



**An tÚdarás Inniúil um
Thorann Aerárthaí**

**Aircraft Noise
Competent Authority**

Draft Regulatory Decision

Appendix F

Assessment of Aircraft Noise Modelling



An tÚdarás Inniúil um
Thorann Aerárthaí
Aircraft Noise
Competent Authority



Noise
CONSULTANTS

Statement in relation to aircraft noise modelling undertaken as part of Application F20A/0668

October 2021



Experts in noise and vibration
assessment and management

Document Control

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1 Introduction

- 1.1 The Airport Noise Competent Authority (ANCA) has asked Noise Consultants Limited (NCL) to review the approach taken to the modelling of aircraft noise as part of Planning application F20A/0668 ('the Application') which was submitted by Dublin Airport Authority ('the Applicant') on 18 December 2020.
- 1.2 This statement of review has taken into account documents submitted by the Applicant with the Application, including documentation provided in response to a direction to provide information as issued by ANCA on 24 February 2021 ('Direction to Provide Information')¹.
- 1.3 ANCA has provided the Applicant with draft guidance in relation to aircraft noise information reporting to support and standardise the information issued as part of the Application. Further to this, a 'Reporting Template' was also provided and completed by the Applicant to relevant information relating to its noise exposure data and forecasts.
- 1.4 The draft guidance note provided to the Applicant which included a section (Section 4.5) concerning the aspects to be covered when describing their modelling methodology. This is reproduced below.

"4.5 Noise Modelling Report

All information should be accompanied by a modelling report describing the approach and supporting evidence for modelling works, including;

- *Confirmation of the noise assessment method I.e. ECAC Doc 29 4th Edition including the modelling software utilised;*
- *Confirmation of input datasets including:*
 - *Schedules / Flight Records including copies of relevant flight operations report*
 - *Meteorological conditions*
 - *Inputs to flight track assumptions including dispersions*
 - *Inputs to flight profile and aircraft type assumptions*
 - *Model Splits*
- *Validation Methodologies and Adjustments*
 - *Reporting of any validation activities including the preparation and evidencing of:*

¹ Appendix A, ANCA Direction to Tom Phillips

- *Customised procedures profiles; and/or*
 - *NPD adjustments based on noise monitoring data.*
 - *Calculation Settings, including:*
 - *Grid resolutions / dynamic grid settings*
 - *Receptor definitions*
 - *Application of meteorology*
 - *Use of band angle*
 - *Ground attenuation.*
- 1.5 The review summarised in Section 3 has had regard for the information provided by the Applicant taking into account the detail requested in the draft guidance and the requirements of the relevant legislation and other relevant standards and guidance which are described in Section 2.

2 Calculation of Aircraft Noise

- 2.1 Within the context of EU Regulation 598/2014² (the Aircraft Noise Regulation) and EC Directive 2002/49/EC³ (END), it is necessary to undertake the calculation of aircraft noise using the methodology set out within EU Directive 2015/996⁴ (CNOSSOS-EU:2015), which is the legal implementation of the calculation methodology set out in ECAC Doc 29 4th Edition 2016⁵. This is the latest version endorsed by the European Civil Aviation Conference (ECAC) and the International Civil Aviation Authority (ICAO).
- 2.2 The methodology is made up of several parts:
- Volume 1: Application Guide;
 - Volume 2: Technical Guide; and
 - Volume 3: Reference Cases and Verification Framework.
- 2.3 The calculation methodology set out in ECAC Doc 29 4th Edition is implemented within the US Federal Aviation Authority (FAA) Aviation Environmental Design Tool (AEDT) software. The software is accompanied by a Technical Manual which describes how the ECAC document has been implemented into a software environment.
- 2.4 Additional guidance on the application of the ECAC Doc 29 methodology has also been provided by the UK Civil Aviation Authority (CAA), through:
- CAP 1616a Airspace Design: Environmental Requirements Technical Annex⁶;
 - ERCD Report 1006 Measurement and Modelling of Aircraft Noise at Low Levels⁷; and

² REGULATION (EU) No 598/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC

³ DIRECTIVE 2002/49/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL relating to the assessment and management of environmental noise

⁴ COMMISSION DIRECTIVE (EU) 2015/996 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council

⁵ ECAC.CEAC Doc 29 4th EDITION Report on Standard Method of Computing Noise Contours around Civil Airports

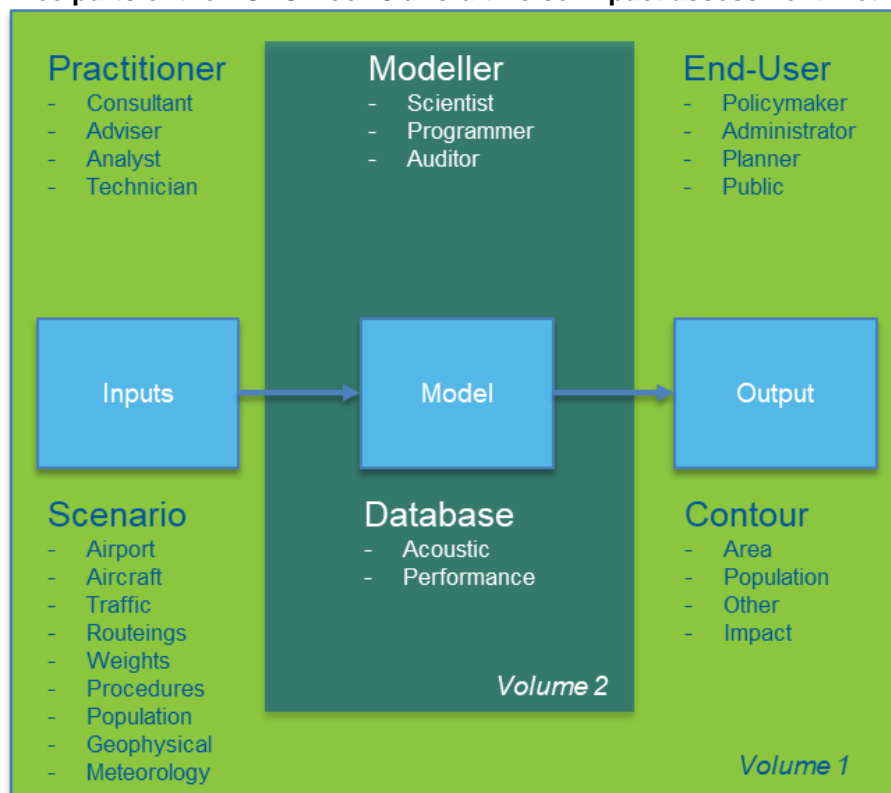
⁶ Available here: <http://publicapps.caa.co.uk/docs/33/CAP%201616a%20Environmental%20requirements%20technical%20annex.pdf>

⁷ Available here: <http://publicapps.caa.co.uk/docs/33/ERCD%20Report%201006%20Low%20Level%20Monitoring%202nd%20Edition.pdf>

- CAP 2091 Policy on Minimum Standards for Noise Modelling⁸.

- 2.5 These documents collectively may be used to describe the methodology and guidance on how an aircraft noise model can be prepared. However, any requirements which are described in EU Directive 2015/996 take primacy.
- 2.6 Figure 1 below provides an overview of the calculation process set out within ECAC Doc 29 and provides an overview of the input data required to develop a scenario, and the output data generated.
- 2.7 Figure 1 shows that most of the scenario input data is specific to the actual aircraft and how they operate at the airport. Details such as the specific use of arrival and departure routes, the aircraft take-off weight and vertical flight profiles can all affect the calculated noise levels, and the extent of the resulting contour areas.

Figure 1 - Three parts of the ECAC Doc 29 aircraft noise impact assessment methodology



- 2.8 Due to the specific details required within the calculation methodology, it is generally the case that aircraft noise calculations are undertaken in close collaboration with the airport, air navigation service and airspace designers, in order to gain access to the necessary input data.

⁸ Available here:

[https://publicapps.caa.co.uk/docs/33/CAA%20Policy%20on%20Minimum%20Standards%20for%20Noise%20Modelling%20\(CAP2091\).pdf](https://publicapps.caa.co.uk/docs/33/CAA%20Policy%20on%20Minimum%20Standards%20for%20Noise%20Modelling%20(CAP2091).pdf)

2.9 This has led to the airports being the primary developers of aircraft noise contours, including the statutory designation of the Applicant as the noise mapping body for strategic noise maps under the European Communities (Environmental Noise) Regulations, S.I. No 549 of 2018⁹, which transposes the END into Irish legislation.

⁹ Available here: <http://www.irishstatutebook.ie/eli/2018/si/549/made/en/pdf>

3 Review of the Applicant's Modelling Approach

3.1 The latest documentation provided by the Applicant with respect to their approach to aircraft noise modelling as part of the Application is available within the document:

- Bickerdike Allen Partners, A11267_19_RP035_4.0, Dublin Airport North Runway Relevant Action Application, Noise Information – ANCA Request, February 2021

3.2 Section 5 and Appendix 2 of this document sets out the noise modelling, population and demographic assessment methodologies relied on by the Applicant.

3.3 Further information is also available within Appendix 13B of the Environmental Impact Assessment Report¹⁰.

Choice of Noise Model

3.4 The Applicant has confirmed that the noise modelling software utilised as part of the Application is the 'Federal Aviation Authority Aviation Environmental Design Tool (AEDT) version 2d SP2'. This model is compliant with ECAC.CEAC Doc 29 4th Edition and therefore aligns with the requirements of EU Directive 2015/996¹¹.

3.5 The AEDT version relied on by the Applicant is not the most recent version and nor does it hold the most recent version of the Aircraft Noise and Performance Database (ANP)¹² which can be utilised by aircraft noise modellers for use with ECAC.CEAC Doc 29. However, this is not in itself problematic providing that the Applicant's model has been subject to a form of validation to account for new aircraft types. This is discussed in the following sections.

AEDT Study Settings

3.6 The documentation provided by the Applicant confirms that the noise modelling has utilised default weather settings for Dublin Airport and all-soft ground terrain for lateral attenuations. This is considered appropriate given a validation exercise has taken place as is discussed below.

¹⁰ Dublin Airport North Runway Relevant Action Application, Environmental Impact Assessment Report, Volume 4 – Appendices, September 2021

¹¹ COMMISSION DIRECTIVE (EU) 2015/996 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council

¹² Available here: <https://www.aircraftnoisemodel.org/>

- 3.7 Terrain data has also been incorporated into the study. This is again considered appropriate and in line with the guidance set out by the UK CAA¹³ which states that terrain adjustments must be included.
- 3.8 The Applicant confirms that the airfield layouts including the location of runways have been taken from the Airport's AIP¹⁴. From our review of the noise contour and associated grids provided with the Application there are no concerns with the airfield layouts adopted in the Applicant's modelling.

Aircraft Movements

- 3.9 The Applicant has provided an extensive breakdown of the aircraft movements which have been modelled in each of the scenarios considered. This has been provided in detail within a completed aircraft noise reporting template¹⁵. This includes historic records of aircraft movements by period and by type as well as those relating to the forecasts used within the Application.
- 3.10 The documentation notes that for the majority of aircraft types noise emissions have been based those provided within the ANP database¹⁶ and where this has not been possible 'substitutes' have been adopted based on the aircraft's size and engine details. However as discussed below, this has been subject to a validation exercise.
- 3.11 Helicopters and military aircraft have not been included in the Applicant's modelling. This is in keeping with EU Directive 2015/996¹⁷.
- 3.12 The aircraft noise modelling prepared by the Applicant has excluded activities such as taxiing, engine testing and the use of auxiliary power units as part of the considering various runway use and restriction scenarios. The Applicant notes that this is allowed under EU Directive 2015/996¹⁸ providing that such activities "*do not contribute materially to the overall population exposure*".
- 3.13 Having regard for the noise exposure statistics provided with the Application and within the EIAR¹⁹, we consider this to be the case, however note the potential for some locations to the immediate north and south of the Airport to receive comparable levels of noise from departing and landing aircraft on the runway, to those which are taxiing.

¹³ Paragraph 1.20, CAP1616a

¹⁴ EIDW AD 2.24-1, dated 28 March 2019, http://iaip.iaa.ie/iaip/IAIP_Frame_CD.htm

¹⁵ CA434_5.0 ANCA Reporting Template 2021 Update.xlsx

¹⁶ Aircraft Noise and Performance Database, <https://www.aircraftnoisemodel.org>

¹⁷ Para 2.7.5, EU Directive 2015/996

¹⁸ Para 2.7.1, EU Directive 2015/996

¹⁹ Dublin Airport North Runway Relevant Action Application, Environmental Impact Assessment Report, Volume 2 – Main Report, September 2021, Section 13

Runway Use

- 3.14 The runway usage data reported by the Applicant is based on historic analysis over a 10-year period. The assumptions made by the Applicant are reasonable and are supported by further material provided in Appendix 3B of the EIAR with respect to use of the crosswind runway.

Modelled Routes and Dispersion

- 3.15 The location and dispersion of arrival and departure routes is a critical part of an aircraft noise model and directly effects the number and location of receptors modelled as being exposed to aircraft noise.
- 3.16 NCL is broadly satisfied that the approach taken by the Applicant in modelling its arrival and departure routes is acceptable, however we have made the following observations:
- Limited data has been provided to demonstrate how the current situation has been modelled with respect to how the existing departure routes are flown. However, noise contours provided for 2016, 2018 and 2019 appear consistent with the location of flight paths reported in the Airport's Noise Action Plan²⁰.
 - A single dispersion assumption has been used for all scenarios based on analysis that the Applicant undertook in 2016 and reviewed in 2018. It is of course impossible to consider dispersion in future forecast scenario, however NCL notes that the dispersion pattern adopted may not reflect RNAV procedures. This cannot be determined at this point therefore it is highly recommended that from the commencement of North Runway operations that dispersion patterns are remeasured and included in future modelling exercises.

Route Usage

- 3.17 For all historic modelling the Applicant has confirmed that movement logs have been used as the basis for assigning aircraft to routes. For future forecasts it is stated that departure route information has been provided for some movements but where this is not available, destination has been used as a proxy to determine the departure routing. This is considered appropriate and in the case of forecasts reduces some uncertainty by having data which indicates the associated departure route.

Flight Profiles and Departure Stage Lengths

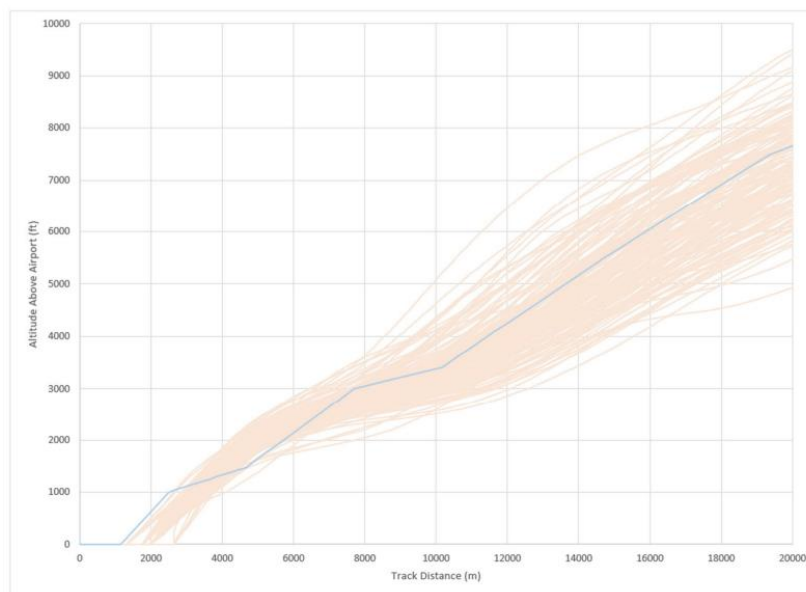
- 3.18 CAP2091 requires airports with a certain noise exposure to prepare their noise models in line with a certain standard or 'category'. Considering reported exposure in 2019 at Dublin Airport as provided in the reporting template, and the guidance set out in CAP2091, NCL consider the airport to be a 'Category C' airport. This means that there is an expectation that flight profiles are prepared for major aircraft types having regard for local track-keeping data. Further to this, EU Directive 2015/996

²⁰ Add ref

expresses caution towards adopting default profiles from the ANP as they may not reflect the procedures in place by operators at the Airport.

- 3.19 The Applicant has confirmed that flight profiles have been prepared using local track-keeping data. An example is provided in Appendix 13B of the EIAR. The examples provided (for the Airbus A320ceo) show that the modelled profile has been compared to flight profile data. However, in both examples (Charts 13B-1 and 13B-2), the modelled 'USER' profiles do not always reflect the radar track analysis. This is particularly the case for the example departure in Chart 13B-2 (reproduced below) before 6000m along the track. It is not clear to what extent that this may affect calculated noise exposure levels.
- 3.20 It is noted from other information provided by the Applicant that departure profiles have been modified to reflect the Noise Abatement Departure Procedure (NADP) in place at Dublin Airport²¹.

Figure 2 – Chart 13B-2 as reproduced from Appendix 13B of the EIAR



- 3.21 Beyond the information summarised above the Applicant states that similar profiles have been developed for the A320neo, A321ceo, A321neo and Boeing 737max. These types reflect most operations occurring at Dublin Airport in 2019 and forecast to do so in the future.
- 3.22 The Applicant has confirmed that as part of adjusting the profiles, these have been extended from 10,000ft to 30,000ft. This is appropriate given the study area and need for the model to calculate down to levels of 40 dB L_{night} and 45 dB L_{den} .
- 3.23 The Applicant has not stated how, if at all, 'stage length' has been captured in the modelling or as part of the preparation of flight profiles for departing aircraft. 'Stage length' is an approach used in

²¹ Dublin Airport North Runway Relevant Action Application, Draft – Initial Response to ANCA Request for Further Information, June 2021 – Appendix J

AEDT as a proxy for take-off weight. The concept is that the heavier the aircraft, the shallower the climb profile. The Applicant is however correct to identify that EU Directive 2015/996 states that *“Vertical dispersion is usually represented satisfactorily by accounting for the effects of varying aircraft weights on the vertical profiles”*.

- 3.24 The information reported by the Applicant confirms that adjustments have been made to flight profiles. Whilst NCL has identified improvements with respect to transparency and the potential representativeness of the profiles, these are considered observations rather than material issues with the modelling itself.
- 3.25 Having regard for the above, it is recommended that all future modelling present the profiles developed for each aircraft type having regard for the flight profiles observed from the radar data. This should take into account vertical dispersion through stage length.

Validation

- 3.26 Under UK CAA guidance set out in CAP2091, assuming Dublin Airport is a ‘Category C’ airport, the modelling could potentially rely on unadjusted noise data from the ANP. However, EU Directive 2015/996 states as part of its quality framework²² that:

“All input values affecting the emission level of a source, including the position of the source, shall be determined with at least the accuracy corresponding to an uncertainty of $\pm 2\text{dB(A)}$ in the emission level of the source”.

- 3.27 The Applicant has validated its modelling by comparing modelling aircraft noise event levels (in terms of Sound Exposure Level (SEL)) with those measured by the Airport’s Noise and Track Keeping (NTK) System. The Applicant has relied on data measured at three of the airport’s noise monitoring terminals (NMTs) over the period January and December 2018.
- 3.28 This approach is considered appropriate given the primary noise metrics considered are L_{eq} -based which rely on the calculation of aircraft SELs. This underpins the calculation of the L_{den} , L_{day} , L_{evening} , L_{night} and $L_{\text{Aeq,16hr}}$ metrics.
- 3.29 To ensure that this is complied with it is necessary for a form of validation to occur. This effectively is required in two parts: bespoke arrival and departure profiles to ensure that the activity as modelled is representative; and adjustments to the noise emission data for the modelled aircraft having regard for measurements.
- 3.30 The data provided by the Applicant shows that adjustments have been made to the underlying noise-power-distance (NPD) information which is held within the ANP. This shows that for the majority of aircraft types, the adjustments made are within $\pm 2\text{dB(A)}$ of the default data held within AEDT.

²² Para 2.6.2, EU Directive 2015/996

However, for other aircraft types such as the Boeing 787-800 and Boeing 757-200, the adjustments are above 2dB.

- 3.31 The information provided by the Applicant shows that for the Airbus A320neo, that the NPD data used for this aircraft type is based on an adjustment made to data held within the AEDT version adopted by the Applicant for its predecessor, the A320-211. It should be noted that more recent versions of the ANP and AEDT include default data for the A320neo. The adjustments made for the A320neo in the Applicant's modelling are based on measurements taken at three of the Airport's noise monitoring terminals (NMTs). This is the case for all adjustments made with the exception of the ATR72 and the DH4 types.
- 3.32 In total the Applicant has modified NPD data for seventeen aircraft types as part of their modelling.
- 3.33 Where the adjustments have been made using data from the NMTs, no information has been provided to confirm exactly how the adjustments corresponding to what is likely a distribution of measured levels at the NMTs. It has to be assumed that the adjustments have been made to reflect an energetic average SEL from each aircraft type at the relevant NMTs. Wider considerations as to whether the validation has had regard for differing locations of overflight around the NMTs and whether data gathered under during high winds or rain has been excluded.
- 3.34 EU Directive 2015/996 states that:
- "In cases where input data provided in Appendix F to Appendix I are not applicable or cause deviations from the true value that do not meet the conditions presented under 2.1.2 and 2.6.2, other values can be used, provided that the values used and the methodology used to derive them are sufficiently documented, including demonstrating their suitability. This information shall be made publicly available."*
- 3.35 The methodology presented by the Applicant can be followed however details such as those described above are either not reported or are not clear. Nevertheless, adjustments made are broadly within the $\pm 2\text{dB(A)}$ quality framework and reflect NCL's experience of making similar adjustments at other airports.
- 3.36 It is recommended that in future rounds of modelling, particularly with the onset of North Runway operations where additional NMTs could be used to further validate the modelling that validation exercises occur regularly and in manner where the methodology and decisions made in the validation process are clear. This is particularly important with respect to demonstrating compliance with the Noise Abatement Objective for the Airport.
- 3.37 It is noted that the EIAR has prepared modelling of metrics which are underpinned by the calculation of L_{Amax} noise levels. Whilst such data has not been used by ANCA in its assessment work, metrics such as the N60 have been prepared within the EIAR for the Applicant's preferred scenario. Whilst this does not affect the assessments undertaken by ANCA within its draft regulatory decision, a

validation of L_{Amax} may need to be undertaken by the Applicant (if it has not already) if such metrics are to be used routinely.

Modernised Types

- 3.38 The modelling undertaken by the Applicant has made assumptions with respect to the future noise performance of modernised aircraft types such as the Airbus A321LR and A350-900. The approach taken to modelling modernised types is consistent with modelling elsewhere by making adjustment to NPD data of existing aircraft to reflect expected performance.
- 3.39 The data sources cited as part of developing the adjustments are authoritative and in line with adjustments used elsewhere.
- 3.40 Over the period to 2025 and beyond the Applicant's forecasts anticipate the increased prevalence of these types, namely the A321neo and A330neo. There will be a requirement for these types to be the subject of a validation as and when they become established at Dublin Airport.

Population and Demographic Assessment Method

- 3.41 Noise exposure assessment requires the consideration of the location and number of noise sensitive receptors located around an airport. The Applicant has described its methodology for the considerations of this and has relied on data obtained from GeoDirectory 2019 Q2 as a basis. The Applicant states that their approach to estimating population is consistent with that used as part of the noise mapping of the Airport under the ENR. This is based on the Small Areas Population Statistics (SAPS) published by the Central Statistics Office (CSO), GeoDirectory delivery point data from Ordnance Survey Ireland (OSi) and An Post, and PRIME2 building data from OSi²³.
- 3.42 The Applicant's exposure assessment has included an assessment of how population may increase as a result of consented developments and zoned lands. This is considered appropriate.

²³ As described here: <https://www.epa.ie/publications/monitoring--assessment/noise/epa-guidance-note-for-strategic-noise-mapping-for-the-environmental-noise-regulations-2006-version-2--august-2011.php>

4 Conclusion

- 4.1 The review undertaken by Noise Consultant's Limited of the modelling prepared by the Applicant as part of the Application has identified general compliance with the requirements of EU Directive 2015/996.
- 4.2 Based on our review, the modelling is considered sufficient for the purposes assessing and evaluating the scenarios considered by the Application and its supporting material. However, potential improvements have been identified with respect to the transparency of the methodology utilised by the Applicant with respect to NPD validation and the development of flight profiles. This is not considered to affect the assessment work that is undertaken by ANCA.
- 4.3 The assumptions made with respect to flight paths and dispersion are based on the best available information at the time of the Application. This is understandable given that at the time of the modelling North Runway operations are yet to commence. It is strongly recommended that upon commencement of North Runway operations that the Applicant revalidates its model entirely in line with the requirements set by the Noise Abatement Objective for measuring the NAO.