# HEATHROW

# DEPARTURE VERTICAL PERFORMANCE

# NADP 1 AND NADP2 PROCEDURES
# &
# DEPARTURE NOISE CONTROLS

**RICHMOND HEATHROW CAMPAIGN**

**19 JULY 2024**

Revised 25 July 2024
1. Additional Figure 4 and paras 14 & 15 on noise duration.
2. Additional Figure 22 and para 44 & 45 on increasing height to reduce population exposed to noise.
3. Figure & para numbers changed accordingly

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## A. INTRODUCTION AND SUMMARY

1. Richmond Heathrow Campaign (RHC) represents three amenity groups in the London Borough of Richmond upon Thames: The Richmond Society, The Friends of Richmond Green, and the Kew Society, which together have over 2000 members. The members of our amenity groups are adversely affected by noise from Heathrow Airport's flight paths. We acknowledge Heathrow's contribution to the UK economy and seek constructive engagement in pursuit of a better Heathrow. We are an active participant in the Heathrow’s Noise and Airspace Community Forum.

2. This Report is written in the context of the current Airspace Modernisation being undertaken across the UK and in particular Heathrow’s terminal airspace shared with 14 other airports. The gateway from Stage 2 to Stage 3 of the CAA’s CAP 1616 change process has just been passed with a set of flightpath options that will be used by Heathrow, as change sponsor, to produce a shortlist of options for public consultation over the next year and a bit.

3. This Report focusses on Departure Vertical Performance and will be followed by a second report on Lateral Performance.

4. There has been discussion between communities, Heathrow and the CAA about the choice of Departure Procedures known as NADP1 and NADP 2. At Heathrow airlines have historically chosen NADP2 (around 85% of departures). Broadly speaking, in Stage 1, NADP1 applies a higher climb gradient and hence height whereas NADP2 applies higher acceleration and hence speed and reduced noise duration. In Stage 2 the reverse is the case.

5. The first sections of this report examine noise, height and distance from Heathrow for the two Departure procedures. Using the RHC noise model we conclude there is a maximum reduction from NAPD1 compared to NAPD2 of around 3 dBA LAeq90sec Single Event about 7.6km along the track from the end of runway. This benefit grows from zero to the peak over about 5km and then reduces over the next 30km. To the side of track the benefit falls away towards zero after about 1.5km from the track. So the benefit is material but limited in area and hence population impacted.

6. Section E onwards looks at other ways to reduce the noise at ground level and in the first instance we look at NAPD1 modified to retain the higher speed and hence reduced noise duration and for this we use the NAPD2 speed profile. The peak benefit is an additional 1.5dBA LAeq90sec Single Event.

7. We then open up the approach to height and noise by examining the Heathrow noise controls rather than the airline operating Procedures. Lifting the average height or noise weighted height and or reducing the lower height quartile of flights could have wide spread benefit and bring the controls into line with the capabilities of modern two engine aircraft. For example, increasing the height from 2300ft to 3800ft at 10 km from end of runway reduces the Single Event noise under track from 68.7 to 63.0 dBA LAeq 90sec - nearly 6 dBA. The 1500ft height increase reduces population exposed to noise by nearly 30% in the 57dBA contour and by 20% in the 51 dBA contour. Benefits of noise controls include the wide area potentially covered, simplicity, low cost (possibly additional noise monitors) and the fact that Heathrow has the local power to introduce improved height controls. It should be possible to achieve reduced departure noise without increasing the number of infringements and costs from engine wear, pollutants, fuel and CO2.

8. **RHC recommends Heathrow consider the proposals for Noise Controls put forward in this Report with a view to raising the average height and the minimum floor height of departures on all routes.**

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## B. HEIGHT AND SPEED PERFORMANCE

9. The Report examines departure performance at Heathrow using the NADP1 Procedure compared to NADP 2. The Report then considers the wider issue of Departure Noise Controls. The analysis uses Richmond Heathrow Campaign's noise Model v4. The Model has been approximately calibrated with Heathrow's noise monitors but is not fully validated and so is for illustration only. The Detling route on Easterly operations from runway 09R is used for the analysis.

10. The CAA presented four examples of NADP1 and NADP2 departures at Heathrow's NACF on 20 May 2024. These are included here in the Annex for reference. We have used case W2-A and Figures 1 and 2 below replicate the height and speed performance of this case. The replication may not be 100% accurate but is near enough for the present purpose.

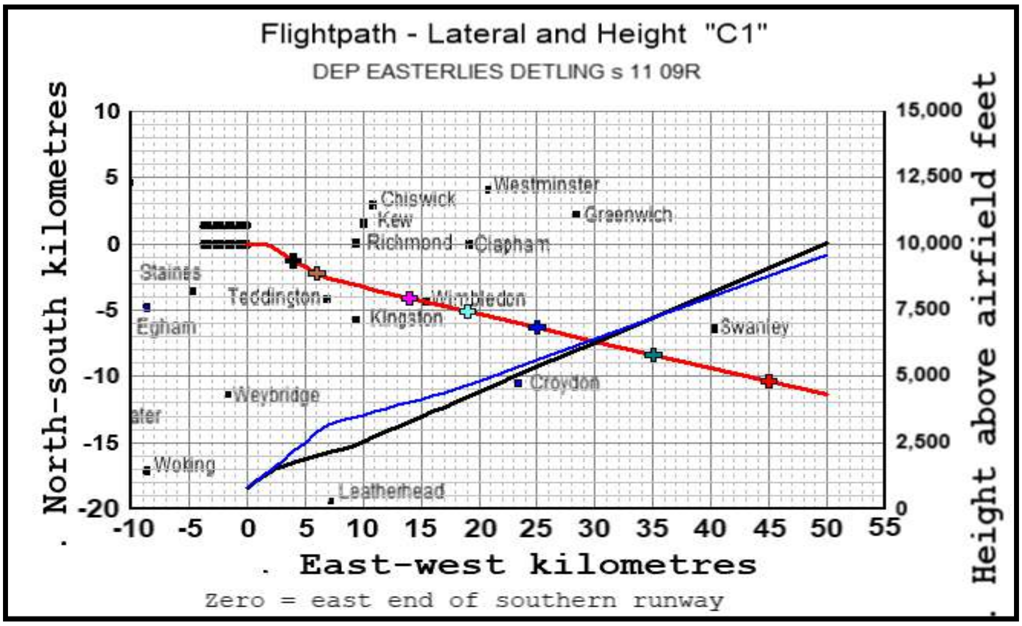


**Figure 1** Source RHC. Red Detling flightpath; Blue NADP1 & Black NADP2 Height

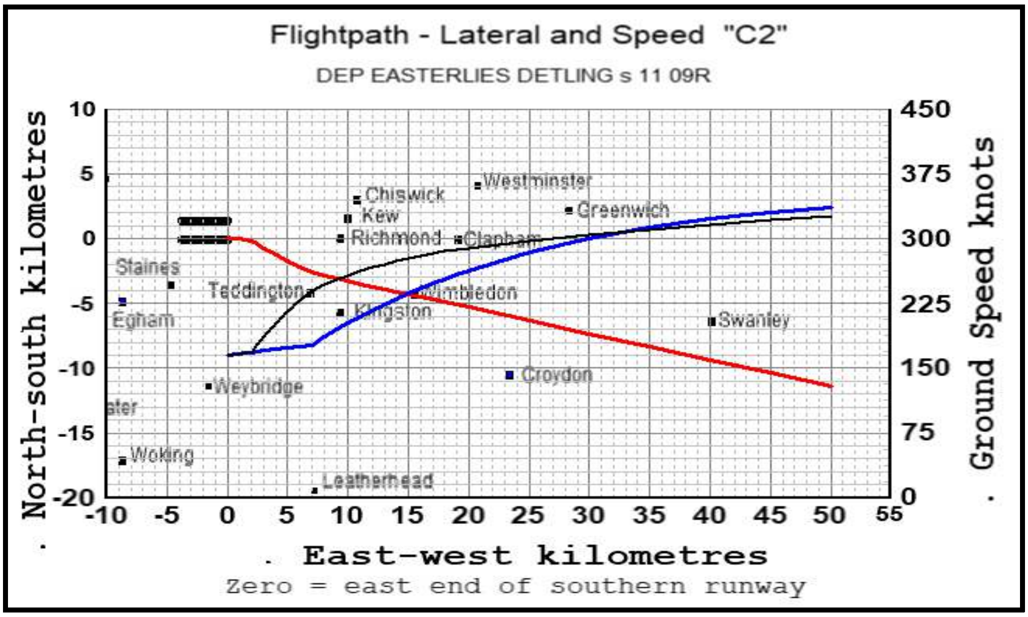


**Figure 2** Source RHC. Red Detling flightpath; Blue NADP1 & Black NADP2 Speed

11. NADP1 and NADP2 are the two Departure Procedures proscribed by ICAO and airlines choose which to use. There are variations within each Procedure as set by coding houses working for the airlines. We understand the fundamental difference is the order of events. In Stage 1, NADP1 applies a higher climb gradient and hence height whereas NADP2 applies higher acceleration and hence speed, as illustrated by Figures 1 and 2. In Stage 2 the reverse applies. Stage 1 starts after the initial take off phase and is required to start not below 800 feet. We understand that initial engine power is typically around 90% of maximum and then is reduced to around 50% at around the time Stage 1 starts. We understand that around 85% of departures from Heathrow use NADP2. We have assumed in this example no change in the engine power profiles between Procedures.

## C. NOISE IMPACT AT 7.6KM FROM END OF RUNWAY

12. Figure 3 shows the Noise cross section at 7.6km from the runway end. This is equivalent to the 10km in the CAA charts with the 2.4km difference being due to the different start points. The RHC model uses the eastern end of the southern runway as 0,0 for its positioning. 7.6km along the track is used here to illustrate the maximum height difference between NADP1 and NADP2 as shown by Figure 1 and is also approximately the location of the largest noise benefit from using NADP1 compared to NADP2.

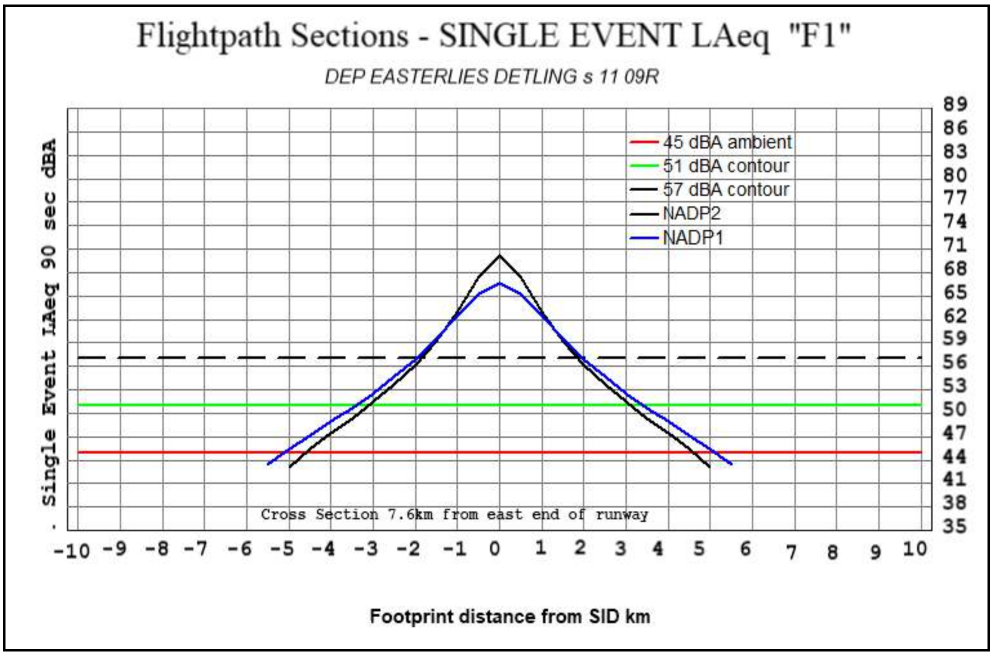


**Figure 3** Source RHC. NADP1 and NADP2 Single Event Noise Cross Section at7.6km from end of runway. Absorption 8dBA for double the distance. SID Track = 0. LAeq 90 sec dBA

13. In this example the Single Event noise at ground level under the track 7.6km from the runway end is 69.5 dBA LAeq 90sec using NADP2. This is reduced to 66.5 dBA LAeq using NADP1 and thus there is a 3dBA LAeq benefit from NADP1. To the side of track a reducing benefit extends about 1.5km on either side. At lower noise levels further off track, NADP2 performs better than NADP1. The benefit of NADP2 at ambient noise levels of say 45dBA is around 2dBA at around 5km to the side of track in the case examined here.

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14. The benefit of NADP1 is first of all due to increased height and the increased absorption of noise from aircraft source to ground. However, to the side of track the noise reduction difference between the Procedures from absorption decreases as a function of the hypotenuse distance from aircraft to ground. Whereas the noise duration is a function of the noise footprint's chordal length compared to diameter of the footprint and this does not decrease as fast as the increased absorption, so there comes a point to the side of track where NADP2 performs better than NADP1.

15. The analysis discussed here is based on a 3dBA LAeq90sec increase in noise for doubling the duration of the Single Event. In the case of departures, the result is that the track noise levels reduce as speed increases along the track and as the height increases and thereby reduces the diameter of the noise footprint and hence duration of the event. To side of track the noise level reduces also in relation to speed and reducing noise footprint and as a function of the chord length of the noise footprint. The chord length is determined by the position of the ground receptor within the moving circular noise footprint. In the case of arrivals these relationships apply in reverse.

16. Figure 4 below illustrates the duration impact on the Single Event LAeq90sec Detling departure considered here. The hybrid comprises the NAPD1 Speed and NAPD2 gradient. Because of the slower speed of NAPD1 compared to NAPD2 the hybrid track noise at 7.6 km from the end of runway is about one dBA LAeq90sec higher than that for NAPD2. To the side of track the difference increases to about 2 dBA. Figure 4 separates out, for illustration, the duration impact included in Figure 3.

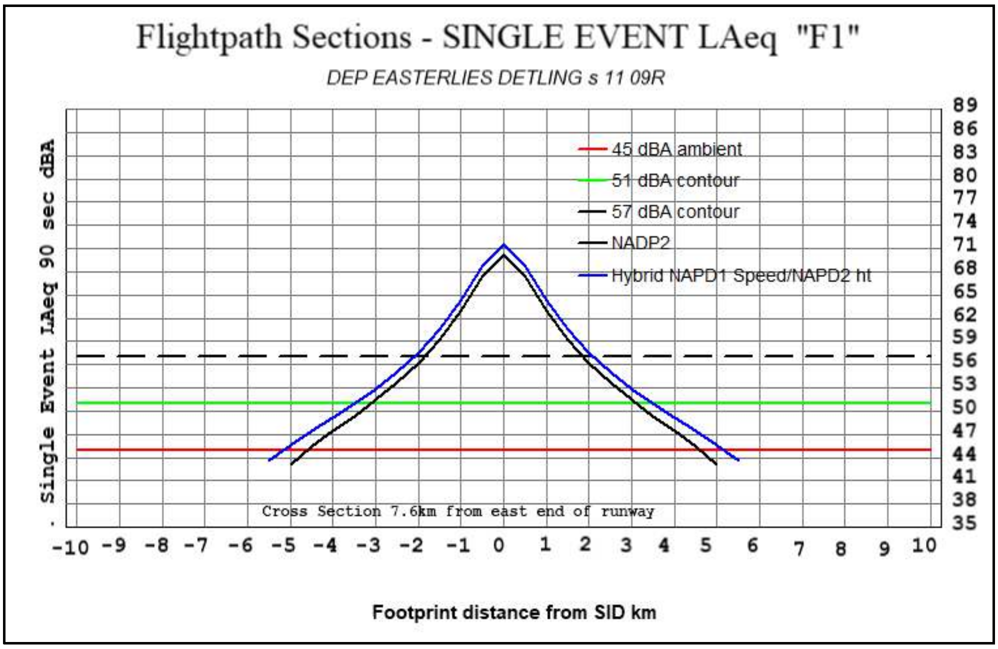



**Figure 4** Source RHC NAPD2 and Hybrid Single Event Noise Cross Section at 7.6km from end of runway. Absorption 8dBA for double the distance. SID track=0. LAeq90sec dBA

17. There has been discussion about noise absorption rates and attenuation. The analysis discussed above is based on an 8 dBA LAeq 90sec reduction for doubling of distance. This is optimistic and is related to earlier noise models for road and rail where surface obstacles

interfered with the noise dispersion. The actual absorption rate depends on air temperature, humidity, attenuation from ground level irregularities and other factors. A 6 dBA LAeq 90sec reduction for doubling of distance is less optimistic and has a much greater effect at lower noise levels, which may have not been so noticeable until more recent attention has been paid to lower noise levels. Figure 5 compares NADP1 and NADP2 using the 6 dBA LAeq 90sec absorption rate instead of 8 dBA. The chart is otherwise a replica of Figure 3.

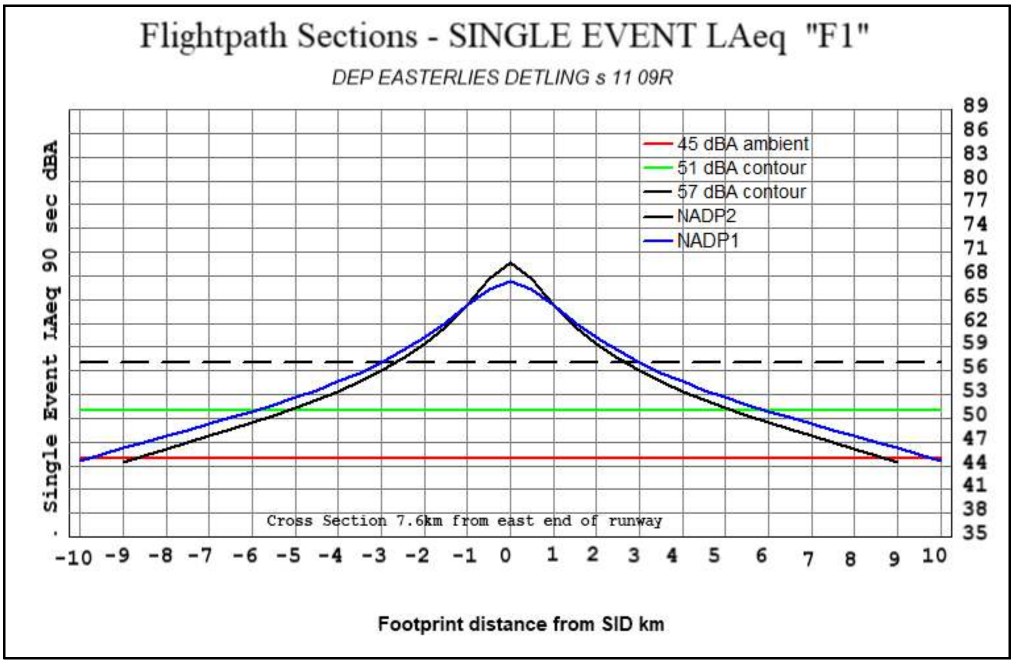
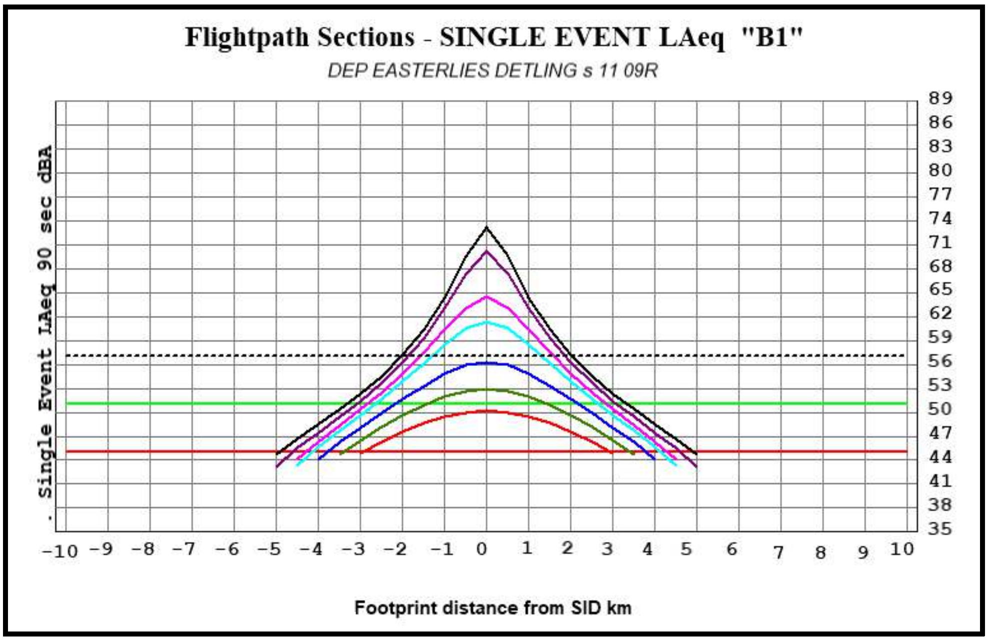



**Figure 5** Source RHC. NADP1 and NADP2 Single Event Cross Section at 7.6km from end of runway. Absorption 6dBA for double the distance. SID track=0. LAeq 90sec dBA

## D. IMPACT SPREAD OVER THE NOISE CONTOURS

18. Figure 6 over-page shows the cross sections at various points up to 51.4km from runway end using NADP2 and it can be seen how the track noise reduces faster than the side of track noise as the aircraft height increases along the flight path. This illustrates the reduced noise benefit to the side of track from increasing aircraft height.

19. It is not part of the discussion here but Figure 6 also shows the separation distances needed to achieve respite depending on the respite noise level chosen. For example, to achieve respite at LOEL of 51dBA LAeq 90sec then at 4.3km from end of runway the footprint is 6km (the black line) and at 41.3km the footprint is 3km (the green line).




| Actual distance from runway km |
|---|
| 4.3 |
| 7.6 |
| 14.8 |
| 19.9 |
| 31.1 |
| 41.3 |
| 51.5 |

Key to Figure 5

**Figure 6** Source RHC. Noise Cross sections LAeq 90sec dBA

20. The noise contours for the Single Event NADP2 are shown in Figure 7

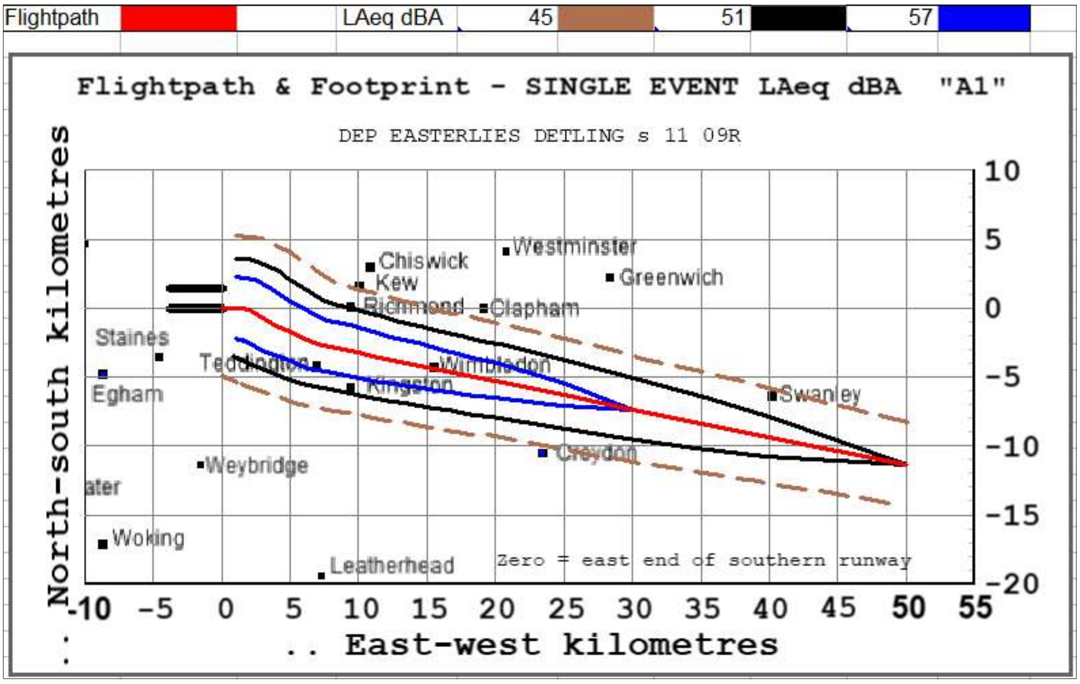



**Figure 7** Source RHC Single Event Noise Contours NADP2 - LAeq 90sec dBA.

21. People actually hear the Single Event noise pattern each time they are overflown. But there is also a pattern of intermittent events. The assumptions used in this example for the Detling Route on Easterly operations are 11.4 ATMs per hour, 8 hours respite a Day from runway alternation (likely when Northern runway is used for departures to the east on cessation of the Cranford Agreement) and 20% Easterly operations over the year. These assumptions can of course be changed.

22. Figures 8 -11 are the NADP2 LAeq contours over the following time periods: Single Event, Hourly, Daily and Annual. It can be seen that areas impacted by noise are substantially less for the Annual compared to the Single Event periods. The noise levels between single events in the hour or during daily respite or during the westerly mode are assumed to be at ambient, which is set in this example at LAeq 45 dBA for the relevant period of time. These are the acoustic impacts and the human impacts from these intermittent noise patterns are another matter and are not discussed here.

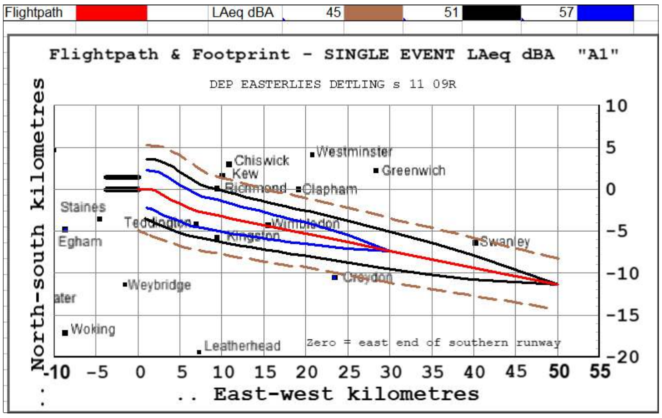



**Figure 8** Source RHC Single Event NADP2

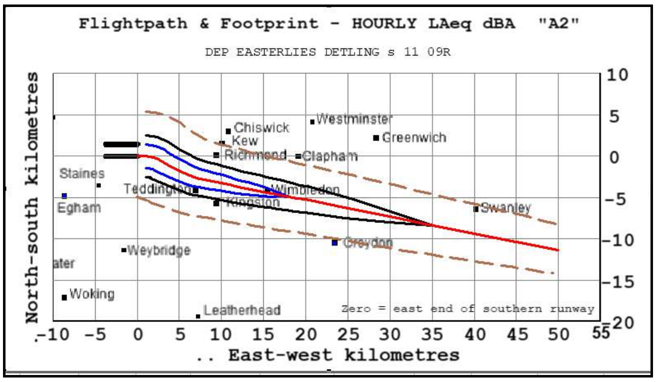



**Figure 9** Source RHC Hourly 11.4 ATMs/Hr NADP2

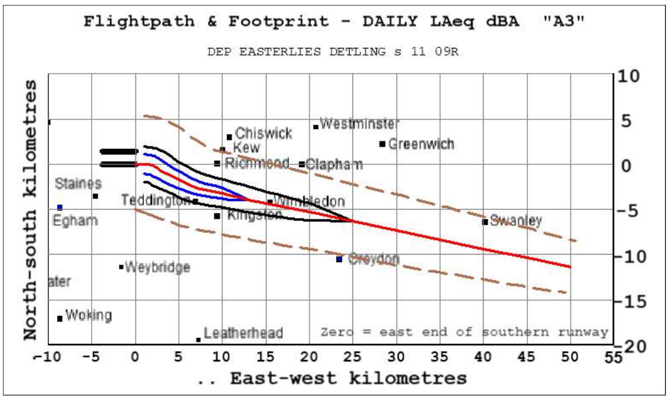



**Figure 10** Source RHC Daily 8 hour respite NADP2

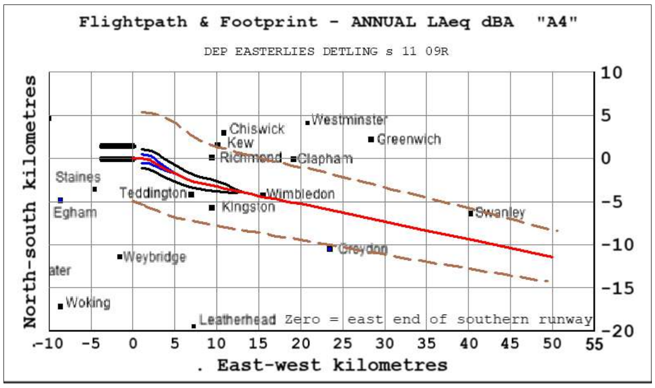



**Figure 11** Source RHC Annual 20% Easterly operations NADP2

23. Figure 12 over-page compares the population numbers exposed by NADP1and NADP2. A broad assumption of 3,000 people per km2 is used for population density. To the east of Heathrow there is high density throughout but interspersed with parks and open spaces. The broad assumption for population numbers exposed to noise is indicative but it is still useful. The difference between the NADP procedures is divided into height and duration components. As can been seen (marked red) at lower noise levels, NADP2 exposes fewer people than NADP1.

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| | | Ambient dBA | Contour dBA | Contour dBA |
|---|---|---|---|---|
| LAeq dBA | | 45 | 51 | 57 |
| **Single Event** | | | | |
| NAPD 2 | | 1240 | 667 | 257 |
| Height | | -1 | 0 | -22 |
| Duration | | 37 | 25 | 22 |
| NAPD1 | | 1276 | 692 | 257 |
| Net ref NAPD2 | | 36 | 25 | 0 |
| Net ref NAPD2 % | | 3% | 4% | 0% |
| | | | | |
| **Hourly** | 11.4 ATM/hr | | | |
| NAPD 2 | | 1245 | 326 | 111 |
| Height | | 0 | -21 | -31 |
| Duration | | 35 | 24 | 17 |
| NAPD1 | | 1280 | 329 | 97 |
| Net ref NAPD2 | | 35 | 3 | -14 |
| Net ref NAPD2 % | | 3% | 1% | -13% |
| | | | | |
| **Daily** | Runway Altn | | | |
| NAPD 2 | | 1246 | 200 | 65 |
| Height | | -1 | -19 | -25 |
| Duration | | 36 | 18 | 8 |
| NAPD1 | | 1281 | 199 | 48 |
| Net ref NAPD2 | | 35 | -1 | -17 |
| Net ref NAPD2 % | | 3% | -1% | -26% |
| | | | | |
| **Annual** | 20% Easterlies | | | |
| NAPD 2 | | 1247 | 65 | 13 |
| Height | | -1 | -25 | -2 |
| Duration | | 36 | 9 | 0 |
| NAPD1 | | 1282 | 49 | 11 |
| Net ref NAPD2 | | 35 | -16 | -2 |
| Net ref NAPD2 % | | 3% | -25% | -15% |

**Figure 12** Population exposed ('000) Comparison of NADP1 and NADP2

## E. AN ALTERNATIVE APPROACH TO NADP1 AND NADP2 FOR CONTROLLING NOISE

24. An alternative approach, other things being equal, is to apply the NADP2 speed profile and NADP1 height profile. This removes the negative impact on LAeq noise levels of extended duration resulting from slower speeds of NADP1, as highlighted above in Figures 3, 5 and 12. Figure 13 compares this hybrid with NADP2.

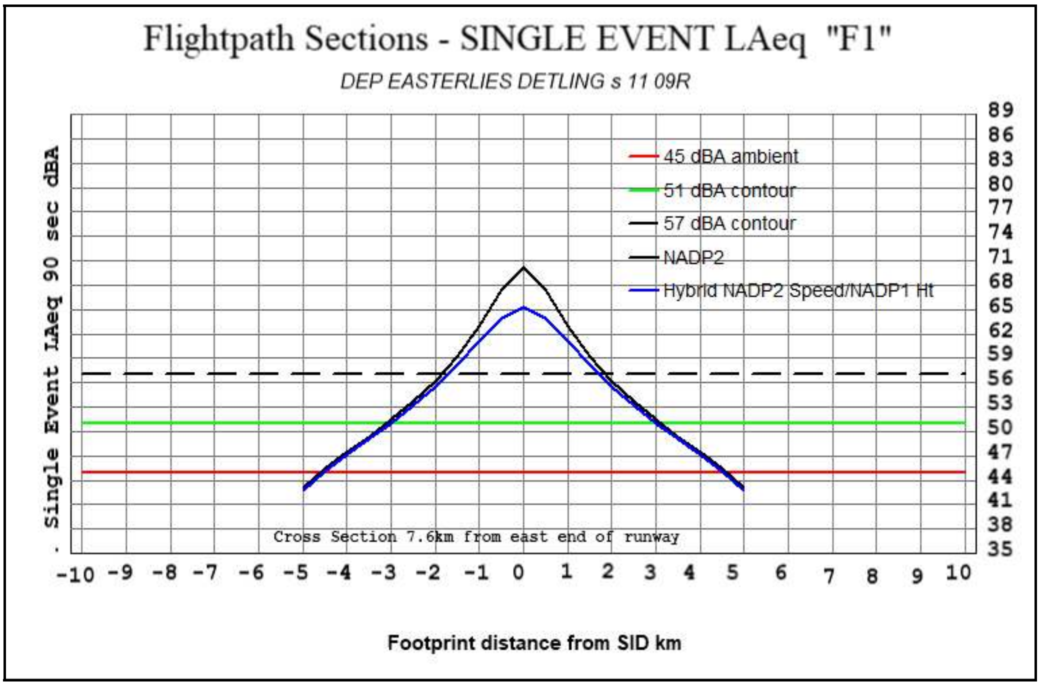


**Figure 13** Source RHC NADP2 and Hybrid Single Event Noise Cross Section at 7.6km from end of runway. Absorption 8dBA for double the distance. SID Track=0. LAeq 90sec dBA

25. Comparing Figure 13 with Figure 3, which compared NADP1 and NADP2, shows the benefit of maintaining the NADP2 speed profile in the Hybrid case.

| **Figure 14** | NADP1 | NADP2 | Hybrid NADP2 Speed /NADP1 Height |
|---|---|---|---|
| Under Track LAeq 7.6km from end of runway. dBA 90 secs Single Event | 66.5 | 69.5 | 65.0 |

26. The Hybrid also removes the negative impact of NADP1 cf NADP2 at the side of track as was shown in Figure 3.

27. Still further, the Hybrid reduces population exposure across the footprint by more than does NADP 1, as shown by comparing Figures 12 and 15 (over-page).

28. The Hybrid illustrated here is based on the two NADP profiles but as discussed later RHC believes the topic of departure height profile is best approached in the current circumstances as a noise control issue rather than an NADP Procedure issue. Potentially, the gradient could be increased further but this gets into the aerodynamic issues of available thrust, flap retraction, etc.

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| | | Ambient dBA | Contour dBA | Contour dBA |
|---|---|---|---|---|
| LAeq dBA | | 45 | 51 | 57 |
| **Single Event** | | | | |
| NAPD 2 | | 1240 | 667 | 257 |
| Height | | -1 | 0 | -22 |
| Duration | | 0 | 0 | 0 |
| Hybrid | | 1239 | 667 | 235 |
| Net ref NAPD2 | | -1 | 0 | -22 |
| Net ref NAPD2 % | | -0% | 0% | -9% |
| | | | | |
| **Hourly** | 11.4 ATM/hr | | | |
| NAPD 2 | | 1245 | 326 | 111 |
| Height | | 0 | -21 | -31 |
| Duration | | 0 | 0 | 0 |
| NAPD1 | | 1245 | 305 | 80 |
| Net ref NAPD2 | | 0 | -21 | -31 |
| Net ref NAPD2 % | | 0% | -6% | -28% |
| | | | | |
| **Daily** | Runway Altn | | | |
| NAPD 2 | | 1246 | 200 | 65 |
| Height | | -1 | -19 | -25 |
| Duration | | 0 | 0 | 0 |
| NAPD1 | | 1245 | 181 | 40 |
| Net ref NAPD2 | | -1 | -19 | -25 |
| Net ref NAPD2 % | | -0% | -10% | -38% |
| | | | | |
| **Annual** | 20% Easterlies | | | |
| NAPD 2 | | 1247 | 65 | 13 |
| Height | | -1 | -25 | -2 |
| Duration | | 0 | 0 | 0 |
| NAPD1 | | 1246 | 40 | 11 |
| Net ref NAPD2 | | -1 | -25 | -2 |
| Net ref NAPD2 % | | -0% | -38% | -15% |

**Figure 15** Source RHC Population Exposed ('000). Comparison of Hybrid and NADP2

29. For completeness, Figure 16 shows the Hybrid Single Event Contours which can be compared with Figure 7 - NADP2 contours. The smaller footprints of the Hybrid may be hard to see from the comparison of the two charts but the model's km distances at the several cross sections and contour lengths and areas (not shown here for reasons of brevity) are less in the Hybrid case. The noise differences along the track are better illustrated in Figures 17 and 18, respectively, in relation to flightpath and in relation to distance from end of runway.

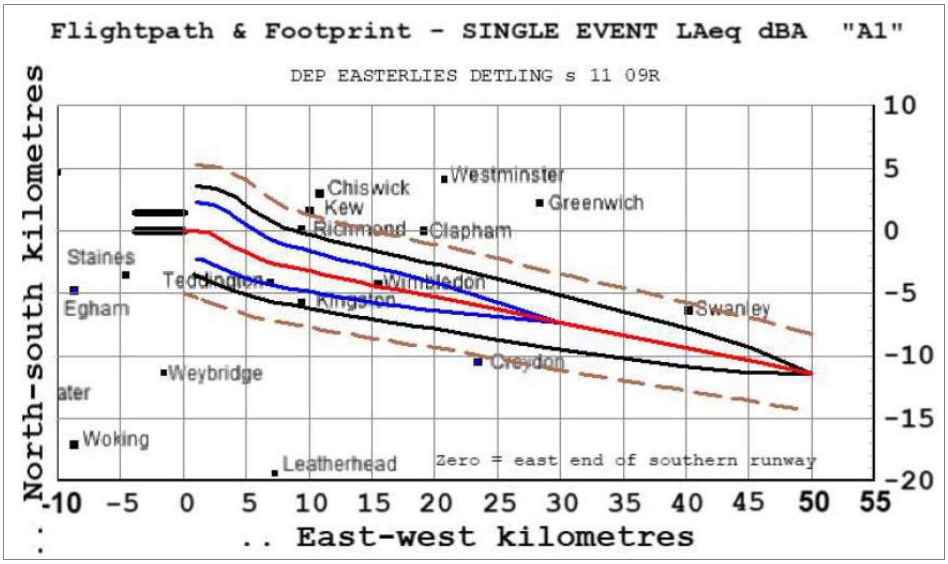

**Figure 16** Source RHC Single Event Noise contours. Hybrid (NADP2 Speed/NADP1 Height). LAeq90sec dBA

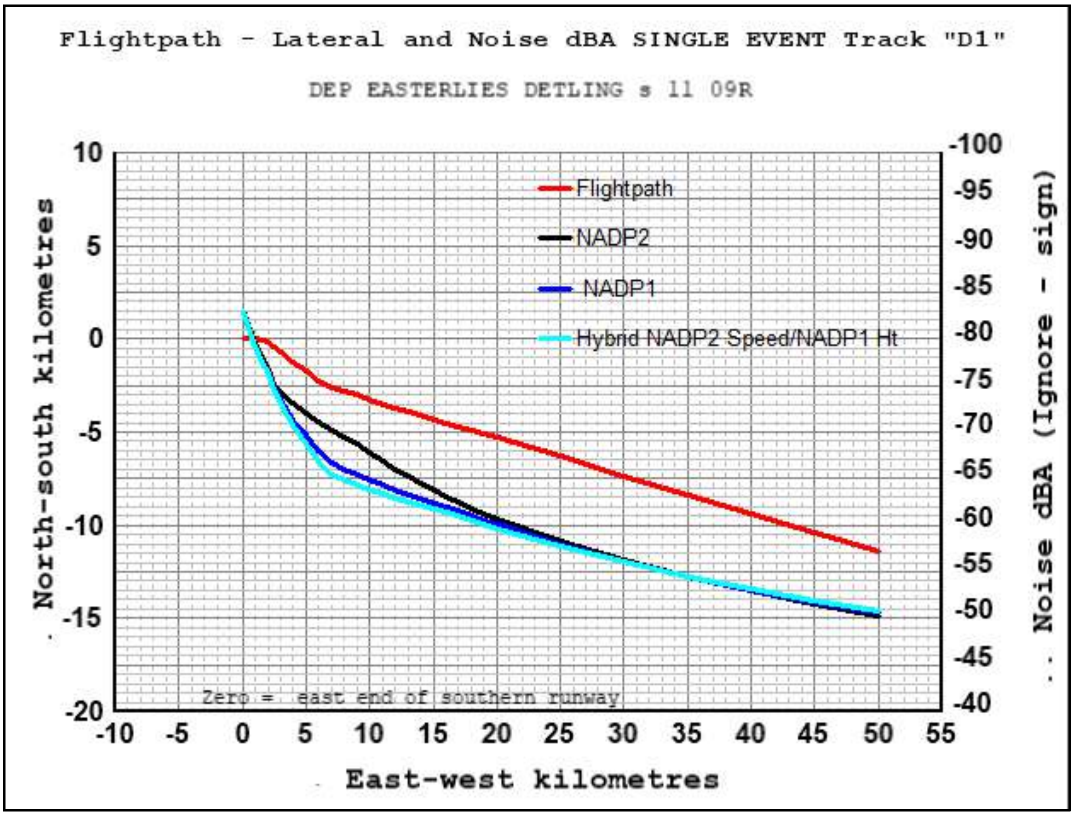


**Figure 17** Source RHC. Single Event LAeq 90sec dBA - NADP1, NADP2, and Hybrid (NADP2 Speed/NADP1 Ht)

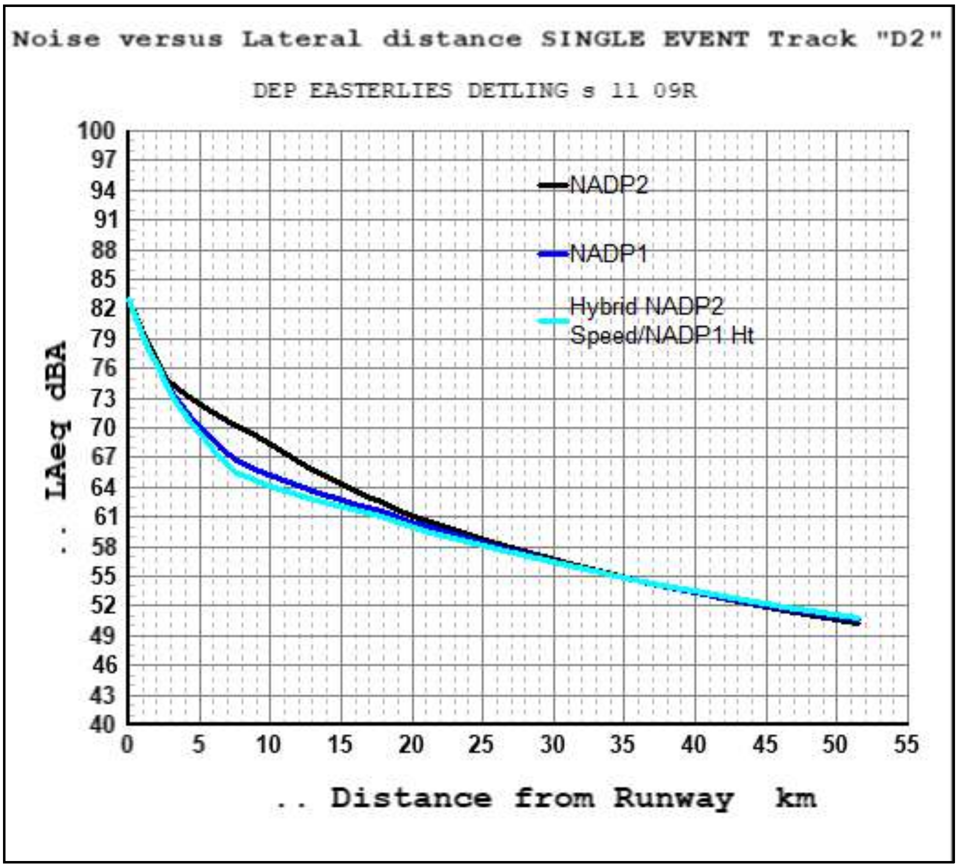


**Figure 18** Source RHC. Single Event LAeq 90sec dBA - NADP1, NADP2, and Hybrid (NADP2 Speed/NADP1 Ht)

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30. The noise sensitivity to height for NADP1, NADP2 and the Hybrid case are shown in Figure 19. The difference between NADP2 and the other two cases is due to speed and hence noise duration.

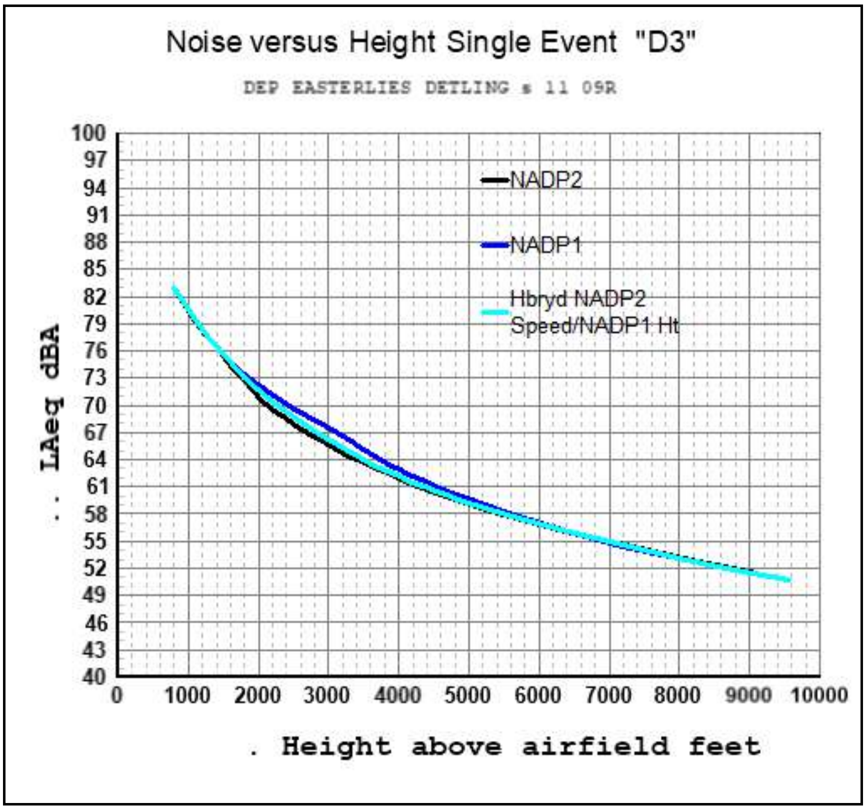


**Figure 19** Source RHC. Single Event LAeq 90sec dBA - NADP1, NADP2, and Hybrid

## F. HEATHROW DEPARTURE NOISE CONTROLS

31. The CAA's Report - Departure Noise Mitigation Review, Dr Darren Rhodes, 18 July 2018 examines control issues. The Noise controls at Heathrow are listed as follows:

Section 78(1) of the Civil Aviation Act 1982.

- Noise limits at 6.5 km after start of take-off roll,
- 94 dBA daytime, 89 dBA shoulder hours, 87 dBA night quota period,
- Financial penalties levied against the limits,
- Reach at least 1,000 ft by 6.5 km after start of take-off roll,
- Maintain a climb gradient of not less than 4% to an altitude of not less than 4,000 feet,
- Progressively reduce noise beyond 6.5km point,
- Track keeping requirements.

32. The CAA Report concluded that infringements against each of the controls had reduced over the years to relatively low levels at Heathrow due to retirement of older aircraft. It concluded that there might be scope to reduce noise levels by 1 to 2dBA without increasing infringements. It also concluded that *'The analysis shows that there is no single NADP that will reduce departure noise in all locations; a change of NADP simply moves noise from one*

*location to another.'* RHC's analysis here of NADP1 and NADP2 suggests there are relatively small potential net benefits but concurs there would be gains and losses with the main gains under or near track rising to a peak benefit at around 7.6 km from end of runway and then decreasing. Our focus is therefore on a hybrid approach which re-examines the controls and tightens them to reflect the performance capabilities of Heathrow's modern fleet with monetary incentives for further improvement and dis-incentives for infringement. It may be useful to add a limited number of additional height and noise controls and monitors.

33. In 2017 the DfT undertook an Impact Assessment: *"Noise controls and Noise Preferential Routes (NPRs) at designated airports". "The Assessment: What is the problem under consideration? Why is government intervention necessary? Government is currently responsible for setting various operational noise controls at the three designated airports (Heathrow, Gatwick and Stansted). Intervention is necessary since many of these controls have not been updated for decades, partly due to the lengthy nature of the current process, and the controls therefore no longer reflect what improvements in terms of reducing noise impacts might be possible at these airports. In response to this, in recent years, airports have begun to engage with stakeholders and propose changes to noise controls to government for approval, reducing the need for government to proactively consult on changes. It is Government policy that noise is best managed locally and that airports can better respond to local concerns and environmental factors. There is no rationale for Government to set controls where other airports do locally."*

34. RHC is not clear what might have been the outcome of this assessment but we understand it is within Heathrow's powers to propose and manage noise controls at Heathrow. While the airlines, the community and others should be involved, we believe there is the opportunity for Heathrow to materially update the noise controls and to do so more comprehensively in regard to airspace modernisation than is encompassed by its Noise Action Plan. Moreover, we believe the controls should reflect improved performance of Heathrow's fleet while providing some certainty to the airlines and aircraft manufacturers for a period of time - say the next seven years.

35. RHC suggests the aspiration should be to reduce noise levels along the track and to the side that extend beyond the areas impacted by NADP1 and NADP2 and to achieve a greater reduction in noise levels than achievable by these operating procedures. Of course we would expect there to be an NADP1 or NADP2 for all departures and these are currently selected by the airlines. NADP2 is used, we understand, on about 85% of current Heathrow departures.

36. We have used LAeq in the analysis because it reflects total noise energy and this is affected by both absorption and duration. Lmax is an important measure of loudness but does not include total noise energy during an aircraft's overflight. When considering the human impact of the noise patterns (e.g. single event, hourly, daily and annual) we suggest both LAeq and Lmax (and related 'above' numbers) be taken into account.

37. This analysis focusses on noise and the vertical departure performance. Other factors such as air pollution and $CO_2$ are also important.

## G. DEPARTURE HEIGHT AND LATERAL DISPERSION - RHC RECOMMENDATIONS

38. The analysis is based on a single flightpath in both height and lateral terms. As radar and other data demonstrate, there is dispersion of multiple flights in both dimensions. There is already lateral concentration along the SID routes up to 4,000 feet before aircraft can be vectored. The Noise Preferential Routes allow up to 1.5km on either side of the SID. Examination of the Detling Route using Xplane indicates the lateral dispersion in practice is around +/- 0.5km to 1.0km up to around 15km from end of runway and then it widens at a height of 6,000 feet considerably to avoid interaction with the southeast landing stack (Biggin). Lateral dispersion reduces the noise levels for any particular location on the ground but the actual current lateral dispersion indicated above probably does not reduce the noise levels sufficiently to invalidate the RHC analysis here, which is based on a single flight path without lateral dispersion.

39. The introduction of PBN has the potential to concentrate aircraft and aircraft noise more so than today. It will be even more important to reduce noise through the vertical dimension. This could be through an increase in average ATM height or increase in noise weighted average ATM height. Additionally, reducing the number of flights in say the lower quartile of heights could be particularly helpful to a reduction in the impact of noise. Heavies tend to occupy the lower quartile and their specific noise at source tends to be greater.

40. Our understanding is that twin engine aircraft can climb at a far greater climb gradient than four engine aircraft because the reserve power needed for safety from two engines is far greater than needed by four engines. This reserve power can be used for far greater climb gradients and still be available in emergencies. Also twin engine aircraft can fly increasingly long distances to match distances achievable with four engines. The terms medium and heavy might be usefully qualified in terms of twin and four engine aircraft. With the phasing out of four engine aircraft (with the exception of freight only aircraft) there is a real opportunity now and going forward for increasing the minimum floor height at several points along Heathrow's departure flightpaths.

41. The height data in Figure 20 over-page has been extracted from Xplane in a brief inspection just to give an idea of the actual vertical dispersion. The way in which the data was extracted means it should not be treated as high quality. The Detling Route on 20 June 2024 had approx 191 flights. The number of flights near the airport exceeds this as other routes had not separated out before 10km from the runway end.

## HEATHROW
## DEPARTURE VERTICAL PERFORMANCE

| Number of Flights Detling Route O9R 20 June 2024 Vertical Dispersion. Very Appox data - for illustration only | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Distance from Heathrow end of runway 09R (Approx) | km | 4.3 | 7.5 | 9.9 | 15.5 | 19.8 | 30.9 | 40.7 | 50.9 |
| Height above runway plus | ft | | | | | | | | |
| 500 | ft | 2 | | | | | | | |
| 1000 | ft | 161 | | | | | | | |
| 1500 | ft | 450 | 6 | | | | | | |
| 2000 | ft | 73 | 127 | 5 | | | | | |
| 2500 | ft | 2 | 266 | 48 | 2 | | | | |
| 3000 | ft | | 49 | 64 | 10 | 1 | | | |
| 3500 | ft | | | 101 | 26 | 4 | | | |
| 4000 | ft | | | 56 | 55 | 7 | | | |
| 4500 | ft | | | 7 | 77 | 31 | | | |
| 5000 | ft | | | 5 | 24 | 75 | | | |
| 5500 | ft | | | | 5 | 57 | 3 | | |
| 6000 | ft | | | | | 12 | 95 | 50 | 20 |
| 6500 | ft | | | | | 9 | | | 9 |
| 7000 | ft | | | | | 4 | | | 4 |
| 7500 | ft | | | | 4 | 12 | | | 7 |
| 8000 | ft | | | | | 4 | | | 7 |
| 8500 | ft | | | | 1 | 5 | | | 17 |
| 9000 | ft | | | | | 3 | | | 8 |
| 9500 | ft | | | | 1 | 1 | | | 19 |
| Total | 0 | 688 | 448 | 286 | 205 | 225 | 98 | 50 | 91 |
| Note: Detling approx 191 ATMs, Other routes included | | | | | | | | | |

**Figure 20** Source RHC using Xplane Vertical Dispersion 09R Easterly operations

42. Noise sensitivity to height in Figure 19 illustrates how raising the heights in Figure 20 could be very beneficial. This is illustrated in Figure 21 where 500ft, 1000ft and 1500ft are added respectively to the NADP2 height profile with the noise levels compared.

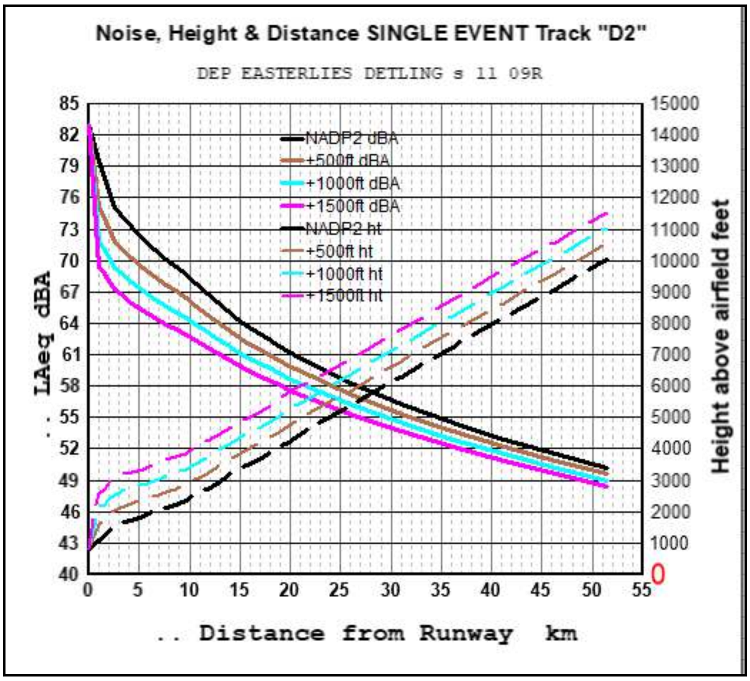


**Figure 21** Source RHC Noise (LAeq90sec dBA), Height (feet) & Distance (km) Single Event Track

43. For example, increasing the height by 1500ft from 2300ft to 3800ft at 10 km from end of runway reduces the Single Event noise under track from 68.7 to 63.0 dBA LAeq 90sec - nearly 6 dBA.

44. This benefit is further illustrated by the reduction in population exposed to noise when aircraft height is increased. The case here is not intended to be precise but as indicative of the reduction of population exposed to noise from height increases of 500ft, 1000ft and 1500ft added to the NAPD2 height profile. The model assumes the additional height is added shortly after take off at 4.3km from end of runway. In practice, this of course could not occur abruptly and the heights could have been spread along the departure profile including the initial height at end of runway of 800ft.

45. The results of increased height are shown for the Single Event in Figure 22. The 51 and 57 dBA contour populations are both reduced by around 10% with a height increase of 500ft. A 1000ft height increase reduces the population exposed by around 20% in the 57 dBA contour and by around 15% in the 51 dBA contour. A 1500ft height increase reduces population exposed by nearly 30% in the 57 dBA contour and 20% in the 52dBA contour.

| SINGLE EVENT POPULATION ('000) | | | |
|---|---|---|---|
| | Detling departures | | |
| **NAPD2 Ht + 500ft** | Ambient dBA | Contour dBA | Contour dBA |
| LAeq dBA | 45 | 51 | 57 |
| **Single Event** | | | |
| NAPD 2 | 1240 | 667 | 257 |
| Height | -22 | -51 | -27 |
| Duration | 0 | 0 | 0 |
| +500ft | 1218 | 616 | 230 |
| Net ref NAPD2 | -22 | -51 | -27 |
| Net ref NAPD2 % | -2% | -8% | -10% |
| | | | |
| **NAPD2 Ht + 1000ft** | Ambient dBA | Contour dBA | Contour dBA |
| LAeq dBA | 45 | 51 | 57 |
| **Single Event** | | | |
| NAPD 2 | 1240 | 667 | 257 |
| Height | -45 | -87 | -50 |
| Duration | 0 | 0 | 0 |
| +1000ft | 1195 | 580 | 207 |
| Net ref NAPD2 | -45 | -87 | -50 |
| Net ref NAPD2 % | -4% | -13% | -19% |
| | | | |
| **NAPD2 Ht + 1500ft** | Ambient dBA | Contour dBA | Contour dBA |
| LAeq dBA | 45 | 51 | 57 |
| **Single Event** | | | |
| NAPD 2 | 1240 | 667 | 257 |
| Height | -71 | -137 | -70 |
| Duration | 0 | 0 | 0 |
| +1500ft | 1169 | 530 | 187 |
| Net ref NAPD2 | -71 | -137 | -70 |
| Net ref NAPD2 % | -6% | -20% | -27% |

**Figure 22** Source RHC. Population Exposed ('000) Single Event. NAPD2 plus additional heights 500ft, 1000ft & 1500ft

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46. If the NADP2 speed profile were maintained then that would retain the duration benefit even were thereto be a change from NADP 2 to NADP1. Enhanced infringement rules for breaches of the new floor heights without adding to the number of infringements could produce a substantial reduction in noise we believe. The noise controls could be addressed in terms of climb gradients rather than heights or some combination. Exceptions could be made for the older four engine aircraft as they are phased out, although their floor heights might also be increased.

47. As mentioned above, the analysis assumes unaltered thrust/power profiles. However, it may be possible to achieve noise benefits from the newer twin engine aircraft by increasing their power profile, which we broadly understand comprises a reduced take off power setting (say 90% of maximum power) followed by a climb power setting (say 50% of maximum power). We recommend consideration be given to either or both settings being higher and/or being held for longer but recognise there may be implications for engine wear, pollutants and CO2.

48. Using height and climb gradient controls has the potential to produce benefit to communities over a large area as well at particular noise hotpots. Also we believe new limits and monitors could be introduced by Heathrow relatively simply at relatively small cost and in the near term. But it will be essential for the minimum heights of Heathrow's four holding stacks to be raised above 7,000 feet. Most of Heathrow's departures interact with one or other of the stacks. This may have implications for the descent gradients and distance travelled by arrivals.

49. The Detling route on Easterly operations using runway 09R has been used as an example but similar analysis applies to the total 24 departure flightpaths on easterly and westerly operations from the four runway ends at Heathrow[1].

50. **RHC recommends Heathrow consider the proposals for Noise Controls put forward here with a view to raising the average height and the minimum floor height of departures on all it routes.**

**ANNEX**: CAA four examples of departures at Heathrow's NACF on 20 May 2024. NB: narrow bodied, W2: wide body twin, etc. A, B and C are the distances, A shorter, B medium, etc. b should be an average for the plane type from Heathrow.

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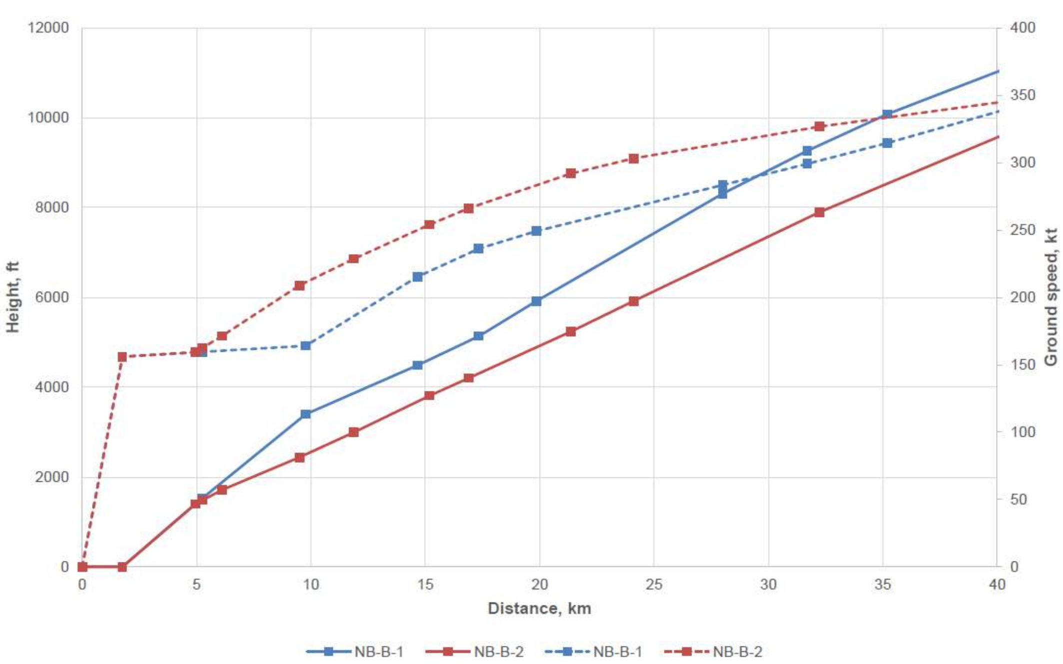
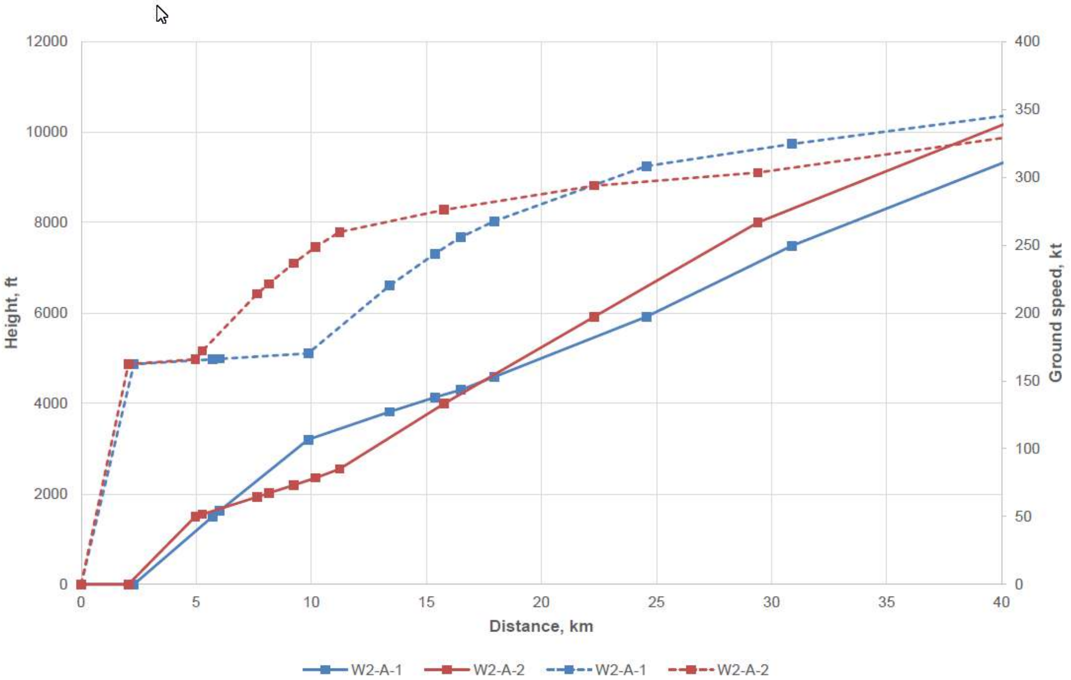
[1] RHC's noise model covers all 24 departure flightpaths as well as the 16 arrival paths and the system combination of all 40 flightpaths.

ANNEX

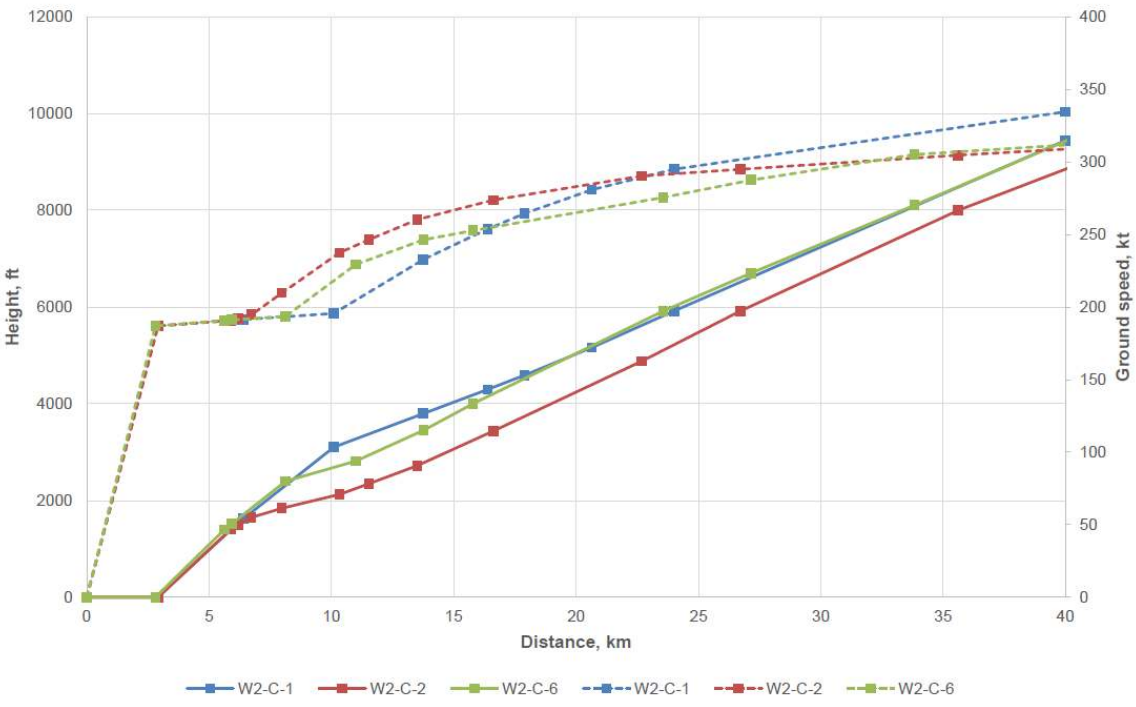
# NB-B



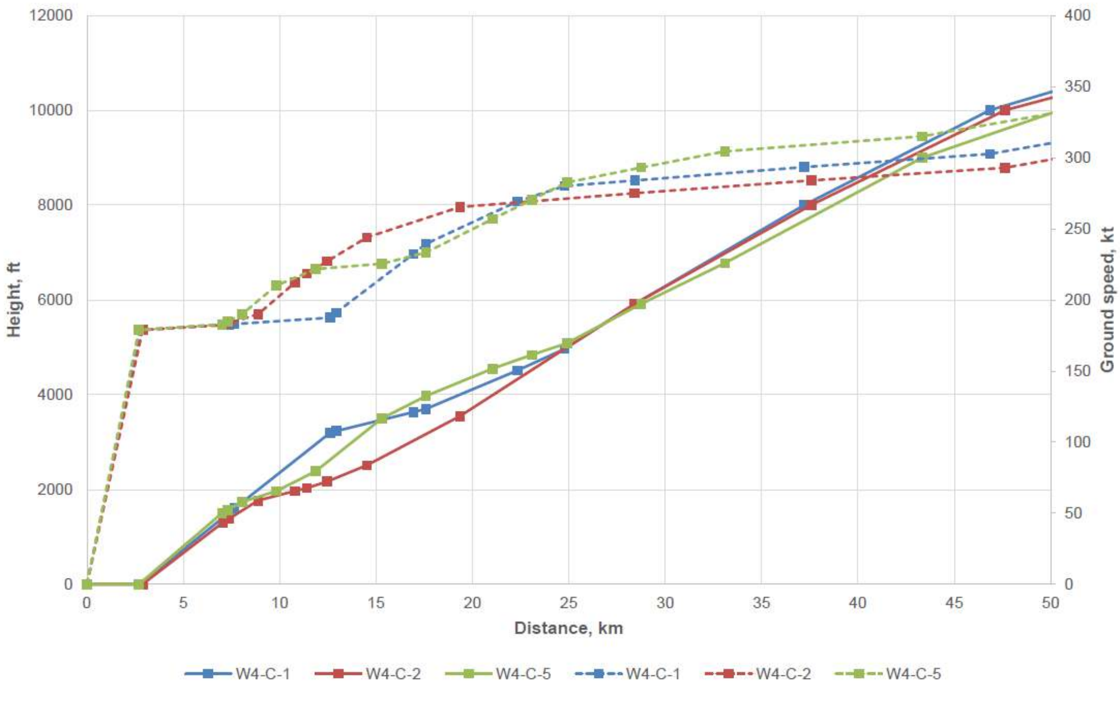

# W2-A



# W2-C


Civil Aviation Autho
12000
10000
8000
6000
4000
2000
0
Height, ft
400
350
300
250
200
150
100
50
0
Ground speed, kt
0
5
10
15
20
25
30
35
40
Distance, km
W2-C-1
W2-C-2
W2-C-6
W2-C-1
W2-C-2
W2-C-6

# W4-C


Civil Aviat Autho
12000
10000
8000
6000
4000
2000
0
Height, ft
400
350
300
250
200
150
100
50
0
Ground speed, kt
0
5
10
15
20
25
30
35
40
45
50
Distance, km
W4-C-1
W4-C-2
W4-C-5
W4-C-1
W4-C-2
W4-C-5