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Report

Round 4 Noise Mapping for Northern Ireland

Belfast City Airport Modelling Report

For Department of Agriculture, Environment and Rural Affairs (DAERA)

6 February 2025

Document Control

Project Title:	Round 4 Noise Mapping for Northern Ireland
Project Number:	14668A-20
Client:	Department of Agriculture, Environment and Rural Affairs (DAERA)
Document Title:	Belfast City Airport Modelling Report
Document Number:	14668A-20-R09-05-F03
Prepared By:	Noise Consultants Limited and Acustica Ltd

Revision History

01	08/11/2024	Draft 1
02	21/11/2024	Final Draft 2
03	03/02/2025	Final
04	06/02/2025	Final

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1 Glossary

Term	Definition
3D	3-dimensional
AEDT 3e	Calculation software used to calculate aircraft noise
Agglomeration	An area of a territory that has a population exceeding 100,000 people with a population density that allows it to be considered as an urbanised area
CNOSSOS-EU	Common Noise Assessment Methods for Europe - the noise modelling method used in the Round 4 noise mapping
CNOSSOS-EU:2020	CNOSSOS-EU as amended by the Delegated Directive
DAERA	Department of Agriculture, Environment and Rural Affairs
dB	Decibel, a logarithmic unit of sound
Delegated Directive (EU) 2021/1226	Commission Delegated Directive (EU) 2021/1226 of 21 December 2020 amending, for the purposes of adapting to scientific and technical progress, Annex II to Directive 2002/49/EC of the European Parliament and of the Council as regards common noise assessment methods
Directive 2002/49/EC	Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Commonly referred to as the 'Environmental Noise Directive' (END)
Directive 2015/996	COMMISSION DIRECTIVE (EU) 2015/996 of 19 May 2015 establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council
EC	European Commission
ECAC	European Civil Aviation Conference
ECAC Doc.29 4th Edition	Report on Standard Method of Computing Noise Contours around Civil Airports
END	Environmental Noise Directive
ENR	Environmental Noise Regulations
EU	European Union
GIS	Geographic Information System
ICAO	International Civil Aviation Authority
$L_{Aeq,16h}$	The equivalent continuous sound level in dB(A) that, over the period 07:00-23:00 hours, contains the same sound energy as the actual fluctuating sound that occurred in that period
L_{day}	The day level, the A-weighted, L_{eq} (equivalent sound level), determined over all the 12-hour day periods (07:00-19:00) of a year
L_{den}	The day-evening-night level indicator for overall annoyance, based upon annual average A-weighted long-term sound over 24 hours. It includes a 5 dB(A) penalty for evening noise (19:00-23:00) and a 10 dB(A) penalty for night-time noise (23:00-07:00)
L_{eve}	The evening level, the A-weighted, L_{eq} (equivalent sound level) determined over all the 4-hour evening periods (19:00-23:00) of a year
L_{night}	The night level indicator for sleep disturbance, based upon the A-weighted, L_{eq} (equivalent sound level) determined over all the 8-hour night periods (23:00-07:00) of a year
Member State	A country that is a part of the European Union
NCL	Noise Consultants Limited
NISRA	Northern Ireland Statistics and Research Agency
OSNI	Ordnance Survey Northern Ireland
QA	Quality Assurance
Raster	Raster data consists of a matrix of cells that are organised into a grid, with each cell containing a value which represents information such as terrain elevation or calculated noise level

Term	Definition
RIVM	The Netherlands National Institute for Public Health and the Environment
RIVM Letter report 2019-0023	Amendments for CNOSSOS-EU, Descriptions of issues and proposed solutions.
Round 3	The previous round of strategic noise mapping
Round 4	The current round of strategic noise mapping
Technical working group	A number of representatives that were nominated by EU member states, whose task was to address the issues identified in CNOSSOS-EU through proposing some refinements to the method
The Regulations	A series of environmental noise regulations including: Environmental Noise Regulations (Northern Ireland) 2006, Environmental Noise (Amendment) (NI) Regulations 2018, The Environmental (Miscellaneous Amendments) (Northern Ireland) (EU Exit) Regulations 2019, and The Environment (Legislative Functions from Directives) (EU Exit) Regulations 2019

2 Introduction

Noise Consultants Limited (NCL) was appointed by the Department of Agriculture, Environment and Rural Affairs (DAERA) to prepare the noise maps and associated noise exposure statistics in Northern Ireland.

NCL collaborated with its partners, Stapelfeldt Ingenieurgesellschaft mbH and Acustica Limited (the "Project Team"), to develop the model and deliver the required outputs. This report is part of a series documenting the data decisions, processing, and outputs associated with the project.

2.1 Background

The requirement to deliver strategic noise maps and noise action plans is mandated by the Environmental Noise Regulations (Northern Ireland) 2006 (ENR[1]), as amended by the Environmental Noise (Amendment) (NI) Regulations 2018[2]. These regulations transposed European Commission Directive 2002/49/EC[3], known as the Environmental Noise Directive (END), into Northern Irish law.

The aim of the END is to define a common approach intended to avoid, present or reduce on a prioritised basis the harmful effects, including annoyance, due to the exposure to environmental noise. The END seeks to manage the impact of environmental noise through strategic noise mapping, and requires the preparation and publication of strategic noise maps and noise management actions plans every five years.

The Regulations serve as the principal framework for the assessment and management of environmental noise in Northern Ireland, aiming to mitigate the adverse effects, including annoyance, caused by environmental noise through a standardised approach.

The Regulations require the competent authorities identified within Regulations to create and update noise maps and action plans every five years, aligning with the requirements of the END. Therefore, each competent authority for the different noise sources, as mentioned below, serves as the main contact point for data collection.

- **Major roads** - the Department for Infrastructure (formerly The Department for Regional Development);
- **Major railways** - Translink (a subsidiary company of Northern Ireland Transport Holding Company);
- **Major airports** – the airport operators; and
- **Industry** - the Department of Agriculture, Environment and Rural Affairs (DAERA).

Under the Regulations, the noise sources that shall be identified and mapped are:

- Agglomerations, as defined in the Regulations as an area identified by the Department of the Environment as:
  "*(a) having a population in excess of 100,000 persons and a population density equal to or greater than 500 people per km²; and*
  (b) which it considers to be urbanised."
- Major roads, which are roads that
  "*(a)are—*
  (i)trunk roads;
  (ii)motorways; or
  (iii)classified roads; and
  (b)have more than three million vehicle passages a year."

[1] https://www.legislation.gov.uk/nisr/2006/387/contents/made (Accessed November 2024)
[2] https://www.legislation.gov.uk/nisr/2018/190/made (Accessed November 2024)
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32002L0049 (Accessed November 2024)

- Major railways, which are *"which have more than 30,000 train passages per year."*
- Major airports, which are *"civil airports which have more than 50,000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft."*
- Industrial noise sources, which are defined as:
  "(a)Part A activities, as defined in Schedule 1 of the Pollution Prevention and Control Regulations (Northern Ireland) 2003[4], within an agglomeration or first round agglomeration; and
  (b)Ports within an agglomeration or first round agglomeration".

The first round of noise mapping in Northern Ireland under the Regulations was completed in 2007. The second round was undertaken five years later in 2012 with the third round carried out in 2017. Under the Regulations, the fourth round of the noise maps should describe the noise situation in 2021.

In accordance with Article 6.2 of the END, the European Commission developed the Common Noise Assessment methods in Europe (CNOSSOS-EU[5]). This assessment method must be adopted for the fourth round of noise maps, it was finalised and given legal effect through Commission Directive 996/2015[6], Which was transposed into Northern Irish law in 2018[7].

The requirement for CNOSSOS-EU to be used as the method of producing noise maps under the Regulations introduces a major change from previous rounds. In the case of road and railway noise, the CNOSSOS-EU method is more sophisticated than the methods previously used in Northern Ireland and the rest of the United Kingdom in delivering the noise maps to date. It introduces a significant number of new data requirements to facilitate the noise maps, includes relatively untested approaches to computing noise emissions, but also provides opportunities in recapturing data so to improve the quality of the maps, which are produced by setting quality standards and providing a more accurate method.

2.2 Purpose of this Report

This report describes the noise modelling platform used to deliver the Belfast City Airport noise strategic noise maps, setting out the regional calculation extents, model calculation run scenarios, and post processing of the model calculation results. It also presents the exposure statistics as required by the Regulations and includes figures of the L_{den} and L_{night} noise maps for Belfast City Airport.

This report should be read in conjunction with the Stage 1 Data Input Report (Ref: 14668A-20-R03-05-F01), hereafter referred to as the 'Stage 1 Report', which sets out the details of the data collection and review, data processing and quality assurance (QA).

This report is specifically intended to provide details on the sources and processes used to develop the Belfast City Airport source dataset and Round 4 noise models. Details on other source types included in the wider Round 4 Noise Mapping can be found in the Stage 2 Final Report (Ref: 14668A-20-R04-05-F01, 'Stage 2 Report'), as well as the relevant "Modelling Reports" for Road, Railway, Industry and Belfast International Airport respectively.

[4] https://www.legislation.gov.uk/nisr/2003/46/contents/made (Accessed November 2024)
[5] https://publications.jrc.ec.europa.eu/repository/handle/JRC72550#:~:text=CNOSSOS%2DEU%20aims%20at%20improving,PAVIOTTI%20Marco%3B%20ANFOSSO%2DL%C3%89D%C3%89E%20Fabienne (Accessed November 2024)
[6] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L0996 (Accessed November 2024)
[7] Environmental Noise (Amendment) (NI) Regulations 2018

3 Data Capture Extents

The aim of the Round 4 strategic noise maps is to have optimal coverage for major road, major rail and major airport sources (as defined by the Regulations) as well as agglomeration coverage for road, railway, airport and industrial sources.

This section summarises the Round 4 data capture extents. Full details are in the Stage 1 Report.

3.1.1 Agglomeration Extents

The Regulations[8] state that DAERA are to prepare maps that identify all agglomerations:

- Having a population in excess of 100,000 persons; and
- a population density equal to or greater than 500 people per km^2; and
- Which it considers to be urbanised.

The Belfast urban area remains the only agglomeration area in Northern Ireland for the Round 4 noise mapping.

In Round 4, the Belfast Agglomeration area from Round 3 was re-evaluated and redefined using Census 2021 data at the data zone level, as well as 1 km and 100 m grid areas. The updated Round 4 Belfast Agglomeration area continues to accurately represent the densely populated regions surrounding the Belfast urban area, complies with the Regulations, aligns with the population distribution throughout Belfast, and has been adopted for Round 4.

The Round 4 Belfast Agglomeration has a total area of 208.5 km^2, representing a 0.9 km^2 decrease on the Round 3 Belfast Agglomeration boundary. The Belfast Agglomeration boundary for Round 4 was developed through merging and dissolving the Northern Ireland Statistics and Research Agency (NISRA) 2005 and 2015 settlement boundaries, then clipping the dissolved boundaries to the OSNI Largescale NI boundary.

The Round 4 Belfast Agglomeration data capture extent was developed though buffering the agglomeration boundary by 3km and clipping to the OSNI Largescale NI boundary.

3.1.2 Airport Modelling Extents

Under the Regulations, major airports shall be identified and mapped as "*civil airports which have more than 50,000 movements per year (a movement being a take-off or a landing), excluding those purely for training purposes on light aircraft*".

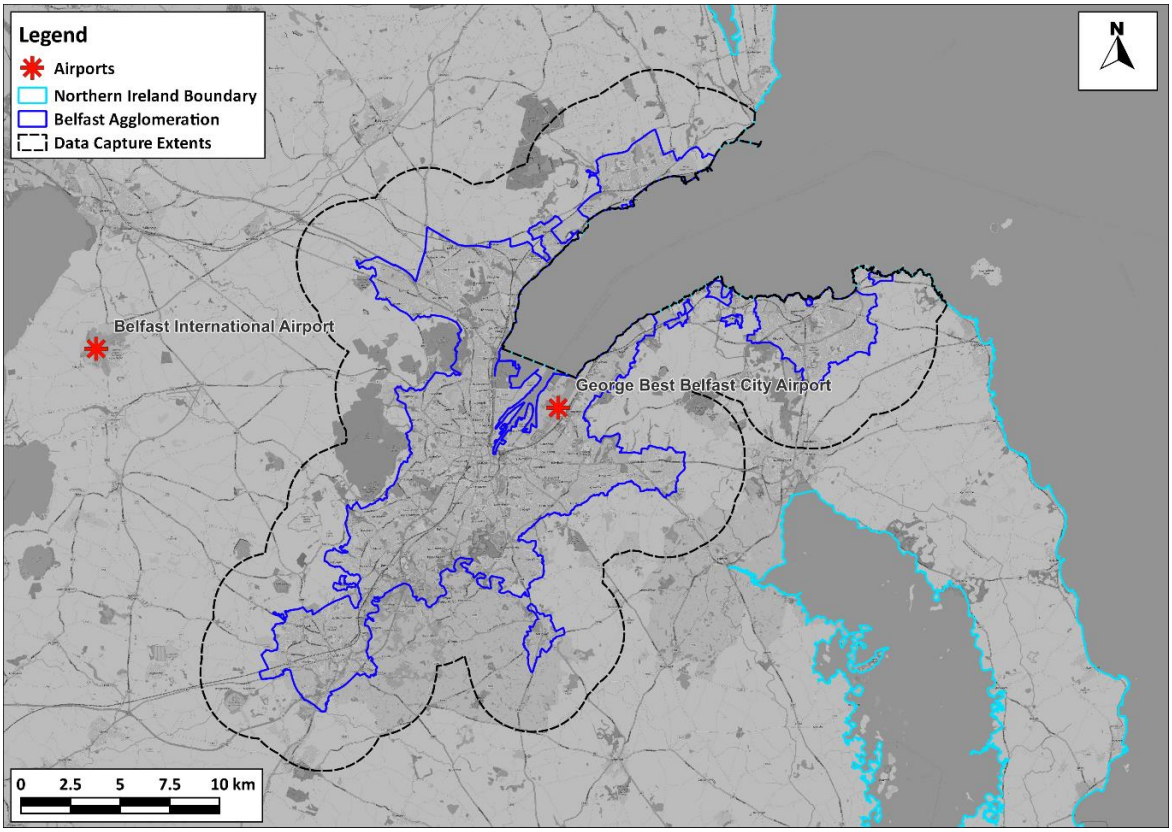
During the 2021 assessment year, both of Belfast City Airport and Belfast International Airports, which were major airports in the Round 3 assessment year of 2016, fell below the 50,000 movements per year threshold. However, considering that the reduction in annual movements during this period was influenced by COVID-19 related travel restrictions and the operational impacts of the pandemic, and therefore not fully representative, the airports have been included in the Round 4 noise mapping. This was agreed with the respective airport operators as the competent authorities

The spatial extents of the air noise assessment for both airports are based on consideration of potential flight paths where aircraft are likely to be operating at or below 10,000 ft.

Figure 1 presents the Round 4 Belfast Agglomeration, agglomeration data capture extents and the locations of Belfast City Airport and Belfast International Airport.

[8] https://www.legislation.gov.uk/nisr/2006/387/contents/made (Accessed November 2024)

Figure 1: Belfast Agglomeration Data Capture Extents, Including Belfast City and Belfast International Airports



4 Calculation Method for Round 4

4.1 Calculation Methods for Previous Rounds

- For all previous rounds of mapping, the calculation methodology described within "Report on Standard Method of Computing Noise Contours around Civil Airports", ECAC.CEAC Doc 29, 2nd Edition, July 1997, was used for aircraft noise calculations.

As discussed in **Section 2.1**, for Round 4 there is a requirement to use the Common Noise Assessment Methods in Europe (CNOSSOS-EU) methodology (equivalent to ECAC Doc 29 4th Edition, December 2016), which is somewhat different to the methodology used in previous rounds.

4.2 CNOSSOS-EU

4.2.1 Background

The European Commission published Directive 2015/996[9] in July 2015, which established common noise assessment methods according to Directive 2002/49/EC (the END). It replaced Annex II of the END, removing the Interim Methods and now requiring that Member States apply CNOSSOS-EU for the noise modelling of road, rail, aircraft and industrial sources.

Shortly after the publication of Directive 2015/996, some formatting and typographical errors were identified which were addressed in the Corrigendum[10] which was published in January 2018.

The Netherlands National Institute for Public Health and the Environment (RIVM) had identified a number of issues with the CNOSSOS-EU method after undertaking research into the method as set out in Directive 2015/996. Following this, in 2018 the EC approved the formation of a technical working group. The technical working group consisted of a number of representatives that were nominated by EU member states, whose task was to address the issues identified in CNOSSOS-EU through propose some refinements to the method.

In April 2019, the working group published a report (Amendments for CNOSSOS-EU, Descriptions of issues and proposed solutions, RIVM Letter report 2019-0023[11]), which led to the EC drafting Delegated Directive (EU) 2021/1226[12] that set out a number of refinements to be applied to Annex II of the END. Following public consultation, and consultation with The Noise Expert Group[13], it was published in December 2020 with publication in the Official Journal in July 2021.

4.2.2 Calculation of Aircraft Noise

A workshop on aircraft noise prediction was held in January 2010, allowing EU experts to discuss the aircraft noise module of CNOSSOS-EU. This event was organised by the European Commission's Joint Research Centre (JRC) in liaison with the Directorate-General for the Environment (DG ENV) and the European Environment Agency (EEA).

The discussions acknowledged that aircraft noise modelling is distinct in comparison to road, rail and industry sources. While there are well established performance databases and prediction methods at international level, there is scope for improving the existing methods and procedures. Additionally, it was recognised that "*worldwide resources to develop and maintain aircraft noise modelling tools are limited,*

[9] https://eur-lex.europa.eu/eli/dir/2015/996/oj (Accessed November 2024)
[10] https://www.ecac-ceac.org/documents/ecac-documents-and-international-agreements (Accessed November 2024)
[11] https://www.rivm.nl/bibliotheek/rapporten/2019-0023.pdf (Accessed November 2024)
[12] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021L1226 (Accessed November 2024)
[13] https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&do=groupDetail.groupDetail&groupID=2809&Lang=EN (Accessed November 2024)

and as such it is critical to increase synergies among the stakeholders affected and maximise the commonality of both the methodology and the input data".

A Working Group (WG) was set up for aircraft noise (WG 4), tasked with continuing the previous work to make formal recommendations on the aircraft calculation method.

There was a requirement that the methodology must be used by the airport operating restrictions Directive (Directive 2002/30/EC[14]). Two methods were considered:

1. ECAC Doc. 29 3rd Edition – which was published in 2005 and provides a recommended method for calculating aircraft noise around civil airports; and
2. AzB 2008 – which is a German tool developed for the enforcement of the German Act for Protection against Aircraft Noise, which came into force in 2007.

WG 4 found that whilst AzB 2008 and its database could be developed to meet need the needs of the method used for calculating aircraft noise for strategic noise mapping, ECAC Doc. 29 3rd Edition and the International Civil Aviation Organization Aircraft Noise and Performance (ICAO ANP) database version 2 *"were better suited to the additional requirements imposed by Directive 2002/30/EC at this time."*

WG 4 concluded that *"ECAC Doc. 29 3rd Edition (December 2005) and the ICAO ANP database version 2 are therefore recommended as the aircraft noise calculation method and database for incorporation into Annex II of the Environmental Noise Directive 2002/49/EC (END)."*

Delegated Directive (EU) 2021/1226 subsequently amended Annex II of the END to bring the CNOSSOS-EU method for aircraft noise calculations into alignment with ECAC Doc 29 4th Edition, December 2016.

4.2.3 Quality Criteria

Section 2.1.2 of CNOSSOS-EU sets out a quality framework. It states the following on the accuracy of input values:

"All input values affecting the emission level of a source shall be determined with at least the accuracy corresponding to an uncertainty of ± 2 dB(A) in the emission level of the source (leaving all other parameters unchanged)."

The approach to assembling the noise model for Northern Ireland had the objective of ensuring that the source emission levels are calculated in a manner which conforms to the CNOSSOS-EU ± 2.0 dB(A) quality criteria.

[14] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32002L0030 (Accessed November 2024)

5 Dataset Specification and Requirements

The calculation method and the need to create a comprehensive 3D model of buildings, terrain, and bridges for noise propagation dictate the dataset specifications and requirements. The dataset specification and requirements are summarised briefly in this section of the report, with full details provided in the Stage 1 Report.

5.1 CNOSSOS-EU:2020 Model Requirements

5.1.1 Propagation Model

The propagation model consists of features representing terrain elevations (breaklines, spot heights, equal height contours), bridges, buildings, ground cover and meteorological data. Therefore, geospatial objects which can be processed in GIS are required to represent these features.

5.1.2 Aircraft Model Requirements

For aircraft noise modelling, CNOSSOS-EU:2020 requires information on aspects such as aircraft movement data, noise records from fixed and/or temporary noise monitoring terminals, runway information (length and width of runway, runway end coordinates, threshold crossing elevation and glide slope etc.) and arrival and departure flight path information.

6 Noise Modelling Platform

6.1.1 Airport Modelling Platform and Calculation Extents

Airport noise calculations were performed using the Federal Aviation Authority (FAA) Aviation Environmental Design Tool (AEDT 3e) modelling software, which implements the calculation methodology described in the fourth edition of ECAC Doc.29, the same as the methodology set out within Annex II of the END. It has been used for the modelling of aircraft noise at Belfast International Airport and Belfast City Airport. AEDT allows the user to build up a noise model introducing external data such as airfield information. The airspace information is provided by introducing the flight paths into the noise model. Once the airport is built and the tracks are defined the user can add the operation data which includes date and time, operation type, airframe model, flight profile, runway, and flight track.

Calculation Efficiency Settings

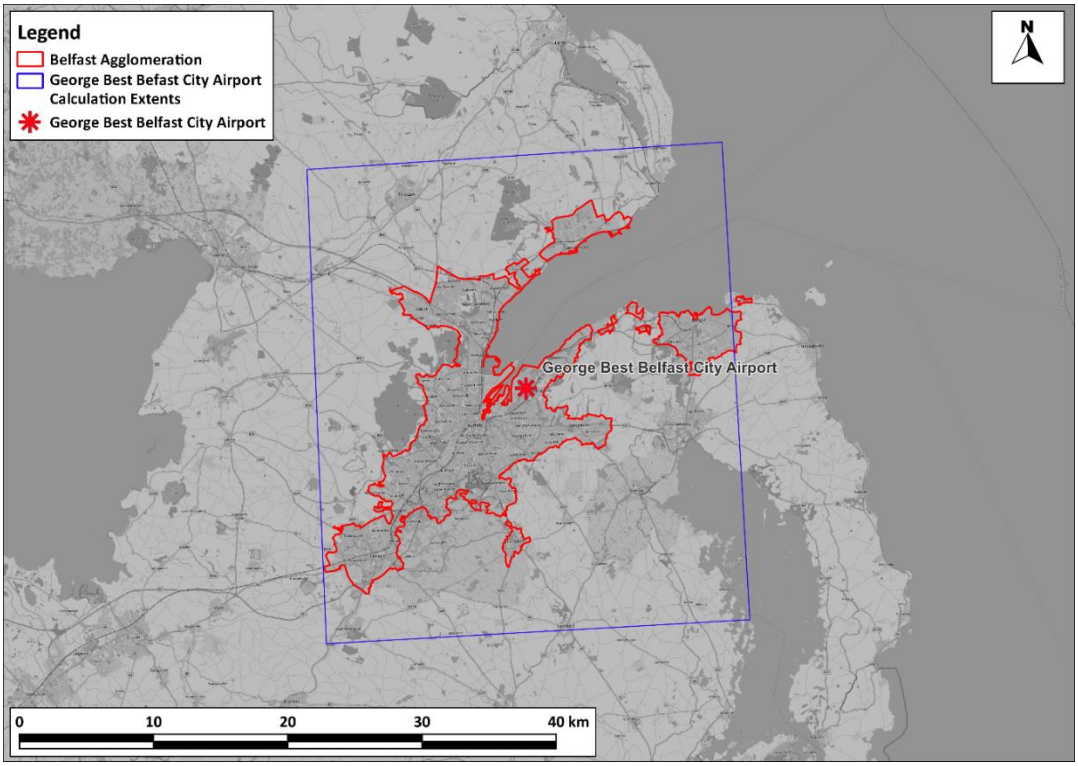
AEDT does not provide the user with the ability to apply calculation efficiency settings such as setting a dynamic error margin. However, given the extents of aircraft models tend to cover a very large area, it is standard practice to define a noise calculation grid of 50m x 50m (rather than 10m x 10m) in order to reduce calculation times. This approach has been applied to the Northern Ireland Round 4 airport noise models, with post-processing of results used to interpolate the output results to the required 10m x 10m spatial resolution.

Calculation Regions

Typically, aircraft noise model calculation extents are defined through determining where aircraft flights are below 7,000 feet, which usually ensures that noise calculations will be performed down to the levels required (in this case 55 dB L_{den} and 50 dB L_{night} as required by the Regulations). For the Northern Ireland Round 4 airport models, the areas in which aircraft are identified to be flying at altitudes below 10,000 feet were identified, with the calculation extents set to be slightly beyond these regions to ensure that noise levels will be calculated down to the required levels.

Figure 2 presents the calculation extents for Belfast City Airport.

Figure 2: Belfast City Calculation Extents



Model Calculation Run Scenarios

The Regulations requires L_{den} and L_{night} results to be produced for airport sources, however AEDT does not output L_{den} results directly, rather L_{den} is calculated from the L_{day}, L_{eve} and L_{night} results using post-processing.

Additionally, it is not possible (or necessary) to run façade receiver calculations in AEDT. Therefore, only grid calculations were performed as summarised in **Table 1**.

Table 1: Model Calculation Run Scenarios

Scenario	Noise Source	Output Noise Metrics*	Results Format
1	Belfast City Airport	L_{day}, L_{eve}, L_{night} and $L_{Aeq,16h}$	50m grid

*The L_{day}, L_{eve} and L_{night} results are post-processed to calculate L_{den}

Post Processing of Model Outputs

As noted above, the AEDT calculation software does not output results for the L_{den} noise metric, therefore L_{den} is calculated from L_{day}, L_{eve} and L_{night} as follows:

$$L_{den} = \left(\frac{1}{24}\left(12 \times 10^{\frac{L_{day}}{10}} + 4 \times 10^{\frac{L_{eve+5}}{10}} + 4 \times 10^{\frac{L_{night+10}}{10}}\right)\right)$$

The AEDT results are output in a uniform 50m x 50m array of grid points. The array of grid points is then converted into a raster grid, with bilinear interpolation applied to increase the spatial resolution from 50m x 50m to 10m x 10m.

7 Exposure Statistics

The Environmental Noise Regulations (Northern Ireland) 2006 (Regulations[15]), as amended by the Environmental Noise (Amendment) (NI) Regulations 2018[16], transposed European Commission Directive 2002/49/EC[17], known as the Environmental Noise Directive (END), into Northern Irish law. The Regulations make reference to Annex VI of the END, which sets out the exposure statistics that are required to be reported.

The END state that the following exposure statistics are required:

For Agglomerations:

"The estimated number of people (in hundreds) living in dwellings that are exposed to each of the following bands of values of L_{den} in dB 4 m above the ground on the most exposed façade: 55-59, 60-64, 65-69, 70-74, > 75, separately for noise from road, rail and air traffic, and from industrial sources. The figures must be rounded to the nearest hundred (e.g. 200 = between 150 and 249; 100 = between 50 and 149; 0 = less than 50)."

And:

"The estimated total number of people (in hundreds) living in dwellings that are exposed to each of the following bands of values of L_{night} in dB 4 m above the ground on the most exposed façade: 50-54, 55-59, 60-64, 65-69, > 70, separately for road, rail and air traffic and for industrial sources."

For major roads, major railways and major airports:

"The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to each of the following bands of values of L_{den} in dB 4 m above the ground and on the most exposed façade: 55-59, 60-64, 65-69, 70-74, > 75."

And:

"The estimated total number of people (in hundreds) living outside agglomerations in dwellings that are exposed to each of the following bands of values of Lnight in dB 4 m above the ground and on the most exposed façade: 50-54, 55-59, 60-64, 65-69, > 70."

And:

"The total area (in km^2) exposed to values of L_{den} higher than 55, 65 and 75 dB respectively. The estimated total number of dwellings (in hundreds) and the estimated total number of people (in hundreds) living in each of these areas must also be given. Those figures must include agglomerations."

7.1 Method

The sections below describe the method for assigning exposure levels to populations and dwellings. The number of dwellings and people in dwellings assigned to the buildings within the model were determined through analysis of OSNI Pointer, OSNI Fusion and CENSUS 2021 data, with full details provided in the Stage 1 Report.

7.1.1 Aircraft Exposure Statistics

For aircraft noise, the method for assigning calculated levels to dwellings and people in dwellings is based upon the calculated noise grid. The processing steps are summarised below:

[15] https://www.legislation.gov.uk/nisr/2006/387/contents/made (Accessed November 2024)
[16] https://www.legislation.gov.uk/nisr/2018/190/made (Accessed November 2024)
[17] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32002L0049 (Accessed November 2024)

1. Extract residential, hospital and school buildings from the processed buildings dataset (as described in the Stage 1 Report) and convert the building polygons to points (where a point is generated for every building at its centre of gravity)
2. Sample the calculated level from the interpolated 10m x 10m raster grid (as described in **Section 6.1.1**) at the building points
3. Assign the dwellings and number of people in the dwellings to the sampled level

7.2 Exposure Statistics

The tables in the following sections summarises the population exposure statistics from the road traffic, railway, industry and aircraft sources as required by the Regulations.

Details of the estimated area exposed, as well as the number of dwellings and noise sensitive buildings exposed to noise bands, in **Appendix A1**. The estimated exposure statistics calculated in 1 dB bands across the noise metrics L_{day}, L_{eve}, L_{night}, $L_{Aeq,16hr}$ and L_{den} are provided in **Appendix A2**.

7.2.1 Belfast Agglomeration Statistics

Table 2: Belfast City Airport – Population Exposed

Noise Exposure (dB)	L_{den}	L_{day}	$L_{evening}$	$L_{Aeq,16hr}$	L_{night}
50-54	N/A	N/A	N/A	N/A	0
55-59	2,383	3,098	0	1,837	0
60-64	0	0	0	0	0
65-69	0	0	0	0	0
70-74*	0	0	0	0	0
>=75	0	0	0	0	N/A

*Represents >=70 dB for L_{night}

8 Discussion and Conclusions

It is important to reiterate that the datasets and calculation methodology, and therefore calculation extents for deriving the statistics found in the Round Four report differ from those used in previous rounds of noise mapping.

The first three rounds of strategic noise maps have been developed using computation methods set out in Environmental Noise Regulations 2006 (S.I. 140/2006) (ECAC Doc 29 2nd Edition), however Round 4 requires the use of the Common Noise Assessment Methods for Europe (CNOSSOS-EU) method (ECAC Doc 29 4th Edition). It is therefore not appropriate to make direct comparisons between the exposure statistics derived for Round 4 with those derived for earlier rounds due to the changes both in the calculation and exposure assessment methodologies.

8.1 Key Observations

8.1.1 Belfast Agglomeration

The extent of the Round 4 Belfast Agglomeration covers 208.5km^2, with 1.73 km^2 (<1% of the agglomeration area) exposed to noise levels from Belfast City Airport greater than 55 dB L_{den}. During the night-time, less than 1 km^2 (<1% of the agglomeration area) is exposed to noise levels greater than 50 dB L_{night}.

An estimated total of 1,207 dwellings are exposed to noise levels greater than 55 dB L_{den} from Belfast City Airport within the Belfast Agglomeration, which statistically contain an estimated population of 2,383. During the night-time period, it is estimated that no dwellings are exposed to noise levels greater than 50 dB L_{night}.

The total number of school buildings exposed to noise levels greater than 55 dB L_{den} and 50 dB L_{night} from Belfast City Airport within the Belfast Agglomeration are 2 and 0, respectively.

The total number of hospital buildings exposed to noise levels greater than 55 dB L_{den} and 50 dB L_{night} from Belfast City Airport within the Belfast Agglomeration are 0 and 0, respectively.

Appendices

A1 Exposure Statistics – 5 dB Bands

A1.1 Agglomeration Statistics

Table A1.1: Belfast City Airport – Area of Noise Bands in km²

Noise Exposure (dB)	L_{den}	L_{day}	$L_{evening}$	$L_{Aeq,16hr}$	L_{night}
50-54	N/A	N/A	N/A	N/A	0
55-59	2	2	1	2	0
60-64	0	0	0	0	0
65-69	0	0	0	0	0
70-74*	0	0	0	0	0
>=75	0	0	0	0	N/A

*Represents >=70 dB for L_{night}

Table A1.2: Belfast City Airport – Number of Dwellings

Noise Exposure (dB)	L_{den}	L_{day}	$L_{evening}$	$L_{Aeq,16hr}$	L_{night}
50-54	N/A	N/A	N/A	N/A	0
55-59	1,207	1,581	0	925	0
60-64	0	0	0	0	0
65-69	0	0	0	0	0
70-74*	0	0	0	0	0
>=75	0	0	0	0	N/A

*Represents >=70 dB for L_{night}

Table A1.3: Belfast City Airport – Number of School Buildings

Noise Exposure (dB)	L_{den}	L_{day}	$L_{evening}$	$L_{Aeq,16hr}$	L_{night}
50-54	N/A	N/A	N/A	N/A	0
55-59	2	2	0	2	0
60-64	0	0	0	0	0
65-69	0	0	0	0	0
70-74*	0	0	0	0	0
>=75	0	0	0	0	N/A

*Represents >=70 dB for L_{night}

Table A1.4: Belfast City Airport – Number of Hospital Buildings

Noise Exposure (dB)	L_{den}	L_{day}	$L_{evening}$	$L_{Aeq,16hr}$	L_{night}
50-54	N/A	N/A	N/A	N/A	0
55-59	0	0	0	0	0
60-64	0	0	0	0	0
65-69	0	0	0	0	0
70-74*	0	0	0	0	0
>=75	0	0	0	0	N/A

*Represents >=70 dB for L_{night}

A2 Exposure Statistics – 1 dB Bands

A2.1 Agglomeration Statistics

Table A2.1: Belfast City Airport – Population Exposed

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
50-51	5,565.01	4,879.06	3,066.07	2,680.34	0.00
51-52	4,574.29	4,807.53	2,608.08	4,044.38	0.00
52-53	3,273.78	3,401.04	1,919.30	2,880.03	0.00
53-54	2,846.50	2,859.81	898.61	2,884.70	0.00
54-55	2,529.80	2,595.19	155.94	2,263.11	0.00
55-56	1,455.30	1,883.63	0.00	1,315.62	0.00
56-57	927.62	1,090.08	0.00	521.67	0.00
57-58	0.00	123.96	0.00	0.00	0.00
58-59	0.00	0.00	0.00	0.00	0.00
59-60	0.00	0.00	0.00	0.00	0.00
60-61	0.00	0.00	0.00	0.00	0.00
61-62	0.00	0.00	0.00	0.00	0.00
62-63	0.00	0.00	0.00	0.00	0.00
63-64	0.00	0.00	0.00	0.00	0.00
64-65	0.00	0.00	0.00	0.00	0.00
65-66	0.00	0.00	0.00	0.00	0.00
66-67	0.00	0.00	0.00	0.00	0.00
67-68	0.00	0.00	0.00	0.00	0.00
68-69	0.00	0.00	0.00	0.00	0.00
69-70	0.00	0.00	0.00	0.00	0.00
70-71	0.00	0.00	0.00	0.00	0.00
71-72	0.00	0.00	0.00	0.00	0.00
72-73	0.00	0.00	0.00	0.00	0.00
73-74	0.00	0.00	0.00	0.00	0.00
74-75	0.00	0.00	0.00	0.00	0.00
75-76	0.00	0.00	0.00	0.00	0.00
76-77	0.00	0.00	0.00	0.00	0.00

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
77-78	0.00	0.00	0.00	0.00	0.00
78-79	0.00	0.00	0.00	0.00	0.00
79-80	0.00	0.00	0.00	0.00	0.00
>=80	0.00	0.00	0.00	0.00	0.00

Table A2.2: Belfast City Airport – Number of Dwellings

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
50-51	3,036	2,642	1,673	1,468	0
51-52	2,492	2,616	1,367	2,207	0
52-53	1,814	1,875	994	1,592	0
53-54	1,529	1,566	442	1,531	0
54-55	1,319	1,357	79	1,176	0
55-56	740	973	0	669	0
56-57	467	543	0	256	0
57-58	0	65	0	0	0
58-59	0	0	0	0	0
59-60	0	0	0	0	0
60-61	0	0	0	0	0
61-62	0	0	0	0	0
62-63	0	0	0	0	0
63-64	0	0	0	0	0
64-65	0	0	0	0	0
65-66	0	0	0	0	0
66-67	0	0	0	0	0
67-68	0	0	0	0	0
68-69	0	0	0	0	0
69-70	0	0	0	0	0
70-71	0	0	0	0	0
71-72	0	0	0	0	0
72-73	0	0	0	0	0
73-74	0	0	0	0	0
74-75	0	0	0	0	0
75-76	0	0	0	0	0
76-77	0	0	0	0	0
77-78	0	0	0	0	0
78-79	0	0	0	0	0

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
79-80	0	0	0	0	0
>=80	0	0	0	0	0

Table A2.3: Belfast City Airport – Number of School Buildings

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
50-51	3	5	2	3	0
51-52	12	5	2	11	0
52-53	3	10	1	1	0
53-54	0	0	1	3	0
54-55	4	4	0	1	0
55-56	1	1	0	2	0
56-57	1	1	0	0	0
57-58	0	0	0	0	0
58-59	0	0	0	0	0
59-60	0	0	0	0	0
60-61	0	0	0	0	0
61-62	0	0	0	0	0
62-63	0	0	0	0	0
63-64	0	0	0	0	0
64-65	0	0	0	0	0
65-66	0	0	0	0	0
66-67	0	0	0	0	0
67-68	0	0	0	0	0
68-69	0	0	0	0	0
69-70	0	0	0	0	0
70-71	0	0	0	0	0
71-72	0	0	0	0	0
72-73	0	0	0	0	0
73-74	0	0	0	0	0
74-75	0	0	0	0	0
75-76	0	0	0	0	0
76-77	0	0	0	0	0
77-78	0	0	0	0	0
78-79	0	0	0	0	0

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
79-80	0	0	0	0	0
>=80	0	0	0	0	0

Table A2.4: Belfast City Airport – Number of Hospital Buildings

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
50-51	0	0	0	0	0
51-52	0	0	0	0	0
52-53	0	0	0	0	0
53-54	0	0	0	0	0
54-55	0	0	0	0	0
55-56	0	0	0	0	0
56-57	0	0	0	0	0
57-58	0	0	0	0	0
58-59	0	0	0	0	0
59-60	0	0	0	0	0
60-61	0	0	0	0	0
61-62	0	0	0	0	0
62-63	0	0	0	0	0
63-64	0	0	0	0	0
64-65	0	0	0	0	0
65-66	0	0	0	0	0
66-67	0	0	0	0	0
67-68	0	0	0	0	0
68-69	0	0	0	0	0
69-70	0	0	0	0	0
70-71	0	0	0	0	0
71-72	0	0	0	0	0
72-73	0	0	0	0	0
73-74	0	0	0	0	0
74-75	0	0	0	0	0
75-76	0	0	0	0	0
76-77	0	0	0	0	0
77-78	0	0	0	0	0
78-79	0	0	0	0	0

Exposure Band	L_{den}	L_{day}	L_{eve}	$L_{Aeq,16hr}$	L_{night}
79-80	0	0	0	0	0
>=80	0	0	0	0	0

A3 Strategic Noise Maps

Figure A3.1: Belfast Agglomeration – Belfast City Airport – L_{den}

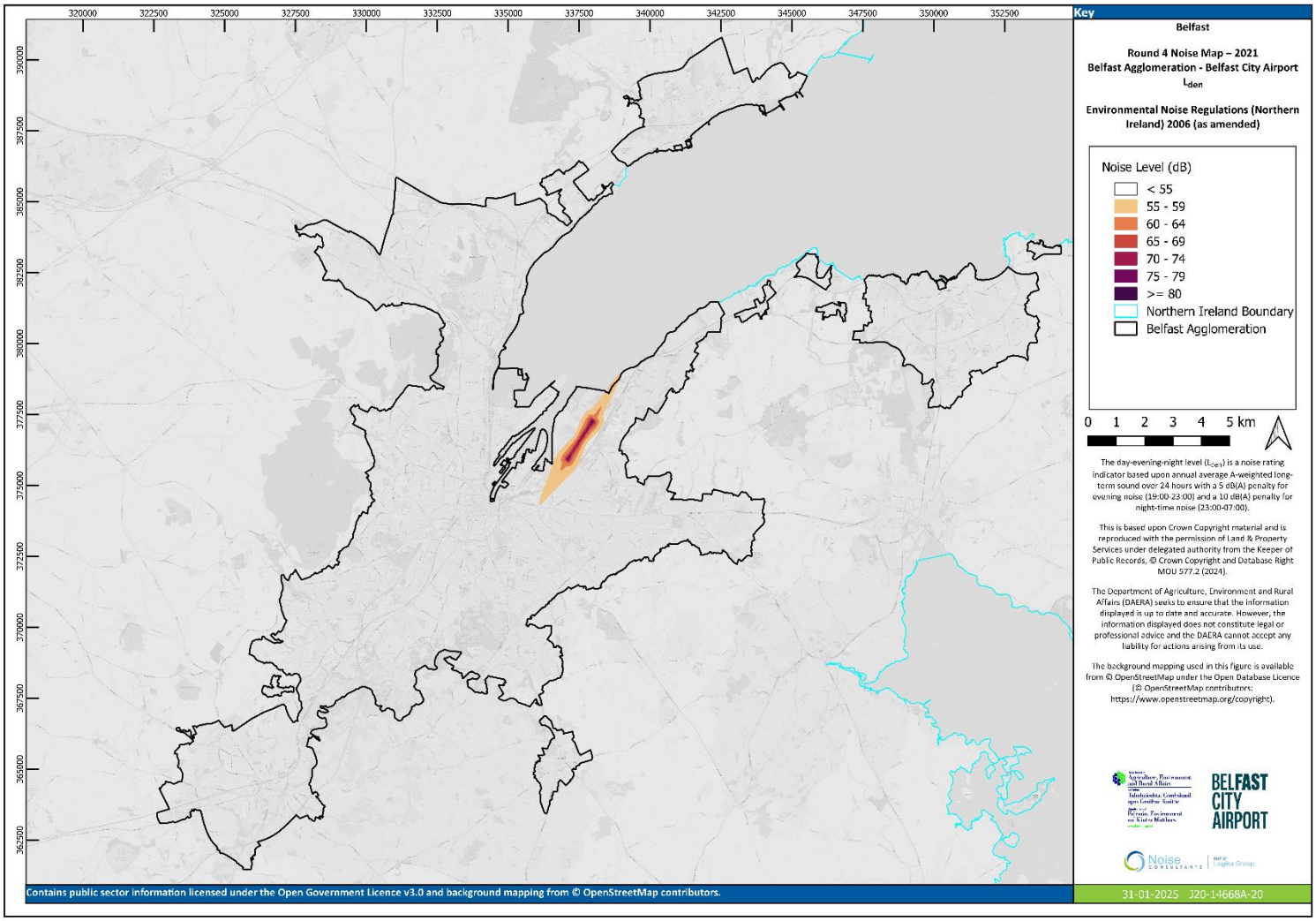


Figure A3.2: Belfast Agglomeration – Belfast City Airport – L_{day}

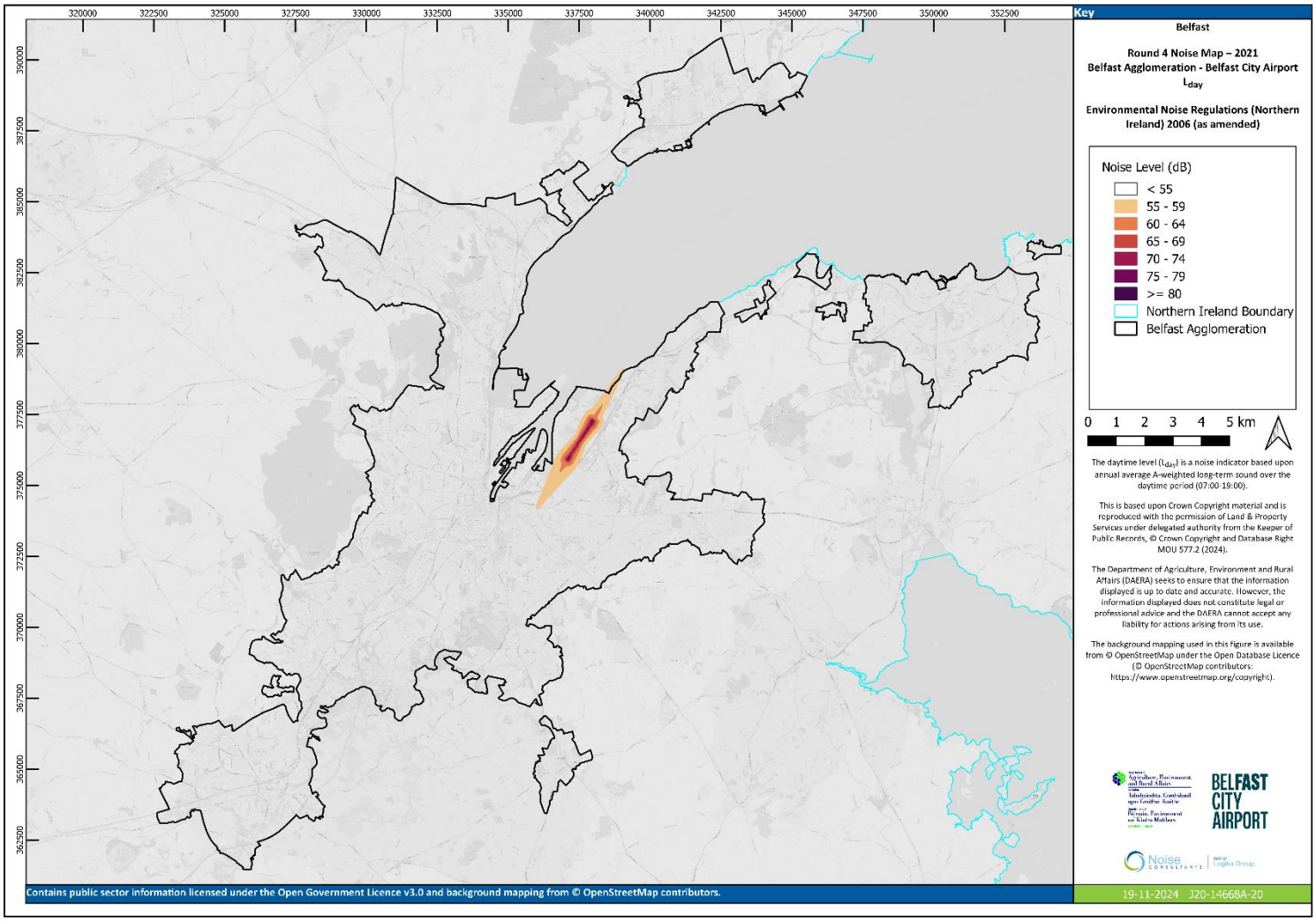


Figure A3.3: Belfast Agglomeration – Belfast City Airport – L_{eve}

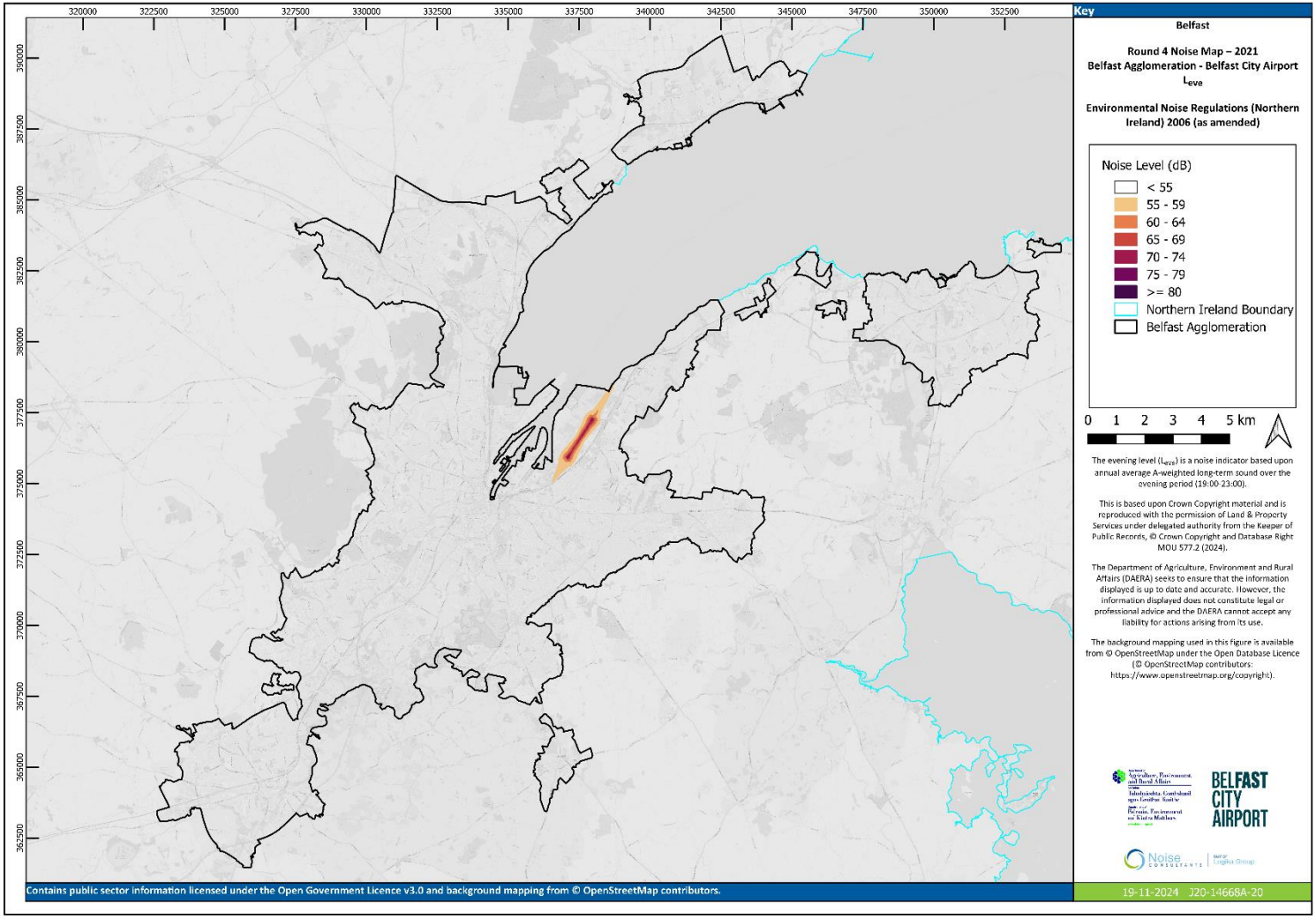


Figure A3.4: Belfast Agglomeration – Belfast City Airport – L_{night}

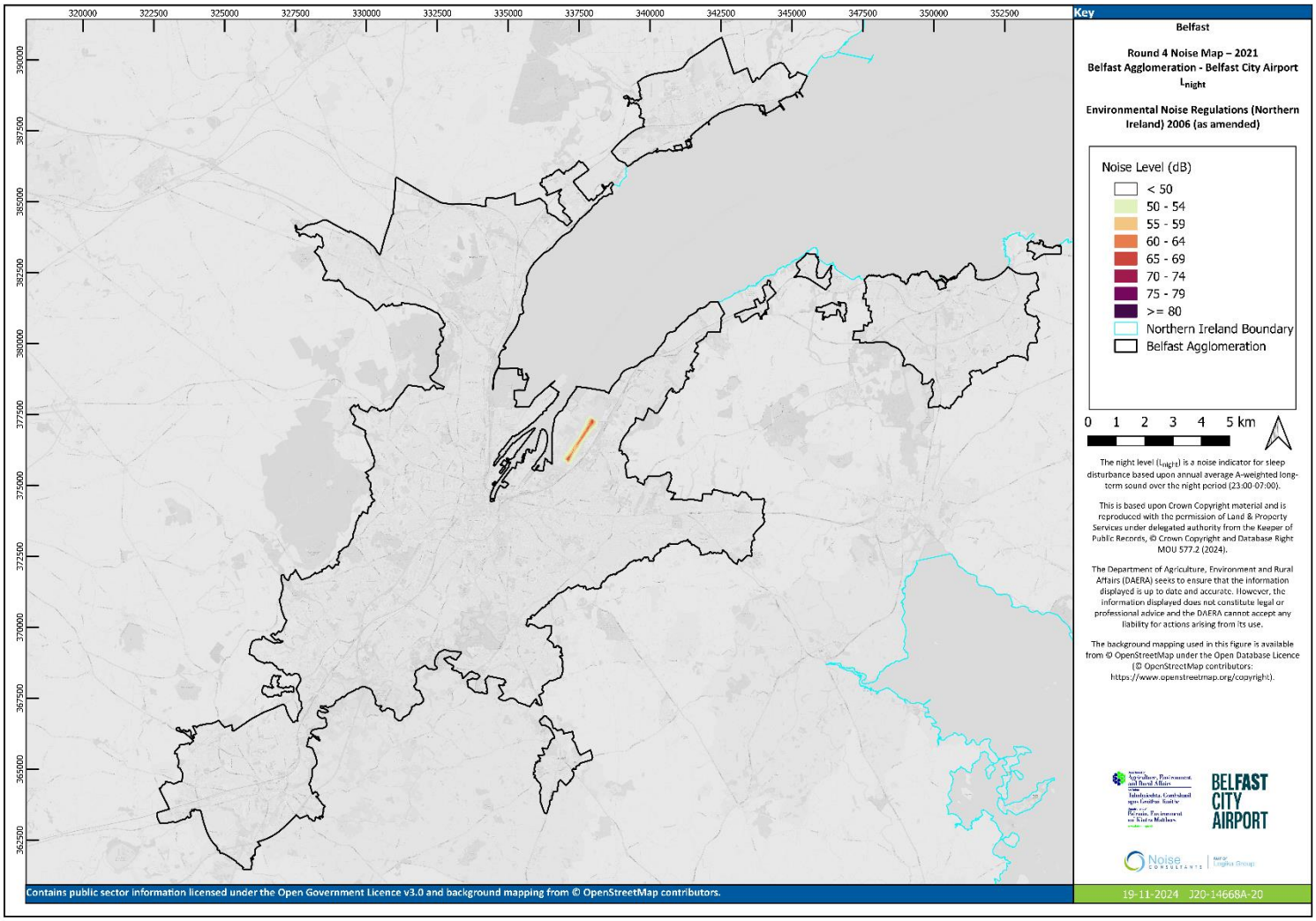
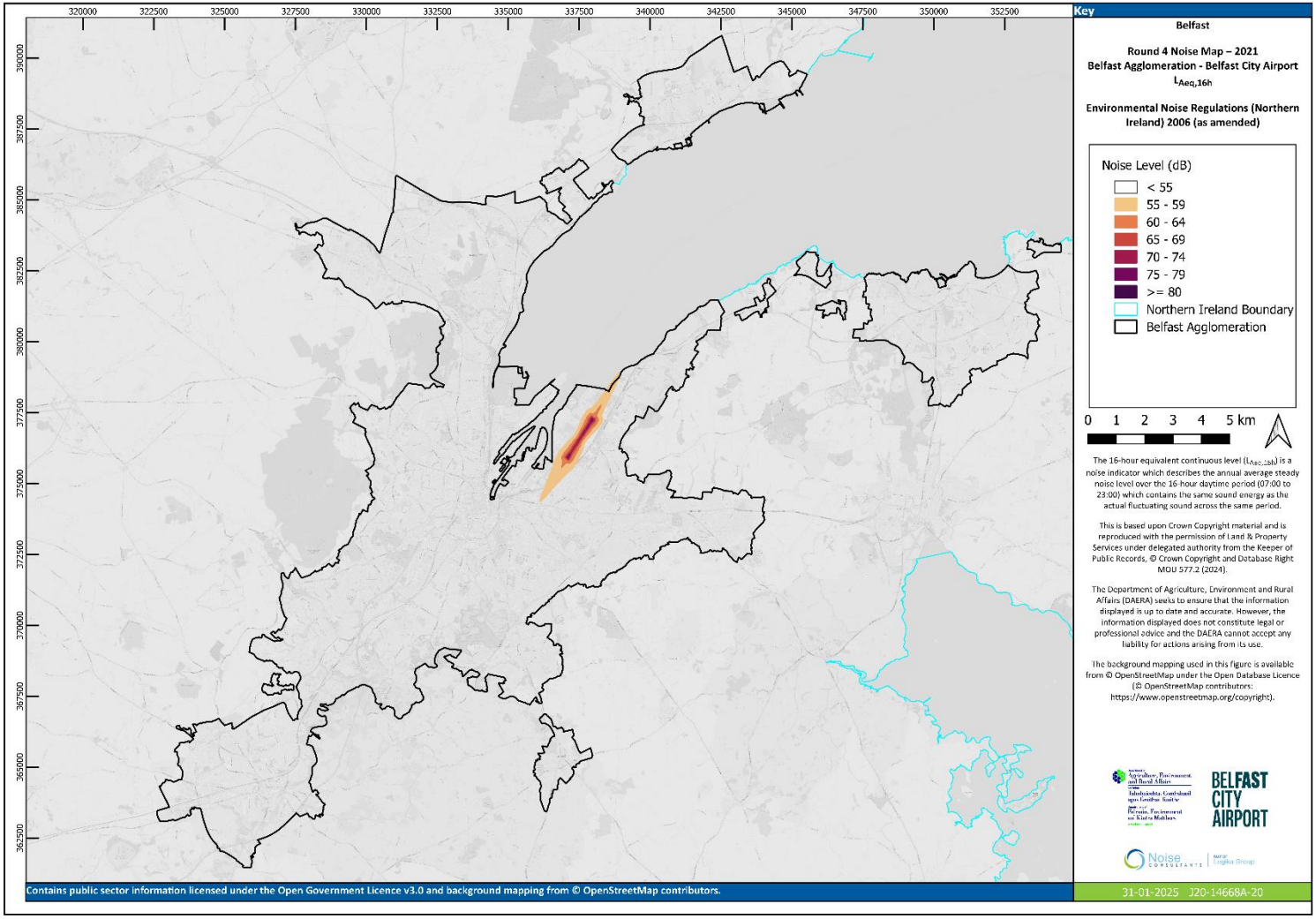


Figure A3.5: Belfast Agglomeration – Belfast City Airport – $L_{Aeq,16h}$



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