# Guidance Note for
# Strategic Noise Mapping (03/2025 May Draft)

# Part 3: Assessment of Noise Exposure
# & Harmful Effects

For the
European Communities (Environmental Noise)
Regulations 2018 (amended)

Published May 2025

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- Harmful Effects Assessment
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  - Harmful Effects
  - Assessment Bands and Thresholds
  - Reporting to EPA

# Introduction

# Introduction

- The objective of this Round 4 guidance note is to provide practical information, advice and guidance to designated Noise Mapping Bodies on the assessment of the results of strategic noise maps developed under the Environmental Noise Regulations.

- Guidance is issued as applicable only to the assessment of the results of strategic noise maps developed under the Regulations. The guidance updates, revises and replaces the previous Version 3 guidance of January 2025, and the revised Section 10 guidance of October 2017.

- The third part of the guidance note provides an overview of the requirements set out within the Regulations, roles and responsibilities of the noise mapping bodies, and sequence of activities to be undertaken during implementation of the Regulations.

- It provides guidance on the assessment of the results of the strategic noise maps to be undertaken to determine noise exposure and harmful effects, as required under the Regulations and to be reported to the EPA.

# Introduction

This third part of the Round 4 guidance is to be read alongside the other parts:

- Part 1: Requirements
- Part 2: Calculation Methodology & Noise Modelling
- Part 4: Publication and Reporting

This document should also be read in conjunction with the following:

- European Communities (Environmental Noise) Regulations 2018, S.I. No. 549 of 2018; and
- European Communities (Environmental Noise) (Amendment) Regulations 2021, S.I. No. 663 of 2021.

# Introduction

- This Round 4 Guidance Note should not be considered as a legal document, nor does it purport to provide comprehensive legal advice or guidance on all acoustical matters.

- If, in any circumstance, the recommendations contained in this guidance seem to be at variance with the Directive, or Regulations, then the text of the Directive must be applied in the first instance, or the Regulations in the second. In many situations it may be necessary to seek expert advice and assistance.

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# Introduction

- Publication and Reporting
  - Within one month of completing the strategic noise maps, there is a statutory requirement to:
    - Publish the maps and exposure results, and
    - Report them to the Agency

- This part of the Round 4 Guidance will provide information to support Noise Mapping Bodies (NMBs) in their statutory roles when publishing and reporting strategic noise mapping results.

# Noise Exposure Assessment

# Overview

- Requirements for Exposure Assessment

- Workflow for Exposure Assessment

- Classification of Noise Levels

- Noise Contours

- Area Exposed to Noise

- Buildings Exposed to Noise

- Harmful Effects

- Reporting to EPA

- Supporting Information

# Requirements for Exposure Assessment

# Requirements for Exposure Assessment

- Requirements are set out within the Regulations:

  - European Communities (Environmental Noise) Regulations 2018

  - European Communities (Environmental Noise) (Amendment) Regulations 2021
    - Fifth schedule
      - Estimated number of people living in buildings:
        - From 55 to >75 dB $L_{den}$
        - From 45 to >70 dB $L_{night}$

# Workflow for Exposure Assessment

# Workflow for Exposure Assessment

- Under Annex II it is now mandatory to calculate two types of receiver locations for land-based sources
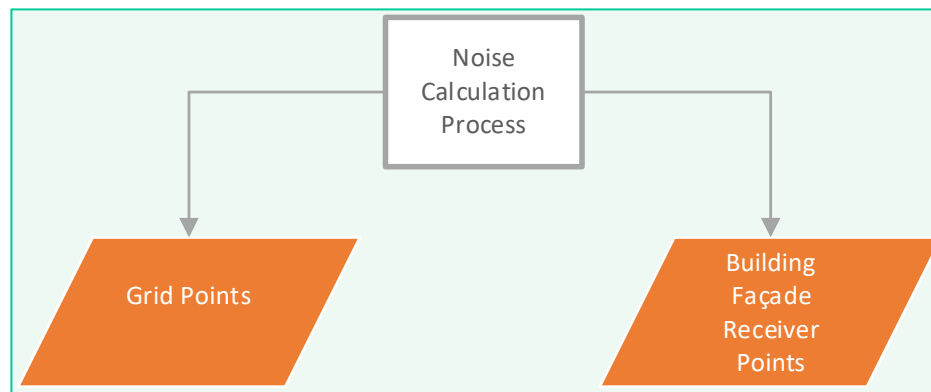


- For aircraft noise calculations are only undertaken at grid points

# Workflow for Exposure Assessment

- **Grid receivers**, 4.0m above the ground, two different grids are used for:
  - Noise contours for graphical maps;
    - Grid points inside buildings are used directly from the calculations, i.e. they are not to be assigned values
  - Area exposed to noise;
    - Grid points inside buildings must be assigned calculated level from lowest grid point outside the building

- **Façade receivers**, 4.0m above the ground:
  - Placed at 0.1m in front of the facades for buildings exposed to noise, such as:
    - Buildings containing dwellings; and
    - Buildings not containing dwellings such as schools and hospitals

# Workflow for Exposure Assessment

- Process results
  - per agglomeration (3), or
  - per Administrative Area (31)

**Note:**

Administrative Areas contain several Local Electoral Areas (LEA), which are equivalent to Eurostat Local Administrative Units (LAU)
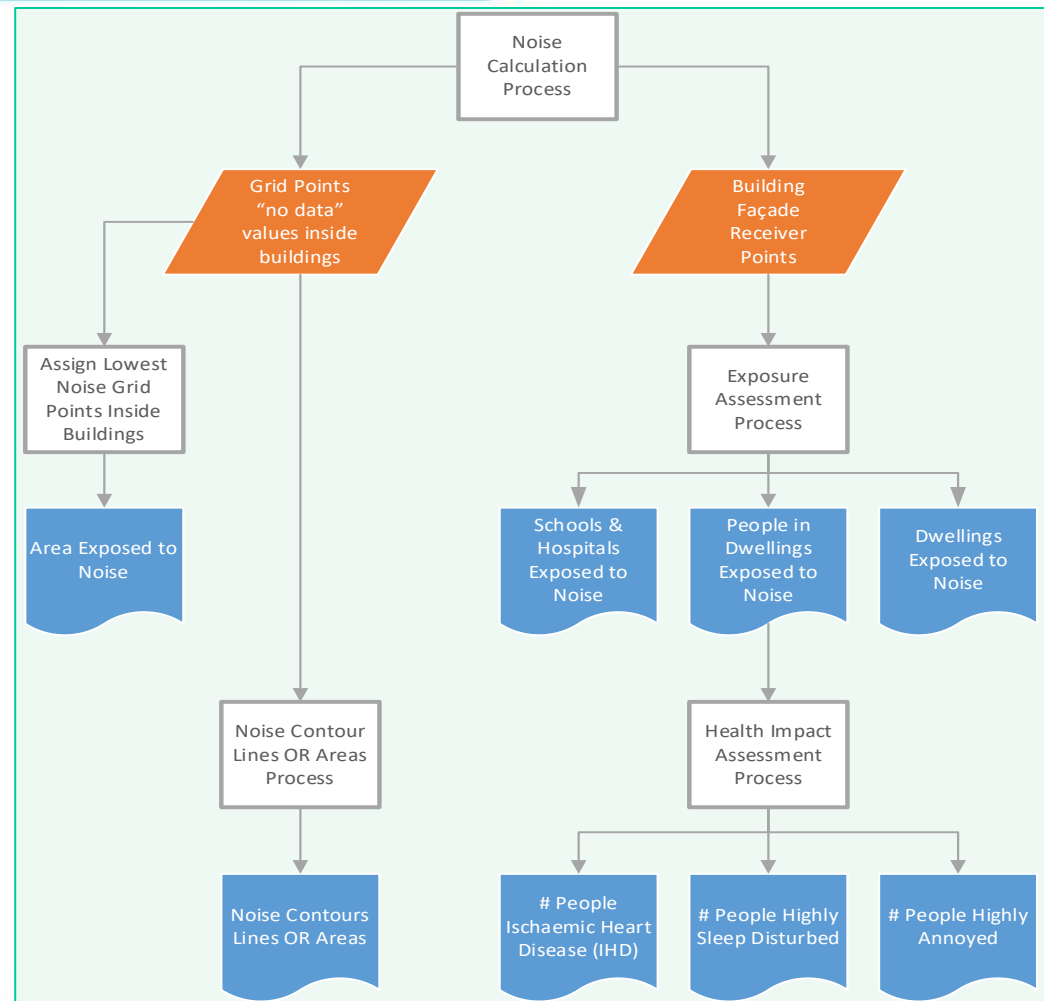
# Classification of Noise Levels

# Classification of Noise Levels

- Contour polygons
  - The line should represent the exact value
    - i.e. 55 dB $L_{den}$ or 60 dB $L_{night}$ etc
  - All class boundaries are .00,
    - i.e. 55-59 represents 55.00 to 59.99. etc.
  - This approach is consistent with the noise contour lines that describe the line where the value is 55.00, 60.00 or 65.00 dB
  - Rounding with MS Excel is not recommended, however the ROUNDDOWN, TRUNC or INT functions may be used to apply the class boundaries
  - This is consistent with EPA Guidance since Round 1 (R1)

# Classification of Noise Levels

- Number of exposed dwellings, people in dwellings, and area exposed:
  - Use the same class boundaries as recommended for noise contours
    - Query such as: 55.000000 to 59.999999; 60.000000 to 64.999999 etc, or
    - Pre-processed and assigned to 5 dB bands i.e. 59.99 classified to 55-59 band, 60.00 classified to 60-64 band
    - This could be accomplished in GIS, or in MS Excel using the ROUNDDOWN, TRUNC or INT functions.
  - This is consistent with EPA Guidance since R1

- The same concept applies for 1 dB bands used for Harmful Effects:
  - 55.00 to 55.99, 56.00 to 56.99 etc

# Noise Contours

# Noise Contours

- ## For aircraft noise:
  - Noise Contours are created using the process set out in CNOSSOS-EU

- ## For road, railway and industry noise:
  - Noise Contours are created from the grid results output from the noise calculations:
    - Grid points inside buildings have "no data" values
      - Such as: NULL, -999, -200, -180, 10.00 etc
    - Recommended approach is based on Delaunay triangulation and linear interpolation
      - Predictor may be used to generate contour polygons
        - It uses the same methodology recommended by the EEA
      - WeTransform with UBA Deutschland have developed a QGIS plug-in to process noise rasters and generate contour polygons:
        - https://github.com/wetransform/noise_raster

# Noise Contours

- The methodology is undertaken in the following steps:

  - Receiver grid points inside buildings with "no data" values are removed or ignored

  - Delaunay triangulation is used to create a triangulated irregular network (TIN) between the calculated grid points

  - Linear interpolation is run along each line in the TIN between grid points

  - Points along the lines with the same levels are connected to form contours

# Noise Contours

- This process may be undertaken in software in the following way:
  - Predictor
    - Results – Analyse Contours …
  - QGIS
    - Process can be replicated using the "Generate contours" plugin
  - ESRI ArcGIS
    - 3D Analyst Tools: "Data Management - TIN - Create TIN",
    - Followed by "Triangulated Surface - Surface Contour"

- The process should be undertaken for each reporting area, for each noise source:
  - Per agglomeration
  - Per Administrative Area (31) for major roads and major railways
    - Each contain several LEA (Eurostat LAU)

# Noise Contours

- Example of noise level contour polygons generated using recommended methodology

# Area Exposed to Noise

# Area Exposed to Noise

- For aircraft noise:
  - Area exposed to noise is based directly on the calculated grids
    - Buildings are not considered during the calculations, therefore a level is always calculated for a grid point, even if it would be inside a building

- For road, railway and industry noise:
  - Grid points inside buildings must be assigned calculated level from lowest grid point outside the building
  - Grid points inside buildings have "no data" values
    - Such as: NULL, -999, -200, -180, 10.00 etc
  - Recommended approach based on searching inside a buffered version of each building

# Area Exposed to Noise

- The methodology is undertaken in GIS in the following steps:
  - For each building create a buffer of 99.9% of grid increment (i.e., 9.99m)
  - For each buffer, search for all calculated grid receivers within the buffer, excluding grid receivers inside any building, and determine the lowest value
  - If no receiver points are found, include receiver points inside adjacent buildings; Substitute all grid receiver points inside the building with this lowest value
  - Repeat until all grid points inside buildings have been assigned levels
  - Depending on the grid resolution, the corresponding area is assigned to each calculation point in the grid i.e. each grid receiver = $100m^2$ for a 10 x 10m grid
  - Sum the areas for all grid points within each 5 dB band
- The process should be undertaken for each reporting area, for each noise source:
  - Per agglomeration
  - Per Administrative Area (31) for major roads and major railways
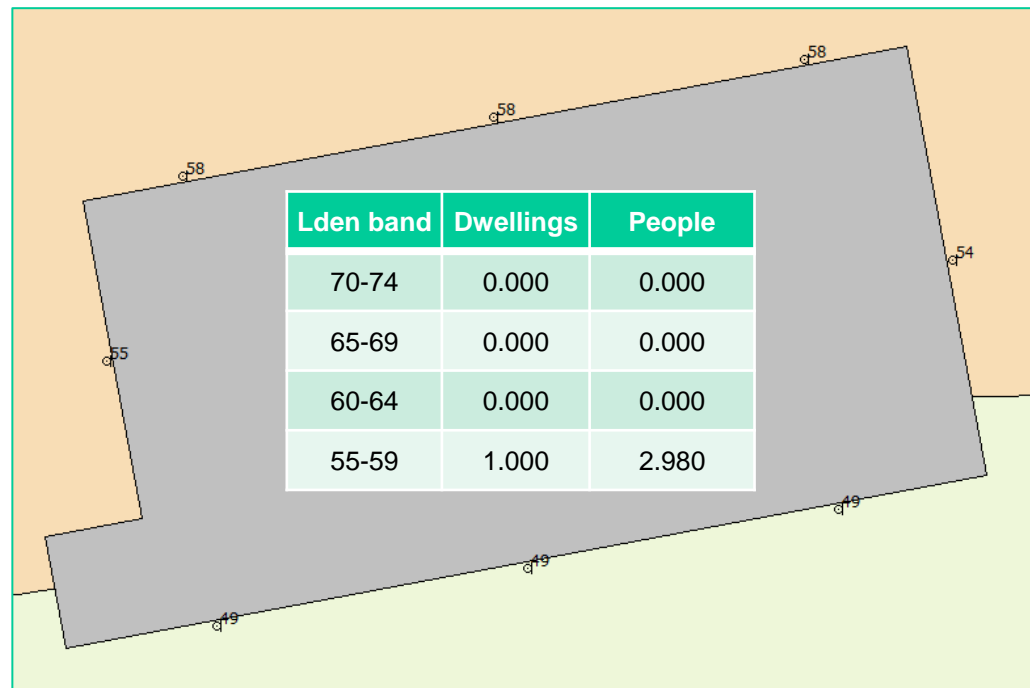    - Each contain several LEA (Eurostat LAU)

# Area Exposed to Noise - Examples
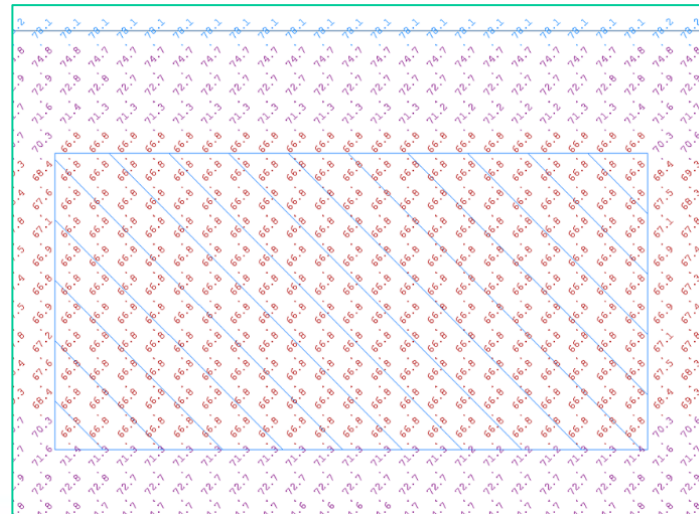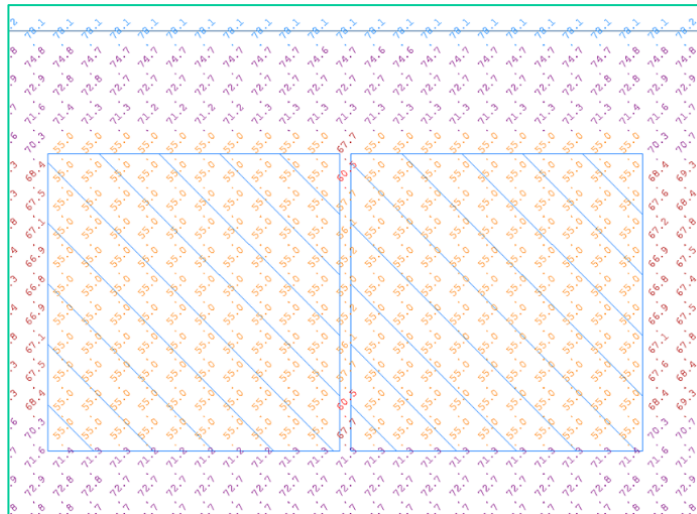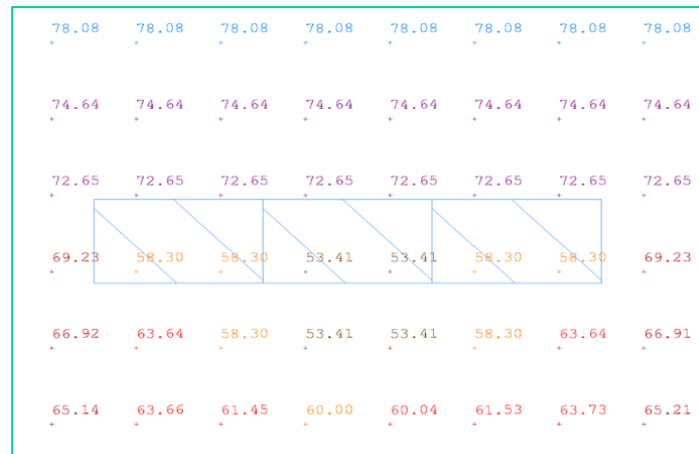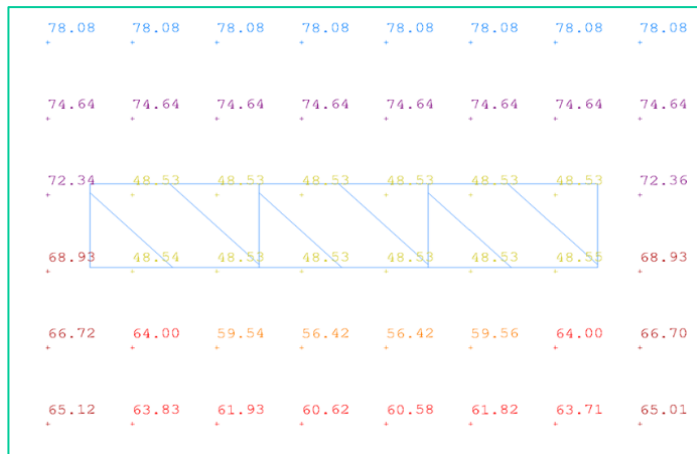
# Buildings Exposed to Noise

# Buildings Exposed to Noise

- For aircraft noise, grid results are used:
  - Dwellings & people living in dwellings
    - All dwellings, and people living in dwellings, within a building are associated to the noisiest noise receiver point falling within the building itself or, if not present, on the grid surrounding the building

  - Schools & hospitals
    - Each building is associated to the noisiest noise receiver point falling within the building itself or, if not present, on the grid surrounding the building

# Buildings Exposed to Noise

- For road, railway and industry noise, façade receiver results are used:
  - Dwellings & people living in dwellings:
    - A) Single dwelling buildings, & buildings where the location of dwellings is known:
      - All dwellings, and people living in dwellings, within a building are assigned the noisiest noise receiver point on its façades.
    - B) Multi-dwelling buildings where location of dwellings is not known:
      - B1) Each dwelling has a single exposed façade:
        - Dwellings, and people in dwellings, are assigned to receiver points weighted by the length of represented façade
      - B2) Each dwelling has multiple exposed façades, or if it is not know (default):
        - Receivers are split into upper and lower half sets, based on the median value for each building
        - Dwellings, and people in dwellings, are distributed equally to the receivers in the upper half set.
  - The total for dwellings, and people in dwellings, within each 5 dB band is the sum of the three sub-totals for each of the three building types
  - Assignment run twice, for $L_{den}$ and $L_{night}$ separately

# Buildings Exposed to Noise

- For road, railway and industry noise, façade receiver results are used:
  - Schools & hospitals
    - The building is associated to the noisiest receiver point on its façades. (Most exposed façade)

- The process may be undertaken in Predictor, or in GIS
  - It is recommended to store the number of people and dwellings in each noise band per building to 3 d.p.

- The process should be undertaken for each reporting area, for each noise source:
  - Per agglomeration
  - Per Administrative Area (31) for major roads and major railways
    - Each contain several LEA (Eurostat LAU)

# Buildings Exposed to Noise
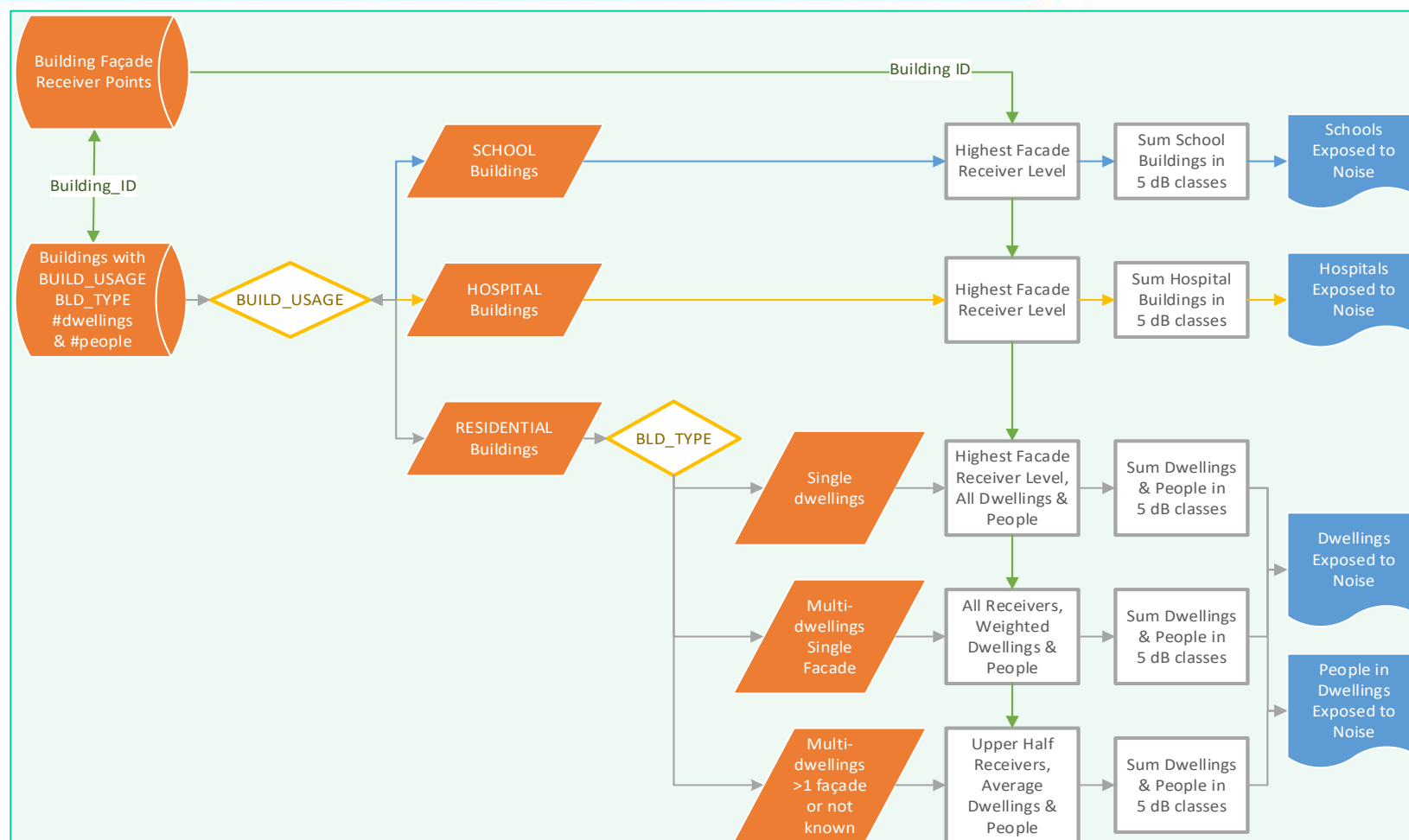
# Buildings Exposed to Noise

- A) Single dwellings, or single dwellings per floor
  - assigned to highest façade level

| Sound level | Dwellings | People |
|:---:|:---:|:---:|
| 57.8 | 1.00 | 2.98 |
| 57.7 | | |
| 57.7 | | |
| 55.4 | | |
| 54.1 | | |
| 48.9 | | |
| 48.8 | | |
| 48.7 | | |
| **Total** | **1.00** | **2.98** |

| Lden band | Dwellings | People |
|:---:|:---:|:---:|
| 70-74 | 0.000 | 0.000 |
| 65-69 | 0.000 | 0.000 |
| 60-64 | 0.000 | 0.000 |
| 55-59 | 1.000 | 2.980 |

# Buildings Exposed to Noise

- B1) Multi-dwellings each with single façade
  - assigned to receiver points weighted by proportion of total façade

| Sound level | Façade length | Dwellings | People |
|---|---|---|---|
| 72.0 | 5.00 | 1.670 | 3.587 |
| 70.0 | 5.00 | 1.670 | 3.587 |
| 70.0 | 5.00 | 1.670 | 3.587 |
| 70.0 | 5.00 | 1.670 | 3.587 |
| 69.8 | 5.00 | 1.670 | 3.587 |
| 65.9 | 5.00 | 1.670 | 3.587 |
| 65.4 | 5.00 | 1.670 | 3.587 |
| 61.6 | 5.00 | 1.670 | 3.587 |
| 61.4 | 5.00 | 1.670 | 3.587 |
| 58.4 | 5.00 | 1.670 | 3.587 |
| 58.3 | 4.88 | 1.630 | 3.501 |
| 57.4 | 5.00 | 1.670 | 3.587 |
| **Total** | **59.88** | **20.00** | **42.96** |

| Lden band | Dwellings | People |
|---|---|---|
| 70-74 | 6.680 | 14.349 |
| 65-69 | 5.010 | 10.762 |
| 60-64 | 3.340 | 7.174 |
| 55-59 | 4.970 | 10.675 |
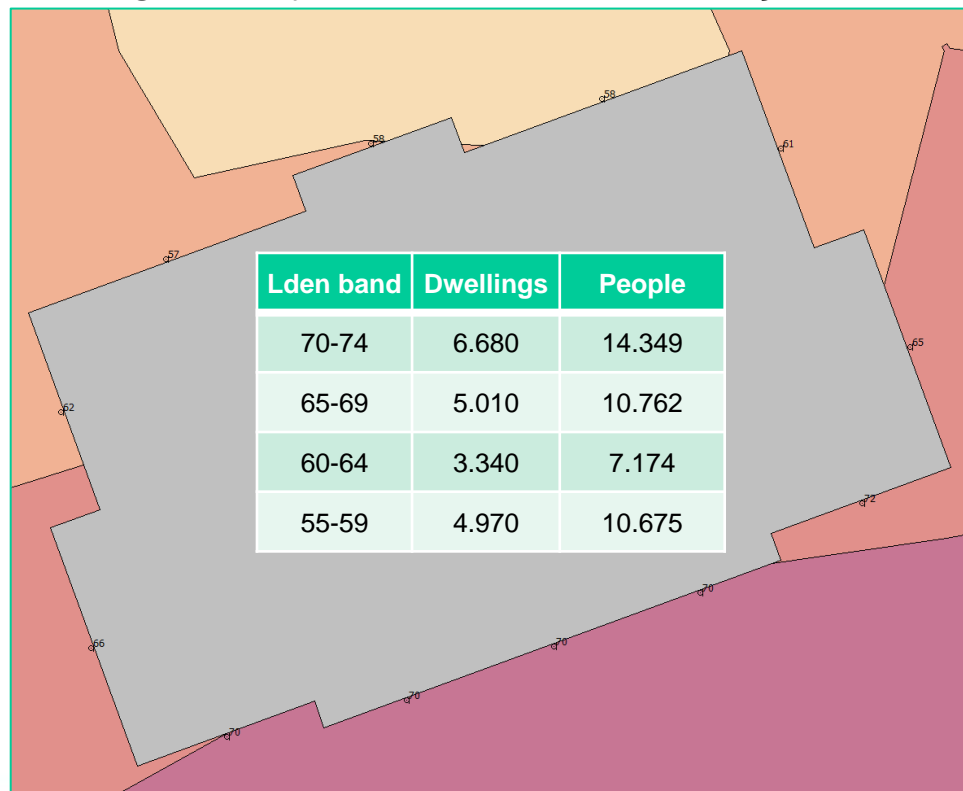
# Buildings Exposed to Noise

- B2) Multi-dwellings each with >1 façade
  - assigned mean to upper half receiver points

| Sound level | Dwellings | People |
|:---:|:---:|:---:|
| 72.0 | 3.333 | 7.160 |
| 70.0 | 3.333 | 7.160 |
| 70.0 | 3.333 | 7.160 |
| 70.0 | 3.333 | 7.160 |
| 69.8 | 3.333 | 7.160 |
| 65.9 | 3.333 | 7.160 |
| 65.4 | 0 | 0 |
| 61.6 | 0 | 0 |
| 61.4 | 0 | 0 |
| 58.4 | 0 | 0 |
| 58.3 | 0 | 0 |
| 57.4 | 0 | 0 |
| **Total** | **20.00** | **42.96** |

| Lden band | Dwellings | People |
|:---:|:---:|:---:|
| 70-74 | 13.332 | 28.640 |
| 65-69 | 6.666 | 14.320 |
| 60-64 | 0.000 | 0.000 |
| 55-59 | 0.000 | 0.000 |
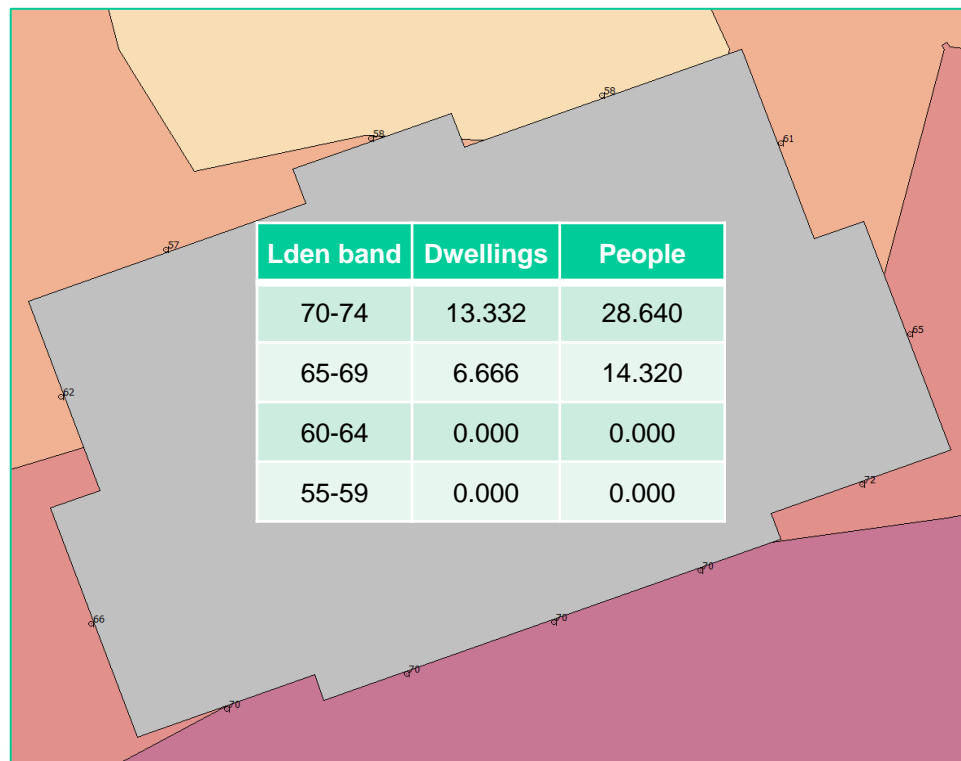
# People & Dwellings Exposed to Noise

- ## Example in Predictor-LimA

  - EC Population option
  - Run twice for major roads, then all roads
  - Run twice for major railways, then all railways
  - Repeat for Schools, then Hospitals using "Method 1: most exposed façade"

# Reporting to EPA

# Reporting to EPA

- NMBs report to EPA using DF4_8 Noise Maps templates from EEA
  - In 5 dB bands
    - From 55 to >75 dB $L_{den}$
    - From 45 to >70 dB $L_{night}$
  - Area exposed to noise
  - School and Hospital buildings exposed to noise
  - Dwellings exposed to noise
  - People in dwellings exposed to noise
  - Noise contour polygons for $L_{den}$ and $L_{night}$

- For details see: *EPA Guidance Note for Strategic Noise Mapping – Part 4: Publication and Reporting*

Assessment of Harmful Effects

# Overview

- Requirements for Assessment of Harmful Effects

- Buildings Exposed to Noise

- Harmful Effects

- Assessment Bands and Thresholds

- Reporting to EPA

# Requirements for Assessment of Harmful Effects

# Requirements for Assessment of Harmful Effects

- Requirements are set out within the Regulations:
  - European Communities (Environmental Noise) Regulations 2018
  - European Communities (Environmental Noise) (Amendment) Regulations 2021
    - Regulation 9 (2):
      - Noise-Mapping bodies shall calculate harmful effects in accordance with the Second Schedule. The Action Planning Authorities shall estimate the expected reduction in the harmful effects of noise exposure to the population as a result of the mitigation measures contained in their Noise Action Plans.
    - Second Schedule
      - Replicates the Annex of Directive 2020/367
    - Fifth schedule
      - Estimated number of people living in buildings:
        - From 55 to >75 dB $L_{den}$
        - From 45 to >70 dB $L_{night}$

# Buildings Exposed to Noise

# Buildings Exposed to Noise

- Assign noise levels to buildings in line with Annex II, guidance available:
    - See "Buildings Exposed to Noise", slides 24 - 31 above

# Buildings Exposed to Noise
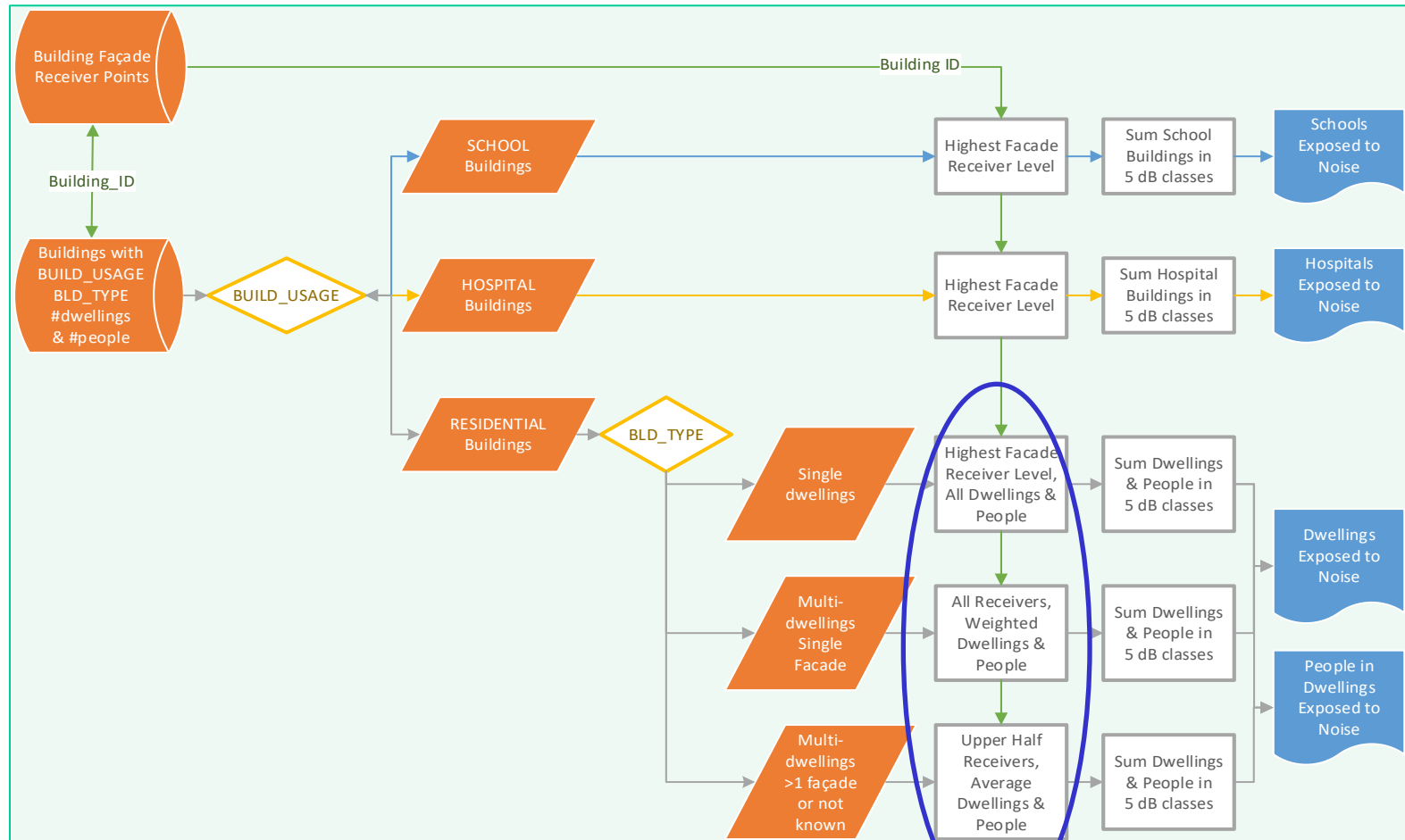
# Buildings Exposed to Noise

- The number of people per noise band is known per building
  - Bands may be 0.1 dB, 1 dB or 5 dB wide
  - Predictor tool can provide results in 5 dB or 1 dB bands
  - Buildings assessment in 0.1 dB bands would require a new tool



Address Result Countings

| ID | Name | Description | Designated use | Building type | #Receivers | #Addresses | #People | #Dwellings | < 40 (Lden) | | 40 .. 45 (Lden) | | 45 .. 50 (Lden) | | 50 .. 55 (Lden) | | 55 .. 60 (Lden) | | 60 .. 65 (Lden) | | > 65 (Lden) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | #People | #Dwellings | #People | #Dwellings | #People | #Dwellings | #People | #Dwellings | #People | #Dwellings | #People | #Dwellings | #People | #Dwellings |
| Total | | | | | 98224 | 27584 | 93656 | 31443 | 281.55 | 96.80 | 3859.31 | 1168.86 | 18414.02 | 5882.95 | 27135.06 | 9167.18 | 26638.63 | 9194.42 | 13308.86 | 4478.43 | 3991.03 | 1440.36 |
| 1118972 | 32684524 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 4 | 1 | | | | | | | | | 3.64 | 1.00 | | | | |
| 1118973 | 32867123 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 4 | 1 | | | | | | | 3.64 | 1.00 | | | | | | |
| 1118974 | 32684520 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | | | 3.64 | 1.00 | | | | |
| 1118975 | 32866020 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | 3.64 | 1.00 | | | | | | |
| 1118976 | 32866006 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | 3.64 | 1.00 | | | | | | |
| 1118977 | 50659886 | R | Residential building | Single dwelling - most exposed facade | 4 | 1 | 3 | 1 | | | | | | | 3.07 | 1.00 | | | | | | |
| 1118979 | 37111144 | R | Residential building | Single dwelling - most exposed facade | 4 | 1 | 2 | 1 | | | | | | | | | 2.50 | 1.00 | | | | |
| 1118980 | 37111175 | R | Residential building | Single dwelling - most exposed facade | 4 | 1 | 2 | 1 | | | | | | | 2.50 | 1.00 | | | | | | |
| 1118981 | 37111161 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 2 | 1 | | | | | | | 2.50 | 1.00 | | | | | | |
| 1118984 | 50652089 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | | | | | | | 3.52 | 1.00 |
| 1118985 | 50652083 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 4 | 1 | | | | | | | | | | | | | 3.52 | 1.00 |
| 1118986 | 50652085 | R | Residential building | Single dwelling - most exposed facade | 4 | 1 | 4 | 1 | | | | | | | | | | | | | 3.52 | 1.00 |
| 1118987 | 50652037 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 3 | 1 | | | | | | | | | | | 2.98 | 1.00 | | |
| 1118988 | 50652088 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | | | | | | | 3.52 | 1.00 |
| 1118989 | 50652087 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | | | | | | | 3.52 | 1.00 |
| 1118990 | 50652027 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 3 | 1 | | | | | | | | | | | 2.98 | 1.00 | | |
| 1118991 | 50594001 | R | Residential building | Single dwelling - most exposed facade | 2 | 1 | 3 | 1 | | | | | | | | | 2.74 | 1.00 | | | | |
| 1118992 | 35646816 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 3 | 1 | | | | | | | 3.13 | 1.00 | | | | | | |
| 1118993 | 27022275 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 3 | 1 | | | | | | | 2.74 | 1.00 | | | | | | |
| 1118994 | 38111437 | R | Residential building | Single dwelling - most exposed facade | 2 | 1 | 0 | 1 | | | | | | | | | | | 1.00 | | | |
| 1118995 | 27002763 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | 3.59 | 1.00 | | | | | | |
| 1118996 | 36951515 | R | Residential building | Single dwelling - most exposed facade | 2 | 1 | 4 | 1 | | | | | | | 3.59 | 1.00 | | | | | | |
| 1118997 | 36951481 | R | Residential building | Single dwelling - most exposed facade | 3 | 1 | 4 | 1 | | | | | | | | | 3.59 | 1.00 | | | | |
| 1118998 | 27002773 | R | Residential building | Single dwelling - most exposed facade | 5 | 1 | 4 | 1 | | | | | | | 3.59 | 1.00 | | | | | | |

To Shape | Close | Help

# Harmful Effects

# Harmful Effects

- Assessment of harmful effects to follow:
    - Commission Directive (EU) 2020/367
    - Transposed through European Communities (Environmental Noise) (Amendment) Regulations 2021

- *"Effects are to be calculated at the central value of each noise band, depending on availability of data, e.g.:*
    - *50.5 dB for the noise band defined between 50-51 dB, or*
    - *52 dB for the noise band 50-54 dB"*

- Harmful effects to be assessed:
    - Ischaemic Heart Disease (IHD)
        - Agglomeration roads & Major roads
    - High Annoyance (HA) & High Sleep Disturbance (HSD)
        - Agglomeration roads & Major roads
        - Agglomeration railways & Major Railways
        - Agglomeration airports and Major Airports

# Harmful Effects - IHD

- ## Assessment of number of cases of Ischaemic Heart Disease (IHD)
  - Calculate relative risk (*RR*) of harmful effect, in each band

$$RR_{IHD,i,road} = \begin{cases} e^{\left[\left(ln(1.08)/10\right)*(L_{den}-53)\right]} & for\ L_{den}\ greater\ than\ 53\ dB \\ 1 & for\ L_{den}\ equal\ or\ smaller\ than\ 53\ dB \end{cases}$$

  - Calculate total population attributable fraction (*PAF*) across all bands

$$PAF_{x,y} = \left(\frac{\sum_j [p_j \cdot (RR_{j,x,y}-1)]}{\sum_j [p_j \cdot (RR_{j,x,y}-1)]+1}\right)$$

  - Calculate number of cases (.......... the total population (*P*) of the assessment area

$$N_{x,y} = PAF_{x,y,i} * I_y * P$$

    - *Iy* is the incidence rate of IHD in the assessment area
    - Noise-Health project calculated *Iy* in Ireland as 0.29

  - Note:
    - 5 dB bands calculated using centres at $L_{den}$: 57, 62, 67, 72, 77, 82
    - 1 dB bands calculated using centres at $L_{den}$: 53.5, 54.5, 55.5, 56.5, 57.5, 58.5, 59.5, 60.5 etc
    - 0.1 dB bands calculated using calculated results to 1 d.p. $L_{den}$: 53.0, 53.1, 53.2, 53.3, 53.4, 53.5 etc

# Harmful Effects - HA

- ## Assessment of number of cases of High Annoyance (HA)
  - Calculate absolute risk (A$R$) of harmful effect, in each band, per source

$$AR_{HA,road} = \left(78.9270 - 3.1162 * L_{den} + 0.0342 * L_{den}^2\right)\big/100$$

$$AR_{HA,rail} = \left(38.1596 - 2.05538 * L_{den} + 0.0285 * L_{den}^2\right)\big/100$$

$$AR_{HA,air} = \left(-50.9693 + 1.0168 * L_{den} + 0.0072 * L_{den}^2\right)\big/100$$

  - Calculate total number of people affected by high annoyance ($N$) in the assessment area, across all bands, per source

$$N_{x,y} = \sum_j\left[n_j * AR_{j,x,y}\right]$$

  - $n_j$ is the number of people exposed to the $j$-th band, per source

  - Note:
    - 5 dB bands calculated using centres at L$_{den}$: 47, 52, 57, 62, 67, 72, 77, 82
    - 1 dB bands calculated using centres at L$_{den}$: 45.5, 46.5, 47.5, 48.5, 49.5, 50.5, 51.5, 52.5 etc
    - 0.1 dB bands calculated using calculated results to 1 d.p. L$_{den}$: 45.0, 45.1, 45.2, 45.3, 45.4, 45.5, 45.6, 45.7 etc

# Harmful Effects - HSD

- ## Assessment of number of cases of High Sleep Disturbance (HSD)
  - Calculate absolute risk (A*R*) of harmful effect, in each band, per source

$$AR_{HSD,road} = \left(19.4312 - 0.9336 * L_{night} + 0.0126 * L_{night}^2\right)\Big/100$$

$$AR_{HSD,rail} = \left(67.5406 - 3.1852 * L_{night} + 0.0391 * L_{night}^2\right)\Big/100$$

$$AR_{HSD,air} = \left(16.7885 - 0.9293 * L_{night} + 0.0198 * L_{night}^2\right)\Big/100$$

  - Calculate total number of people affected by high sleep disturbance (*N*) in the assessment area, across all bands, per source

$$N_{x,y} = \sum_j \left[n_j * AR_{j,x,y}\right]$$

  - *n_j* is the number of people exposed to the *j*-th band, per source

  - Note:
    - 5 dB bands calculated using centres at $L_{night}$: 47, 52, 57, 62, 67, 72, 77, 82
    - 1 dB bands calculated using centres at $L_{night}$: 45.5, 46.5, 47.5, 48.5, 49.5, 50.5, 51.5, 52.5 etc
    - 0.1 dB bands calculated using calculated results to 1 d.p. $L_{night}$: 45.0, 45.1, 45.2, 45.3, 45.4, 45.5, 45.6, 45.7 etc

# Assessment Bands and Thresholds

# Assessment Bands and Thresholds

- Effects are assessed using dose-response relationships from WHO *Environmental Noise Guidelines for the European Region*, 2018 (WHO 2018)

- WHO 2018 recommendations based on reducing adverse health effects:
  - Road traffic noise
    - 53 dB $L_{den}$, 45 dB $L_{night}$
  - Railway noise
    - 54 dB $L_{den}$, 45 dB $L_{night}$
  - Aircraft noise
    - 45 dB $L_{den}$, 40 dB $L_{night}$

- Dose-response curves are not linear, therefore width of noise band will influence the overall results, 0.1 dB bands will have the closest fit, 5 dB bands the loosest fit, 1 dB bands somewhere between the two

- 5 dB bands cannot fully account for WHO recommended levels for roads and railways, but 1 dB bands can

# Assessment Bands and Thresholds

- Assessment based on:
  - People in Dwellings Exposed to Noise in accordance with END Annex II
    - Results in 5 dB bands (or 1 dB bands, or 0.1 dB bands)
    - Predictor tool "EU Population Exposure" will analyse People in Dwellings Exposed to Noise in line with Annex II in 5 dB or 1 dB bands
    - Analysis in 0.1 dB bands would require development of an additional tool

- Following the analysis of the People in Dwellings Exposed to Noise in accordance with END Annex II

- Health Effects assessment in accordance with Annex III may be undertaken within a spreadsheet, within GIS, or within the a database tool

- If health effects are assessed per building, it may be possible to map distribution of health effects

# Assessment Bands and Thresholds

- Test assessment carried out:
  - Based on the area within *"Technical investigation – exposure to noise"*

| RESIDENTIA | BLD_TYPE | Buildings | Dwellings | People |
|---|---|---|---|---|
| 0 | No dwellings | 3,541 | 0 | 0 |
| 1 | Single dwelling - most exposed façade | 31,054 | 31,504 | 93,908 |
| 2 | Multiple dwellings - >1 facade, or not known | 576 | 1,152 | 3,299 |
| >2 default value | Multiple dwellings - >1 facade, or not known | 340 | 3,158 | 8,164 |
| >2 manually assign | Multiple dwellings - single exposed façade | 59 | 1,573 | 3,713 |
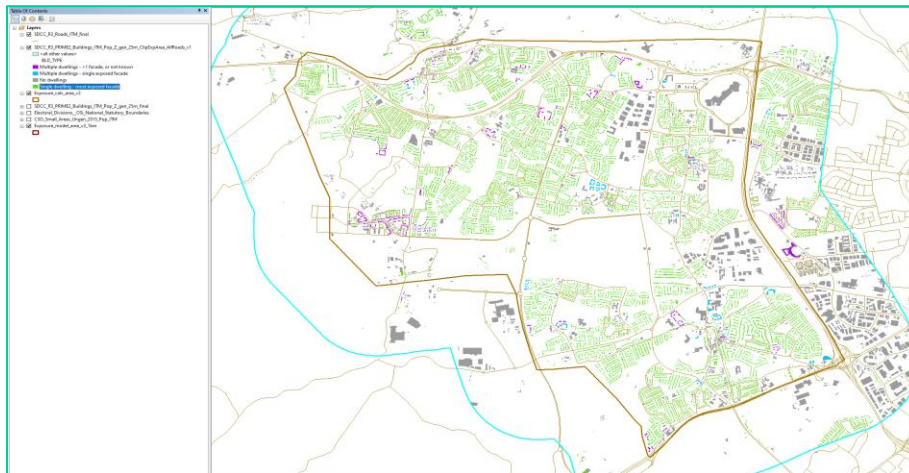
# Assessment Bands and Thresholds

- Test assessment carried out:
    - Harmful effects due to exposure to road traffic noise
    - Effect of noise bands; 0.1 dB, 1 dB or 5 dB
    - Effect of threshold; >40 dB, WHO 2018, END 2002

# Assessment Bands and Thresholds

- Results of test assessment:
  - Threshold: >40 dB
  - Differences are compared to 1 dB bands

| >40 dB Lden & >40 dB Lnight | | Bands | | | Diff. vs 1 dB bands | | |
|---|---|---|---|---|---|---|---|
| | | 0.1 | 1 | 5 | 0.1 | 1 | 5 |
| Population | | 93,044 | 93,044 | 93,044 | | | |
| HA in the case of road noise | Formula 12 | 12,437 | 12,439 | 12,105 | -0.02% | 0.00% | -2.68% |
| % of population HA associated with road noise | | 13.37% | 13.37% | 13.01% | | | |
| IHD in the case of road noise | Formula 11 | 969 | 970 | 896 | -0.10% | 0.00% | -7.62% |
| % of population with IHD associated with road noise | | 1.04% | 1.04% | 0.96% | | | |
| HSD in the case of road noise | Formula 12 | 4,169 | 4,171 | 4,039 | -0.04% | 0.00% | -3.15% |
| % of population HSD associated with road noise | | 4.54% | 4.54% | 4.39% | | | |

# Assessment Bands and Thresholds

- Results of test assessment:
  - Threshold: WHO 2018 guidelines for road traffic noise
  - Differences are compared to 1 dB bands

| >53 dB Lden & >45 dB Lnight | | Bands | | | Diff. vs 1 dB bands | | |
|---|---|---|---|---|---|---|---|
| | | 0.1 | 1 | 5 | 0.1 | 1 | 5 |
| **Population** | | 93,044 | 93,044 | 93,044 | | | |
| **HA in the case of road noise** | Formula 12 | 10,679 | 10,683 | 9,311 | -0.04% | 0.00% | -12.84% |
| % of population HA associated with road noise | | 11.48% | 11.48% | 10.01% | | | |
| **IHD in the case of road noise** | Formula 11 | 969 | 970 | 896 | -0.10% | 0.00% | -7.62% |
| % of population with IHD associated with road noise | | 1.04% | 1.04% | 0.96% | | | |
| **HSD in the case of road noise** | Formula 12 | 3,857 | 3,859 | 3,747 | -0.05% | 0.00% | -2.89% |
| % of population HSD associated with road noise | | 4.20% | 4.20% | 4.08% | | | |

# Assessment Bands and Thresholds

- Results of test assessment:
  - Threshold: END 2002 mandatory reporting for road traffic noise
  - Differences are compared to 1 dB bands

| >55 dB Lden & >50 dB Lnight | | Bands | | | Diff. vs 1 dB bands | | |
|---|---|---|---|---|---|---|---|
| | | 0.1 | 1 | 5 | 0.1 | 1 | 5 |
| Population | | 93,044 | 93,044 | 93,044 | | | |
| HA in the case of road noise | Formula 12 | 9,522 | 9,527 | 9,311 | -0.06% | 0.00% | -2.27% |
| % of population HA associated with road noise | | 10.23% | 10.24% | 10.01% | | | |
| IHD in the case of road noise | Formula 11 | 945 | 946 | 896 | -0.14% | 0.00% | -5.28% |
| % of population with IHD associated with road noise | | 1.02% | 1.02% | 0.96% | | | |
| HSD in the case of road noise | Formula 12 | 2,555 | 2,558 | 2,539 | -0.15% | 0.00% | -0.75% |
| % of population HSD associated with road noise | | 2.78% | 2.78% | 2.76% | | | |

# Assessment Bands and Thresholds

- ## Results of test assessment
    - As the width of noise bands change (from 0.1 dB to 1 dB to 5 dB),
    - the total number of people exposed to harmful effects:
        - Reduce by less than 0.2% for 0.1 dB bands compared to 1 dB bands
        - Reduce by between 0.75% and 12.84% for 5 dB bands comparted to 1 dB bands

- These results indicate that **1 dB noise bands** provide **almost equivalent results** to **0.1 dB bands**, therefore:
    - It is not recommended to develop an additional tool to support assessment of people per noise band per building in 0.1 dB bands,
    - The existing Predictor tool may be used for assessment of people per noise band per building in 1 dB bands

# Assessment Bands and Thresholds

- ## Results of test assessment
    - As threshold level increases (from >40 dB, to WHO 2018, to END)
    - the total number of people assessed as being exposed to harmful effects:
        - Remains almost constant for IHD:
            - RR = 1 for $L_{den}$ less than or equal to 53 dB
        - Decreases for HA:
            - 23% from >40 to END
            - 11% from WHO to END
        - Decreases for HSD:
            - 39% from >40 to END
            - 34% from WHO to END

- The results indicate that the **threshold** can have a **large influence** on the results:
    - It is recommended to use the WHO 2018 thresholds as these align with the dose response curves used for the assessment

# Assessment of Harmful Effects

- The process should be undertaken for each reporting area, for each noise source:

  - Per agglomeration for agglomeration roads, railways, airports and industry

  - Per County (26) for major roads and major railways
    - Each contain several Local Electoral Areas (LEA) (Eurostat LAU)

# Assessment of Harmful Effects

- Predictor tool "EU Population Exposure" can analyse People in Dwellings Exposed to Noise in line with Annex II in 1 dB bands
  - Use Predictor *Contours and Results Labels – Wizard* function to setup 1 dB bands from 40 dB to 90 dB

# Assessment of Harmful Effects

- Predictor *EU Population* tool then used to assess exposure to noise of dwellings and people in dwellings

# Assessment of Harmful Effects

- Health Effects assessment in accordance with Annex III may be undertaken within a spreadsheet, within GIS, or within a database tool
  - Spreadsheet for use with Predictor circulated by EPA

- Results dialogue then copied into EPA spreadsheet template

| | A | B |
|---|---|---|
| 1 | #Receivers | 98,224 |
| 2 | #Addresses | 27,584 |
| 3 | **#People** | **93,656** |
| 4 | #Dwellings | 31,443 |
| 5 | | |
| 6 | **WHO Guidelines** | |
| 7 | **>53 dB Lden & >45 dB Lnight** | 1dB bands |
| 8 | | |
| 9 | **total number N of cases of IHD** | **978** |
| 10 | % of population with IHD | 1.04% |
| 11 | | |
| 12 | **People N,road,HA** | **10,759** |
| 13 | % of population HA | 11.49% |
| 14 | | |
| 15 | **People N,road,HSD** | **3,883** |
| 16 | % of population HSD | 4.15% |

# Reporting to EPA

# Reporting to EPA

- NMB report to EPA using a spreadsheet template from EPA:
    - Number of people affected by the harmful effects of noise
        - Ischaemic Heart Disease (IHD)
        - High Annoyance (HA)
        - High Sleep Disturbance (HSD)
    - In 1 dB bands
    - From WHO 2018 recommended levels:
        - Road traffic noise
            - 53 dB $L_{den}$, 45 dB $L_{night}$
        - Railway noise
            - 54 dB $L_{den}$, 45 dB $L_{night}$
        - Aircraft noise
            - 45 dB $L_{den}$, 40 dB $L_{night}$
- For details see: *EPA Guidance Note for Strategic Noise Mapping – Part 4: Publication and Reporting*