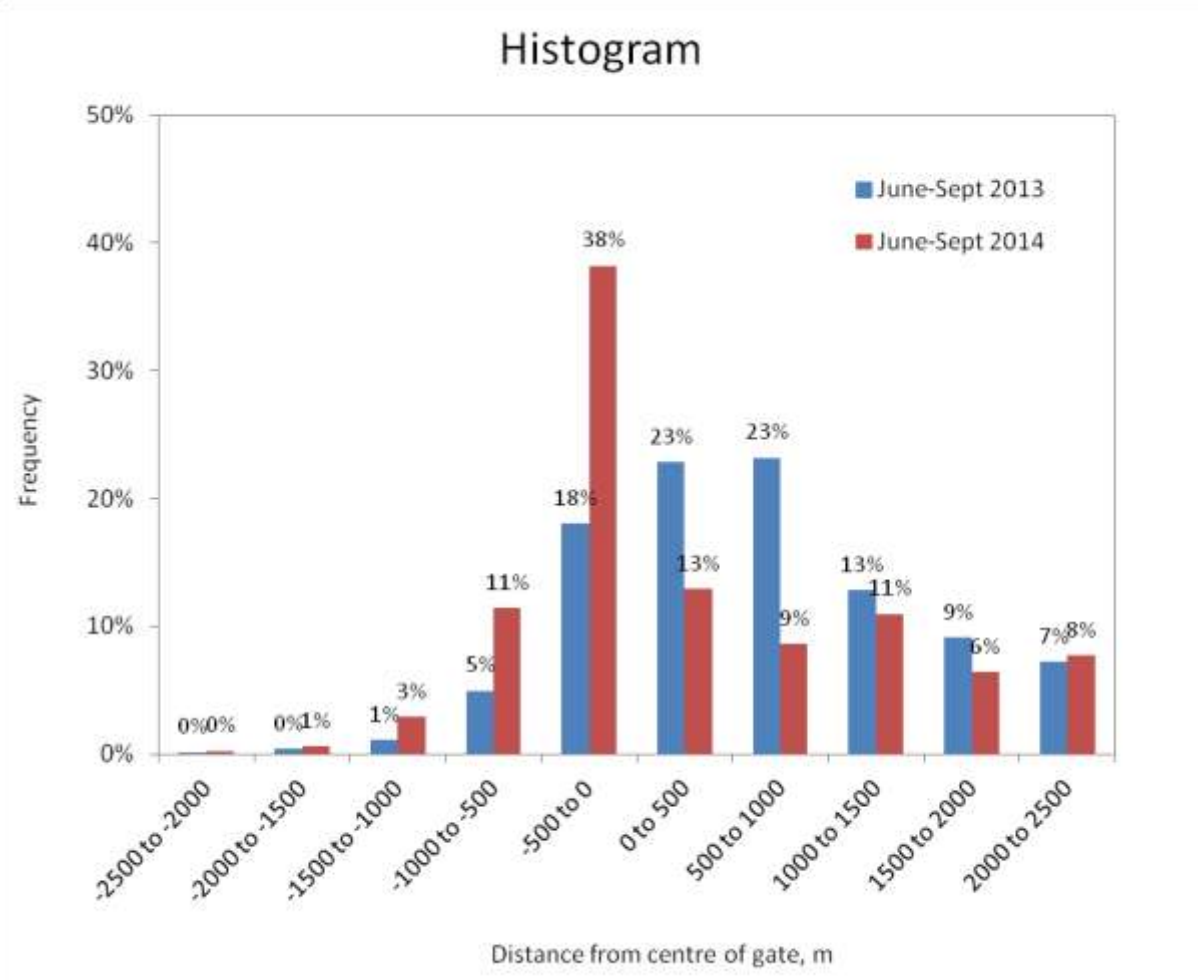
- 0 (zero) on the x-axis is the position of the NPR, the thicker vertical line is the approximate location of Slinfold
- The units used for the x-axis are metres, the units used for the y-axis are feet
- The charts represent a view looking south, through the gate


1 June - 30 Sept 2013
Aircraft height above runway, ft
14000
12000
10000
8000
6000
4000
2000
0
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
2500
Distance from centre of gate, m


1 June - 30 Sept 2014
Aircraft height above runway, ft
14000
12000
10000
8000
6000
4000
2000
0
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
2500
Distance from centre of gate, m

APPENDIX F

Spread of flights passing through the gate, Route 7



APPENDIX G

Average noise levels (dBA, L_{max}) based on the gate analysis for Route 7