An tÚdarás Inniúil um Thorann Aerárthaí

Aircraft Noise Competent Authority

Draft Regulatory Decision

Appendix J

Cost Effectiveness Methodology and Results

METHODOLOGY FOR COST-EFFECTIVENES ANALYSIS

The following appendix details the cost-effectiveness evaluation, showing how it brings in the various inputs from other aspects of the noise assessment work that ANCA has undertaken. It sets out the cost-effectiveness analysis undertaken by the Applicant in support of the Application and reviews it against the guidance contained within Aircraft Noise Regulation, the Act of 2019, and the cost effectiveness guidance issued by ANCA as set out in Appendix J. ANCA has separately undertaken its own cost-effectiveness evaluation, also detailed in this appendix, making changes to the Applicant's methodology and assumptions as necessary to ensure robustness.

1.1. Background to cost-effectiveness analysis

In support of its application to replace Conditions 3(d) and 5, the Applicant has undertaken extensive modelling of noise impacts, air traffic and passenger volumes, and costs. This cost-effectiveness analysis builds on the modelling and assumptions provided to us by the Applicant. ANCA has undertaken a high-level review of the assumptions that the Applicant has used to estimate the costs of the different noise mitigation measures, and in some instances, replaced these with assumptions considered more appropriate.

All the monetary values in the cost-effectiveness analysis are presented in 2020 prices. The costs of each measure assessed within this cost-effectiveness analysis are presented in cumulative terms over the five-year period from 2022 to 2026 – 2022 has been selected as the start year as it is the year the North Runway is expected to become operational while 2026 has been selected as it is the final year that the operating restrictions are expected to impose a cost. This has allowed ANCA to compare the options on a consistent time basis. This appendix also notes where the use of a different time horizon for the cost-effectiveness evaluation may lead to differing results.

To present the effectiveness of the different mitigation measures, ANCA has chosen a single effectiveness year, 2025. This is because 2025 is the peak year for noise exposure and, therefore, the peak year for health effects from noise exposure, according to the Applicant's noise modelling. As a result, the cost-effectiveness ratios presented in the analysis below are in the format:

Cumulative cost between 2022 and 2026 per person no longer impacted in 2025.

The next section presents a discussion of the metrics used to determine the number of people no longer impacted under the various noise mitigation measures.

1.2. Noise Abatement Objective and effectiveness metric

ANCA has previously concluded that the Applicant's application to replace operating restrictions due to take effect once Dublin Airport's north runway opens, would create a noise problem as documented in Appendix C. ANCA, therefore, recommended the establishment of a NAO for Dublin Airport which is set out in Appendix D.

The policy objective set by ANCA for the NAO is to:

> Limit and reduce the long term adverse effects aircraft noise on health and quality of life, particularly at night, as part of the sustainable development of Dublin Airport.

The following explanatory text has also been included:

> Noise from Dublin Airport should be limited and reduced in line with principles of sustainable development. As the airport grows, the long-term adverse effects on health and quality of life should progressively reduce over the lifetime of this NAO. The Balanced Approach will be used to ensure that all practicable and sustainable measures are implemented to achieve this objective.

Finally, ANCA has determined that the following outcomes are expected to be achieved through the NAO:

> In context of its recovery from the global pandemic noise exposure from Dublin Airport is expected to increase up to 2025. Whilst the resultant health effects are expected to be lower than what occurred prior to the pandemic and in the years 2018 and 2019, these effects should continue to be reduced over the long-term so to improve the noise situation at the airport whilst allowing for sustainable growth. ANCA therefore expects the following outcomes to be achieved through this NAO as set against the measures described in Part 3.
>
> The number of people highly annoyed and highly sleep disturbed shall reduce so that compared to conditions in 2019:
>
> - the number of people chronically affected in 2030 has reduced by 30% compared to 2019;
> - the number of people chronically affected in 2035 has reduced by 40% compared to 2019;
> - the number of people chronically affected in 2040 has reduced by 50% compared to 2019
>
> and;
>
> - The number of people exposed to aircraft noise above 55 dB L_{night} and 65 dB L_{den} shall be limited and reduced compared to 2019.

As set out in the cost-effectiveness guidance presented by ANCA to the Applicant, it is necessary to select an appropriate metric (or metrics) to evaluate the noise benefit (or effectiveness) of different measures for achieving the NAO. The selected metric(s) must be related to the noise problem identified and consistent with the NAO.

1.2.1. Applicant's proposed effectiveness metrics

The Applicant proposed five metrics to assess the effectiveness of different noise mitigation measures:

- **Number of people highly sleep disturbed (HSD).** This metric is a measure of the harmful effects of night-time noise exposure and is estimated using the L_{night} noise indicator. The measure reflects a relationship where the proportion of people experiencing sleep disturbance increases as their exposure to night noise increases. It is estimated using a dose-effect formula recommended in WHO guidelines and endorsed by the European Commission through the amended EU Environmental Noise Directive.[1]
- **Number of people highly annoyed (HA).** This metric is a measure of the harmful effects of all-day noise exposure and is estimated used the L_{den} noise indicator. Similar to the HSD metric, the measure acknowledges that not all people experience annoyance at the same noise level but that generally, the proportion of people annoyed increases with greater noise. Again, it is estimated using a dose-effect formula presented in the amended EU Environmental Noise Directive.
- **Number of people exposed to a medium impact (over 50 dB L_{night})**. This is a relatively simple measure showing the number of people exposed to medium levels of night-time noise, based on the L_{night} indicator.
- **Number of people exposed to a high impact (over 55 dB L_{night}).** This is a relatively simple measure showing the number of people exposed to high levels of night-time noise, based on the L_{night} indicator.
- **Number of people significantly adversely affected (SAA).** This metric aims to show the number of people exposed to material increases in noise exposure compared with the 2018 situation and has also been used to compare with the noise situation in the same year as their forecasts with relevant action. The Applicant estimates it in two ways, using the L_{den} and L_{night} indicators, based on a series of thresholds (as presented in

[1] Directive 2020/367 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020L0367&from=EN

- Table 0-1).

Table 0-1: The Applicant's thresholds for determining if a person is significantly adversely affected

Noise indicator	Threshold based on absolute noise exposure and increase in noise exposure compared with a situation
L_{den}	Exposed to noise levels between 45 dB and 50 dB L_{den} and an increase at or higher than 9 dB
	Exposed to noise levels between 50 dB and 55 dB L_{den} and an increase at or higher than 6 dB
	Exposed to noise levels between 55 dB and 65 dB L_{den} and an increase at or higher than 3 dB
	Exposed to noise levels between 65 dB and 70 dB L_{den} and an increase at or higher than 2 dB
	Exposed to noise levels 70 dB L_{den} or higher and an increase at or higher than 1 dB
L_{night}	Exposed to noise levels between 40 dB and 45 dB L_{night} and an increase at or higher than 9 dB
	Exposed to noise levels between 45 dB and 50 dB L_{night} and an increase at or higher than 6 dB
	Exposed to noise levels between 50 dB and 55 dB L_{night} and an increase at or higher than 3 dB
	Exposed to noise levels between 55 dB and 60 dB L_{night} and an increase at or higher than 2 dB
	Exposed to noise levels 60 dB L_{night} or higher and an increase at or higher than 1 dB

Source: Ricondo, daa

The Applicant has used different metrics at different stages of its cost-effectiveness analysis. To assess the effectiveness of its proposals to vary the runway pattern during the night period, the Applicant has used the HSD and HA metrics. And after concluding that the various measures all performed equally well under these two metrics, the Applicant then assessed the performance of the measures against the two SAA metrics (using the L_{den} and L_{night} indicators. For its noise insulation proposals, the Applicant has used the number of people exposed to a high impact to assess the effectiveness. And finally, when comparing the operating restrictions against the Applicant's preferred alternative, the Applicant has used the HSD and HA metrics.

1.2.2. Effectiveness metrics used

ANCA disagrees with the Applicant's approach:

- There is no clear line of sight between the Applicant's candidate NAO and the choice of metrics. For example, the Applicant's candidate NAO makes no reference to minimising the number of people newly affected by noise, yet the SAA metric is used within the cost-effectiveness analysis.

- The use of different cost-effectiveness metrics at each stage of the process prevents us from comparing the performance of different types of noise mitigation measures, and understanding how various combinations of measures perform collectively.
- The use of five different metrics makes it difficult to derive any meaningful insights from the cost-effectiveness analysis.

ANCA has taken a different approach by assessing the cost-effectiveness of different measures under two metrics. The choice of metrics is aimed at assessing performance against the targets set within the NAO, while attempting to limit the number of metrics used. These same two metrics are used throughout the CEA:

- **Number of people Highly Sleep Disturbed (HSD) in 2025**. The NAO sets targets for the number of people HA and HSD by 2030, 2035 and 2040. ANCA has selected the HSD metric instead of the HA metric as it relates more directly to night-time noise exposure and, is therefore, a more relevant metric when assessing the performance of different measures for mitigating night-time noise. And ANCA has taken 2025 as our assessment year as it is the peak year for noise exposure according to the Applicant's noise modelling. As the peak year, 2025 is the year when health effects from night-noise are the highest.
- **Number of people exposed to noise levels over 55 dB L_{night} in 2025**. The NAO also sets targets for the number of people exposed to 55 dB L_{night} and 65 dB L_{den}. Again, ANCA has selected the 55 dB L_{night} metric over the 65 dB L_{den} metric as it relates more directly to night-time noise exposure.

ANCA has also had regard for the SSA metric but this has been assessed with respect to the third aspect of the noise problem declared by ANCA.

1.3. Forecast without new measures (baseline scenario)

The forecast without new measures (Scenario P06, FWNM) is used as the baseline scenario i.e. it is the counterfactual against which the costs and noise impacts of all noise mitigation measures are assessed for compliance with the NAO.

The FWNM scenario includes all existing and planned measures to manage aircraft noise, except for Conditions 3(d) and 5 in the planning permission granted to develop Dublin Airport's North Runway. Conditions 3(d) and 5 are excluded as these are operating restrictions that the Applicant has applied to replace; they are:

- Condition 3(d) – Runway 10L-28R (the North Runway) shall not be used for take-off or landing between 23:00 and 07:00 (i.e. the night period).
- Condition 5 – The average number of night-time aircraft movements at the Airport shall not exceed 65 per night (between 23:00 and 07:00) when measured over the 92-day modelling period.

In its FWNM the Applicant provided forecasts of future flight movements and passenger volumes. These are used to forecast both future noise levels around the airport, and to estimate the potential impact of operating restrictions on passenger volumes.

1.3.1. Baseline traffic and passenger volumes

Dublin Airport is currently subject to a planning cap of 32 million passengers per annum (mpaa). In its application to revise conditions 3(d) and 5, the Applicant has not applied to lift the planning cap and, as such, the forecast annual traffic movements (ATMs) and passenger volumes presented by the Applicant reflect this cap continuing to apply. The most recent forecasts presented by the Applicant assume the 32mppa cap will become a binding constraint on growth at the airport by 2025 in the forecast without new measures. The Applicant's forecasts are presented in Table J1 below.

Table J1: Applicant forecasts of ATMs and passenger volumes under the FWNM

	2018	2019	2022	2025	2030	2035	2040
ATMs (thousands)	232.3	238.0	175.7	235.9	235.9	235.9	235.9
Passengers (millions)	31.5	32.9	21.0	32.0	32.0	32.0	32.0

Source: daa

Note: As Dublin Airport exceeded 32 million passengers in 2019, it requested transfer passengers be excluded from the cap to avoid a formal breach.

As can be seen in the table, the Applicant assumes that passenger numbers gradually recover to 2019 levels by 2025, with long-term forecasts derived using the Applicant's internal passenger forecasting model. Although ANCA has not had sight of the Applicant's passenger forecasting model, it has been reviewed by the Applicant's consultants Mott MacDonald, who concluded that the forecasting methodology was 'robust' and formed 'a valid basis for planning airport developments.'

There remains substantial uncertainty around the pace at which traffic levels and passenger volumes will recover, given the continued impact of the COVID-19 pandemic, associated travel restrictions, and the potential for long-term structural changes in the demand for air travel. As such, it is possible that passenger numbers recover sooner than 2025, or substantially later than assumed by the Applicant. Nevertheless, the Applicant's assumption broadly matches the latest position taken by IATA, which sees passenger volumes recovering in Western Europe by 2024.[2] It is also within the range of forecasts developed by Eurocontrol and ACI, as presented to us by the Applicant.

1.3.2. Baseline noise scenarios

Using the forecast ATMs, the Applicant (and its consultant advisors) have estimated noise impacts by taking the following broad steps:

- Constructing a busy day schedule, reflecting a typical summer day, for each forecast year such that the annual movements align with the forecast ATMs. This was done by adapting a base day schedule (the 95th percentile busy day in 2019), and then adding or removing flights so that annual ATMs matched the forecast figure, assuming a common annualisation factor. The flights added or removed, and the origin/destination of those flights were based on market insights and engagement with airlines. Where flights have to be removed, to accommodate operating restrictions for example, flights have been

[2] IATA (2021) COVID-19: An almost full recovery of air travel in prospect. Available at https://www.iata.org/en/iata-repository/publications/economic-reports/an-almost-full-recovery-of-air-travel-in-prospect/

removed broadly in proportion with the existing allocation of night flights between airlines.

- Estimating the fleet mix associated with these busy day schedules, based on the historic fleet mix and likely aircraft upgrade patterns.
- Undertaking noise mapping to understand how households around the airport would be exposed to noise given the likely usage of runways. In its FWNM (Scenario P06), the Applicant's consultants modelled night-time departures as using either the north or south runway depending on destination, and arrivals as evenly split between the two runways unless runway capacity was exceeded.

Based on the noise mapping, the Applicant's estimates of the noise impacts are presented in **Error! Reference source not found.**, using the two core noise metrics.

Table J2: Noise impacts under the FWNM – number of people impacted

	2018	2019	2022	2025	2030	2035	2040
Highly sleep disturbed ***(% change from 2019 levels)***	42,260	47,045	26,261 *(-44%)*	36,592 *(-22%)*	26,057 *(-45%)*	17,639 *(-63%)*	15,095 *(-68%)*
More than 55 dB L_{night} ***(% change from 2019 levels)***	753	1,533	283 *(-82%)*	407 *(-73%)*	301 *(-80%)*	240 *(-84%)*	215 *(-86%)*

Source: daa

As can be seen in the table, noise exposure levels are expected to decline over time despite ATMs returning to close to 2019 levels by 2025. This is due to the Applicant's assumptions around the evolution of the fleet mix, with newer, quieter aircraft, gradually replacing older, noisier aircraft. **Importantly, the Applicant's analysis shows that the NAO targets can be met comfortably without Conditions 3(d) and 5.** The number of people HSD is expected to reduce by 45% by 2030 compared with 2019 (against a target of 30%), 63% by 2035 (against a target of 40%), and 68% by 2040 (against a target of 50%).

The Dublin Airport is currently subject to a planning cap of 32mppa, which is reflected in the number of people impacted by noise under both metrics in Table J2. The cap acts as a constraint to growth by 2025 and so the numbers presented after this year are impacted by this restriction. ANCA's assessment of the forecasts provided by the Applicant shows that, if the cap was lifted, the number of people exposed to noise under both metrics would increase, and diverge from these numbers by an increasing amount over the appraisal period. By 2040, there would be approximately 19,000 HSD people and 300 people exposed to L_{night} > 55dB without the cap under the FWNM.

Despite the Applicant's analysis showing that the NAO targets can be met comfortably without Conditions 3(d) and 5, ANCA recognises that these forecasts are uncertain. As a result, ANCA has considered as part of this cost-effectiveness analysis, the impact of a Noise Quota Scheme as a means of protecting against the noise reductions not materialising. This is considered in more detail alongside the cost-effectiveness assessment of the operating restrictions.

1.3.2.1 Noise mitigation measures already included in the FWNM

Dublin Airport currently operates two noise insulation schemes under existing noise mitigation measures:

- The Home Sound Insulation Programme (HSIP), launched in 2017, is a voluntary noise insulation scheme for residential dwellings located within the 2016 63 dB $L_{Aeq,\ 16\ hr}$ noise contour. In other words for dwellings exposed to noise levels that exceeded 63 dB on average in 2016, when assessed over the 07:00 to 23:00 period.
- The Residential Noise Insulation Scheme (RNIS) is a voluntary noise insulation scheme for residential dwellings located within the forecast 2022 63 dB $L_{Aeq,\ 16\ hr}$ noise contour.

The noise impacts presented in above, do not account for the reduction in noise levels from being insulated under these two schemes. The Applicant anticipates that by 2025, all eligible homes under both RNIS and HSIP will have been fully insulated. Based on this, and the Applicant's assumption that insulation typically leads to a 5 dB reduction in indoor noise levels noise levels, ANCA has estimated that the number of people highly sleep disturbed will be 36,564 by 2025, and the number of people exposed to a night-time noise priority will be 16 by 2025.

1.3.2.2 Night-time Preferential Runway Use and Runway Restrictions

Operational procedures aim to reduce noise pollution around airports by optimising how aircraft are used in day-to-day operations. The measures including using certain runways at certain times, directing aircraft to use certain routes over others (e.g. to avoid densely populated areas), and noise abatement procedures for take-off and landing. The appropriateness of each of these measures will depend on the physical layout of the airport and its surroundings.

1.3.3. List of measures

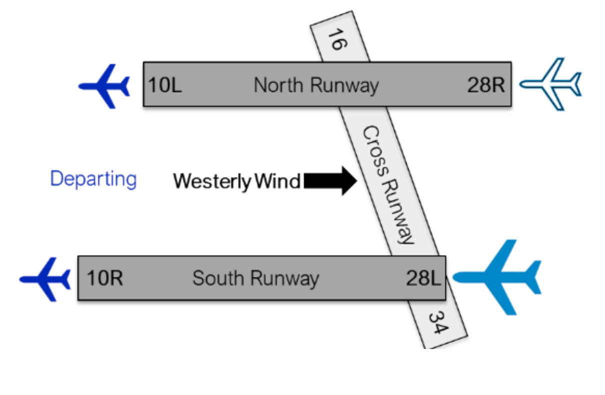
Under this category of measures, the Applicant has tested the impact and cost-effectiveness of different preferential runway use patterns for the night period; changing how and when each runway is used for arrivals and departures as a means of minimising the noise impact on surrounding communities. The Applicant has also tested the cost-effectiveness of measures that restrict the use of certain runways for parts of the night period. Although such measures could be considered a form of operating restriction, they are not treated as such in this assessment as they do not affect the schedule airlines wish to operate.

Dublin Airport already has a form of permitted runway operations for the day period when the new runway becomes operational. This is presented in the table below, where:

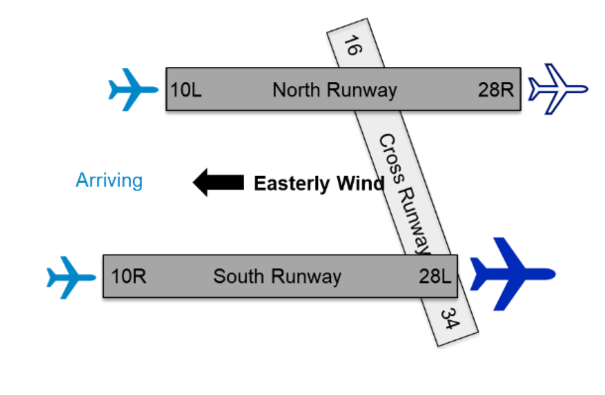
- Runway 10L or 10R, as determined by air traffic control, is preferred for arriving during easterly winds, and Runway 28L is the preferred runway for arriving aircraft during westerly winds.
- Runway 10R is the preferred runway for departing aircraft during easterly winds and either Runway 28L or 28R is used for departing aircraft as determined by air traffic control during westerly winds.

Table J3: Overview of future daytime operations at Dublin Airport

Easterly Winds



Westerly Winds



Source: ANCA

In the FWNM, the Applicant assumes that the night-time operation is without any restrictions. Departures use either the north runway or south runway depending on destination. Arrivals are split evenly between the runways unless the capacity of a runway is exceeded. This is labelled as **Scenario P06.**

In addition to the runway use pattern assumed in the FWNM, the Applicant has assessed the cost-effectiveness of eight other runway use or runway restriction scenarios, and have undertaken noise modelling of two further scenarios following an information request from ANCA. These are presented in Table J4 below.

Table J4: Descriptions of measures relating to preferential runway use and runway restrictions

Measure	Description of runway use or runway restriction scenario
Applicant assessed measures	
FWNM (P06)	No restrictions. Departures use either the North or South runway depending on destination. Arrivals are split evenly between the runways unless the capacity of a runway is exceeded.
P02	During 00:00-06:00, only South runway is used. Otherwise, same usage pattern as day.
P03	Same usage pattern as day.
P04	Opposite use pattern to day pattern. Cross runway only used when wind dictates.
P05	Alternate between Scenarios 3 and 4 (i.e. alternate between day usage pattern and opposite to day usage pattern)
P07	Both runways used for departures depending on destination. Arrivals modelled as per day usage pattern.
P08	Departures modelled as per day usage pattern. Arrivals modelled as even split between two runways unless runway capacity exceeded.
P09	During 00:00-06:00, only North runway is used. Otherwise, same usage pattern as day.

P10	Alternate between using North and South runway during 00:00-06:00. Otherwise, same usage pattern as day.
Further measures modelled by the Applicant following request ANCA	
P12	During 23:00-06:00, only South runway is used. Otherwise, same usage pattern as day.
P13	During 23:30-05:00, only South runway is used. Otherwise, same usage pattern as day.

Note: Runway patterns P01 and P11 are excluded from this table as both include operating restrictions. Runway pattern P01 includes both conditions 3(d) and 5, while runway pattern P11 includes condition 3(d) only. Runway pattern P11 can be distinguished between other similar measures such as patterns P02, P09, P12 and P13 as it prevents airlines from operating the schedule they may wish to operate.

For each of the runway use or runway restriction scenarios presented in Table J4 (as well as the operating restrictions scenarios), the Applicant has undertaken the same noise modelling as it has with the FWNM. However, the Applicant has not presented noise impacts for each of the forecast years under every runway pattern. For four of the runway patterns, only 2025 noise impacts have been estimated.

1.3.4. Cost of measures

The different runway usage patterns do not themselves impose any direct financial cost on Dublin Airport or the aviation industry. However, the Applicant in its cost-effectiveness analysis identified two other impacts:

- **Cost-savings.** The Applicant estimated the potential for cost savings from operating mostly a single runway for parts of the night period rather than two runways. The main saving was from needing one fewer air traffic controller when only one runway is in operation.
- **Indirect costs associated with delays.** The Applicant also considered the potential for delays from managing air traffic movements over a single runway rather than two runways, but considered the impact to be negligible relative to the FWNM.

In its cost-effectiveness analysis, the Applicant only assessed the costs of its preferred runway usage pattern (Scenario P02), where the North runway is not used between 00:00 and 06:00. However, the analysis can be extended to all of the runway patterns described above.

1.3.4.1 Cost savings

The Applicant bases their estimate of the labour cost savings from needing fewer air traffic controllers on consultations with the Irish Aviation Authority (IAA), who is primarily responsible for these costs. The Applicant assumes that the operation of both runways during the night period will require three air traffic controllers, and calculate that the closure of one runway between 00:00 and 06:00 would result in a saving of €1,108,825 per year (in 2020 prices). This implies a saving of approximately €185,000 per hour of runway closure.

To validate these figures, ANCA has used a mixture of assumptions and publicly available sources of information to come up with an alternate estimate of the savings per hour of runway closure:

- The average annual salary of an IAA air traffic controller in 2020, has been estimated by using publicly available information on the average salary in 2010 (€160,000),[3] uprating it by an estimate of average real salary growth between 2010 and 2020 (41%),[4] and uprating it by inflation between 2010 and 2020 (6%).[5] This leaves us with an estimate of €238,000.
- A typical IAA air traffic controller can be expected to work 1,675 hours a year, based on a shift pattern of 8-hours a day, for five days in eight,[6] and assuming 30 days of leave. This implies an hourly salary of €142.
- Assuming there is a 30% premium for night shifts, and assuming one air traffic controller is no longer needed when the airport operates only a single runway, the implied annual saving is €67,500 per hour of runway closure. This is substantially lower than the Applicant's estimate of €185,000.

Based on the above analysis, it is ANCA's view that the Applicant's estimate of the cost savings is likely to be overstated. For example, the Applicant's assumption of €1.1 million savings per annum for Scenario P02 compares with ANCA's estimate of €0.4 million savings per annum. Table J5 below presents the cost savings for each of the runway use or runway restriction scenarios, including the cumulative savings over our appraisal period or 2022 to 2026. Note that several of the scenarios do not result in any reduction in runway operating hours and so do not have any associated cost savings.

Table J5: Cost savings under the different runway use or runway restriction scenarios (€ million, 2020 prices)

Runway use / runway restriction scenario	Applicant estimate		ANCA estimate	
	Annual saving	Total saving (2022-26)	Annual saving	Total saving (2022-26)
P02	- 1.1	- 4.4	- 0.4	- 1.7
P03	-	-	-	-
P04	-	-	-	-
P05	-	-	-	-
P07	-	-	-	-
P08	-	-	-	-
P09	- 1.1	- 4.4	- 0.4	- 1.7
P10	- 1.1	- 4.4	- 0.4	- 1.7
P12	- 1.3	- 5.2	- 0.5	- 2.0
P13	- 1.0	- 4.1	- 0.4	- 1.6

[3] https://www.independent.ie/irish-news/irish-controllers-get-double-the-us-pay-packet-26624932.html

[4] We assume GNI* per capita growth acts as a reasonable proxy for average salary growth, recognising this may be an overestimate. We take GNI* per capita growth data from the Central Statistics Office.

[5] Central Statistics Office

[6] https://www.irishtimes.com/life-and-style/people/this-is-not-a-playstation-game-1.598779

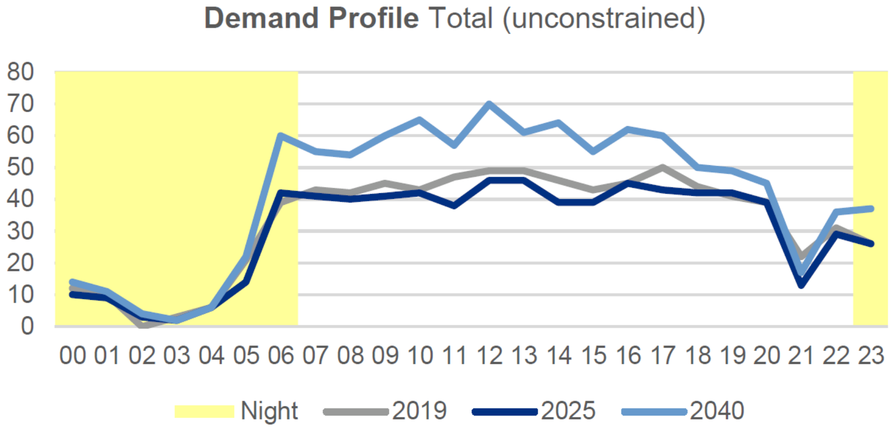
Source: CEPA analysis of daa figures

1.3.4.2 Delay cost

The Applicant assumes that using a single runway between 00:00 and 06:00 would not lead to significant delays compared with the FWNM and, therefore, assume there is no cost.

ANCA agrees with this conclusion. From the figure below, showing the forecast number of movements during a typical busy day in 2019, 2025 and 2040, it can be seen that the number of movements in the 00:00 to 06:00 period is substantially lower than the single runway capacity (as showcased by the 2019 demand profile).

Figure 0-1: Profile of flight movements during typical busy day in 2019, 2025 and 2040



Source: Mott MacDonald analysis

1.3.5. Effectiveness of measures

Changing how the runways are operated means certain areas are overflown more intensively and other areas are overflown less intensively. Certain runway operational patterns can reduce the number of people exposed to harmful effects from noise by limiting flights over densely populated areas, or by limiting how intensively certain areas are overflown.

Table J6 shows the number of people HSD under the different runway patterns outlined above, and Table J7 presents the number of people exposed to a night-time noise priority (i.e. more than 55 dB L_{night}) under the different runway patterns.

Table J6: Number of people highly sleep disturbed under each measure (before accounting for HNIS or RSIP)

Runway use / runway restriction scenario	2022	2025	2030	2035	2040
FWNM (P06)	**26,261**	**36,592**	**26,057**	**17,639**	**15,095**
P02	19,188	37,080	26,979	18,711	16,131
P03	16,227	35,757	25,054	15,431	13,834
P04	-	35,260	-	-	-

P05	-	36,363	-	-	-
P07	26,609	36,699	26,436	17,495	14,910
P08	18,204	35,784	25,321	15,720	13,950
P09	-	34,896	-	-	-
P10	-	36,463	-	-	-
P12	19,413	37,159	27,108	18,885	16,379
P13	17,902	36,275	25,958	16,704	14,585

Source: daa

Note: For scenarios P04, P05, P09 and P10, the Applicant has only undertaken noise mapping for the year 2025. As a result, estimates for the number of people HSD is only available for the one year under these runway patterns.

Table J7: Number of people exposed to noise greater than 55 dB L_{night} (before accounting for HNIS or RSIP)

Runway use / runway restriction scenario	2022	2025	2030	2035	2040
FWNM (P06)	283	407	301	240	215
P02	356	1,059	756	454	354
P03	386	1,055	696	385	296
P04	-	737	-	-	-
P05	-	412	-	-	-
P07	308	989	673	311	249
P08	243	422	303	194	170
P09	-	528	-	-	-
P10	-	426	-	-	-
P12	397	1,119	760	452	352
P13	347	1,055	753	445	316

Source: daa

Note: For scenarios P04, P05, P09 and P10, the Applicant has only undertaken noise mapping for the year 2025. As a result, estimates for the number of people exposed to noise greater than 55 dB L_{night} is only available for the one year under these runway patterns

The tables above show that there is no single runway use scenario that consistently minimises both metrics throughout the modelling period. Certain scenarios perform better in earlier years, but less so in the longer term. And some scenarios perform better at minimising the number of people highly sleep disturbed, but less so at minimising the number of people exposed to high noise levels.

When looking at the number of people HSD, in 2025 (the only year where data exists for all 11 scenarios), the runway usage pattern in Scenario P09 leads to the lowest noise impacts; in all the other years the runway pattern P03 leads to the lowest noise impacts. And when looking at the number of people exposed to noise levels higher than 55 dB L_{night}, the FWNM leads to the lowest number of people affected in 2025 and 2030, whereas runway pattern P08 leads to the lowest number of people affected for the remaining years.

It can also be seen from the tables that many of the runway patterns are in fact less effective than the FWNM in some years, as they lead to more people highly sleep disturbed or exposed to noise levels greater than 55 dB L_{night}. However, ANCA's overarching finding is that the differences between the various runway patterns are very small, and the targets set within the NAO continue to be comfortably met under each of the runway patterns.

The Applicant, in its cost-effectiveness analysis, also considered how the runway patterns perform at minimising the number of people significantly adversely affected; in other words, minimising the number of people affected by a substantial increase in noise compared with their noise exposure in 2018. The Applicant's preferred measure (Scenario P02) is the most effective under this metric, and is the Applicant's justification for proposing Scenario P02 over the other runway patterns. This can be seen in Table J8 below, which compares the effectiveness of the various runway patterns in 2025 compared to the FWNM.

Table J8: Effectiveness of the various scenarios in 2025 compared against the FWNM (before accounting for HNIS or RSIP)

Runway use / runway restriction scenario	HSD	Night-time noise priority	SAA
P02	487	652	-15,180
P03	-835	648	-13,370
P04	-1,332	330	6,347
P05	-230	6	497
P07	106	582	-12,418
P08	-808	15	-2,057
P09	-1,696	121	5,343
P10	-129	19	-2,003
P12	567	712	-
P13	-318	648	-

Source: daa

Note: The Applicant's analysis for number of people SAA was not extended to Scenarios P12 and P13. However, ANCA expects that compared with Scenario P02, Scenario P12 will perform slightly more strongly under the SAA metric while Scenario P13 will perform slightly less strongly.

The table shows show that there is a trade-off between minimising the overall health effects of noise (as showcased by the HSD and night-time noise priority metrics) and minimising the number of people newly affected (as showcased by the significantly adversely affected metric). The measures that perform strongly under the HSD metric do not perform as strongly under the significantly adversely affected metric, and vice versa.

1.3.6. Cost-effectiveness of measures

Table J9 shows the cost effectiveness of the runway patterns firstly in terms of reducing the number of people HSD in 2025, and secondly in terms of reducing the number of people exposed to high levels of night noise (i.e. greater than 55 dB L_{night}). ANCA has calculated these cost-effectiveness ratios by dividing the cumulative cost over the period 2022-26 by the effectiveness; where the effectiveness is number of people no longer HSD or exposed to night-time noise priority in 2025, when compared with the FWNM.

Where a scenario performs worse than the FWNM, i.e. it leads to more people HSD or exposed to night-time noise priority than the FWNM, no cost-effectiveness ratio is presented and instead, the item is highlight in red. As can be seen in the table, scenarios P02, P07 and P12 all perform worse than the FWNM under the HSD metric, and all of the scenarios perform worse than the FWNM under the night-time noise priority metric.

Where a scenario leads to cost savings relative to the FWNM, no cost-effectiveness ratio is presented and instead, the item is highlighted in red. These scenarios reduce costs and lead to lower noise impacts. As can be seen in the table, scenarios P09, P10 and P13 all the most cost-effective because they have runway closures for periods during the night, leading to cost savings.

Table J9 Cost effectiveness of different scenarios relative to the FWNM (€ per person, 2020 prices)

Runway use / runway restriction scenario	HSD	Night-time noise priority
P02	Performs worse than FWNM	Performs worse than FWNM
P03	0	Performs worse than FWNM
P04	0	Performs worse than FWNM
P05	0	Performs worse than FWNM
P07	Performs worse than FWNM	Performs worse than FWNM
P08	0	Performs worse than FWNM
P09	Leads to cost savings	Performs worse than FWNM
P10	Leads to cost savings	Performs worse than FWNM
P12	Performs worse than FWNM	Performs worse than FWNM
P13	Leads to cost savings	Performs worse than FWNM

Source: CEPA analysis of daa data and assumptions

Note: Items highlighted in red are measures that perform worse than the FWNM. Items highlighted in green are measures that lead to cost savings.

More importantly, however, all of the runway usage patterns continue to meet the 2030 targets as set out in the NAO. As this cost-effectiveness analysis does not show one scenario performing consistently better than the alternatives, ANCA considered that all of them could proceed to the next stage of the analysis.

Here, the approach taken by ANCA differs from that taken by the Applicant, which proceeded only with Scenario P02 on the basis that it performed most strongly under the significantly adversely affected metric. This metric is not part of the NAO but it is an aspect of the noise problem, and the evidence from the Applicant is that this scenario would be the best at reducing this aspect of the problem albeit at the expense of more people being exposed to aircraft noise above the night-time priority set out in the NAO.

Scenario P13, which is similar to Scenario P02 but with a shorter restriction on the use of the North Runway, is also likely to perform well against the aspect of the noise problem related to minimising significant adverse effects. It is also cost-effective at reducing the number of people HSD but as with the other scenarios, performs worse than the FWNM in terms of minimising the number of people exposed to aircraft noise above the night-time priority.

1.4. Land-use planning and management measures

Land-use planning and management refers to a range of possible measures to ensure the activities that take place around an airport are compatible with aviation. This includes:

- Locating new airports away from noise-sensitive areas, such as densely populated areas; and
- Introducing land-use zoning around airports to minimise the number of houses and other noise-sensitive premises built around the airport.

Noise insulation schemes are also commonly considered under this category of measures.

1.4.1. List of measures

The Applicant have proposed a new Residential Sound Insulation Grant Scheme (RSIGS) for residential dwellings which fall within eligible noise contours near the airport, specifically to mitigate against additional noise from the operation of the North Runway.

Dwellings will be eligible for the RSIGS if noise exposure is forecast to exceed 55dB under the L_{night} metric in 2025.[7] For dwellings under this scheme, the Applicant will provide a €20,000 grant for insulating the bedrooms, which can be spent on a menu of insulation measures at the discretion of the recipient. The scheme will run in addition to the existing noise insulation scheme, RNIS, which the Applicant expects to be completed by 2022 when the new North Runway opens.

Table J9 presents the full list of land-use planning and management measures assessed in this cost-effectiveness analysis. In addition to the Applicant’s proposed eligibility criteria for the RSIGS, we assess seven variants of the noise insulation scheme with different eligibility criteria. The key difference between noise insulation variants A, C1, C3, and C5 on one hand, and variants B, C2, C4, and C5 on the other, are that the former set eligibility based on 2022 forecast noise exposure levels whereas the latter set eligibility based on 2025 forecast noise exposure levels. Variants C1 to C6 extend eligibility to dwellings that experience a substantial increase in noise (+ 9 dB) relative to a base level.

[7] “Dublin Airport North Runway, Regulation 598/2014 (Aircraft Noise Regulation) Cost Effectiveness Analysis Report (Revision 1 – July 2021)” (2021), RICONDO on behalf of daa

Table J9: Noise insulation measures based on different RSIGS eligibility criteria

Measure	Insulation scheme eligibility criteria
Applicant assessed measures	
RSIGS B	A €20,000 grant for noise insulation given to dwellings exposed to noise levels exceeding 55dB L_{night} in 2025 and not eligible under existing noise insulation schemes
Additional measures assessed by ANCA	
RSIGS A	€20,000 grant for dwellings exposed to noise levels exceeding 55 dB L_{night} in 2022 and not eligible under existing noise insulation schemes
RSIGS C1	€20,000 grant for dwellings exposed to noise levels that, in 2022, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in 2018, provided they are not eligible under existing noise insulation schemes
RSIGS C2	€20,000 grant for dwellings exposed to noise levels that, in 2025, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in 2018, provided they are not eligible under existing noise insulation schemes
RSIGS C3	€20,000 grant for dwellings exposed to noise levels that, in 2022, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in 2019, provided they are not eligible under existing noise insulation schemes
RSIGS C4	€20,000 grant for dwellings exposed to noise levels that, in 2025, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in 2019, provided they are not eligible under existing noise insulation schemes
RSIGS C5	€20,000 grant for dwellings exposed to noise levels that, in 2022, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in a scenario with the operating restrictions, provided they are not eligible under existing noise insulation schemes
RSIGS C6	€20,000 grant for dwellings exposed to noise levels that, in 2025, either a) exceed 55 dB, or b) exceed 50 dB and are 9 dB higher than in a scenario with the operating restrictions, provided they are not eligible under existing noise insulation schemes

Source: daa, ANCA

1.4.2. Cost of measures

The costs of the noise insulation schemes consist of administrative costs, which are the same across all of the variants, and the costs of the grants, which will vary depending on the number of households eligible. The scheme will operate between 2022 and 2024. The Applicant assumes set-up costs will be €300,000 and annual administrative costs for 2023 and 2024 will be €100,000 per year.

ANCA has reviewed these costs based on the evidence provided under RFI 130.[8] The Applicant carried out a detailed analysis of its existing insulation schemes and benchmarked costs against comparable schemes operated by Heathrow Airport. While they acknowledge that the set-up and administrative costs are necessarily high-level estimates prior to final decisions being taken, they

[8] "Dublin Airport Grant Scheme Responses to RFI Nos. 92, 93, 130, 136 and 137," RFI 130, TFT on behalf of daa

consider the estimates to be based on a reasonable work programme and associated labour costs.

To calculate the €20,000 figure for the grant, the Applicant referred to tender rates for similar works carried out under the RNIS. In particular, given that this grant is specifically aimed at preventing disturbed sleep, they focussed on the price of a *“replacement primary window option, using high specification acoustically rated glazing.”* This work would be covered by a €20,000 grant for dwellings with 1-3 bedrooms. The Applicant stated that a high-level review of these properties with Google Streetview suggests that 90-94% of eligible properties have between 1 and 3 bedrooms when having regard for those properties eligible under runway use and restriction Scenario P02.

ANCA considers the focus on insulating bedrooms is reasonable given the aspect of the NAO which is most pertinent under the Application relates to the health effects of sleep disturbance. ANCA also considers the Applicant’s assumption around the majority of dwellings having between 1 and 3 bedrooms to be reasonable, given more general data we have on the average number of residents per dwelling.[9]

As the number of households eligible for noise insulation will depend on noise exposure levels, the costs of the insulation scheme will depend on both the eligibility criteria and the assumed runway use scenario. ANCA has estimated the number of dwellings eligible for insulation under each combination of runway use scenario and noise insulation measure. This is presented in Table J10. It is assumed there will be 100% take up of the grant, both as a simplifying assumption and because the Applicant’s historic experience suggests high take-up of noise insulation schemes.

Table J10: Number of households insulated under each RSIGS scheme

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	5	6	178	812	172	691	653	1,204
P02	21	247	41	249	38	247	77	265
P03	27	252	68	274	61	271	125	533
P04	-	227	-	2,048	-	2,017	-	2,504
P05	-	8	-	810	-	694	-	1,303
P07	7	230	22	249	7	247	31	430
P08	7	10	166	762	148	618	605	1,231
P09	-	59	-	1,387	-	1,317	-	2,143
P10	-	8	-	201	-	177	-	600
P12	21	337	39	337	36	337	75	346
P13	23	245	56	261	48	252	108	442

[9] Data from the CSO shows that the average household size in Fingal was 3.03 in 2016. See cso.ie

Source: CEPA analysis of daa data and assumptions
Note: As we do not have noise exposure data for 2022 under Scenarios P04, P05, P09 and P10, we are unable to estimate the number of households that would be eligible for noise insulation under variants A, C1, C3 and C5.

Following the Applicant's assumptions in its cost-effectiveness analysis, ANCA has then estimated the cost of the noise insulation schemes using the Applicant's cost assumptions as described above. These are presented in Table J11.

Table J11: Total costs associated with RSIGS scheme under different eligibility criteria, 2022-26 (€ million, 2020 prices)

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	0.6	0.6	4.1	16.7	3.9	14.3	13.6	24.6
P02	0.9	5.4	1.3	5.5	1.3	5.4	2.0	5.8
P03	1.0	5.5	1.9	6.0	1.7	5.9	3.0	11.2
P04	-	5.0	-	41.5	-	40.8	-	50.6
P05	-	0.7	-	16.7	-	14.4	-	26.6
P07	0.6	5.1	0.9	5.5	0.6	5.4	1.1	9.1
P08	0.6	0.7	3.8	15.7	3.5	12.9	12.6	25.1
P09	-	1.7	-	28.2	-	26.8	-	43.4
P10	-	0.7	-	4.5	-	4.0	-	12.5
P12	0.9	7.2	1.3	7.2	1.2	7.2	2.0	7.4
P13	1.0	5.4	1.6	5.7	1.5	5.5	2.7	9.3

Source: CEPA analysis of daa data and assumptions
Note: As we do not have noise exposure data for 2022 under Scenarios P04, P05, P09 and P10, we are unable to estimate the costs for noise insulation under variants A, C1, C3 and C5.

These two tables show that eligibility criteria which are based on exposure levels in 2025, i.e. B, C2, C4, and C6, lead to more homes being eligible for insulation and, therefore, higher noise insulation costs. This is unsurprising as 2025 is the peak year for noise exposure according to the Applicant's noise modelling. This effect is most marked for noise insulation measure C6, where eligibility is extended to households that face an increase in noise exposure in 2025, when compared against a scenario where the operating restrictions, Conditions 3(d) and 5, are retained.

1.4.3. Effectiveness of measures

For the RSIGS, the Applicant assumes that the installation of noise insulation will lead to at least a 5 dB reduction in night-time noise exposure for affected dwellings and that *"[f]or the purposes of the EIAR it was considered a fair and reasonable approach to assign properties mitigated under the scheme with a benefit of 5 dB improvement in internal noise levels."*[10]

The Applicant's assumption is based on an assessment commissioned by them in 2020 which sought to understand the internal acoustic reductions resulting from the Residential Noise Insulation Scheme (RNIS). The RNIS has been in place since 2016 and is voluntary for dwellings

[10] "Dublin Airport Grant Scheme Responses to RFI Nos. 92, 93, 130, 136 and 137," RFI 93, TFT on behalf of daa

that are exposed to daytime 16-hour average sound levels of at least 63 dB. The assessment used recognised methods to undertake an acoustic assessment of sample properties before and after sound insulation had been installed.[11] For the surveyed properties, the average airborne sound insulation reduction was 7.7 dB, with a reduction of over 10 dB for several of the properties in the sample.

Although the Applicant states that all surveyed dwellings experienced a reduction of over 5 dB, it can be seen in Figure 93.1 of their RFI response that two out of twenty properties experienced reductions of 3 dB or less. Despite this inconsistency, the overall distribution of noise reduction presented in the graph suggests that assuming a typical 5 dB reduction remains reasonable.

1.4.3.1 Highly Sleep Disturbed

Table J12 below shows how many people are no longer HSD as a result of being insulated, under each variant of the scheme. This varies by runway pattern as the number of households eligible for insulation also varies by runway pattern.

Table J12: Change in people highly sleep disturbed following insulation, 2025

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	-1	-1	-27	-123	-26	-105	-97	-181
P02	-4	-43	-7	-43	-6	-43	-12	-46
P03	-5	-44	-11	-48	-10	-47	-20	-85
P04	-	-40	-	-329	-	-324	-	-396
P05	-	-1	-	-123	-	-105	-	-196
P07	-1	-40	-4	-43	-1	-43	-5	-70
P08	-1	-2	-26	-115	-23	-94	-90	-185
P09	-	-10	-	-216	-	-205	-	-328
P10	-	-1	-	-31	-	-27	-	-89
P12	-4	-59	-6	-59	-6	-59	-12	-60
P13	-4	-43	-9	-45	-8	-44	-17	-72

Source: CEPA analysis of daa data and assumptions

Note: As we do not have noise exposure data for 2022 under Runway Patterns 4, 5, 9 and 10, we are unable to estimate the change in noise impacts for variants A, C1, C3 and C5.

It can be seen that the number of people no longer HSD is significantly smaller than the number of households receiving insulation. It can also be seen that the reduction in the number of people HSD in 2025 is modest compared with the overall numbers of people HSD and compared with the number of dwellings insulated under each combination of measures. The suggests that a reduction in indoor noise exposure of 5 dB, through the installation of insulation, is not very effective at reducing the number of people highly sleep disturbed.

[11] These methods were set out in BS EN ISO 16283-3:2016 Acoustics – Field measurements of sound insulation in buildings and of building elements. Part 3 – Façade sound insulation were followed to measure façade sound insulation performance.

The table above also shows that eligibility criteria measures based on exposure in 2025 (B, C2, C4 and C6) are the most effective in terms of total reduction in number of people HSD. Eligibility criteria C6 is the most effective overall. The rationale for this is the same as for costs, whereby more people are eligible for insulation under these criteria due to the peak in noise exposure during 2025.

1.4.3.2 Night-time noise priority (> 55 dB Lnight)

Table J13 shows the change in number of people exposed to aircraft levels exceeding the night-time noise priority – 55 dB L_{night} – following insulation under the different eligibility criteria.

Table J13 Change in people exposed to noise greater than 55 dB L_{night} following insulation, 2025

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	-14	-16	-14	-16	-14	-16	-14	-16
P02	-62	-781	-62	-781	-62	-781	-62	-781
P03	-80	-796	-80	-796	-80	-796	-80	-796
P04	-	-517	-	-517	-	-517	-	-517
P05	-	-22	-	-22	-	-22	-	-22
P07	-20	-726	-20	-726	-20	-726	-20	-726
P08	-20	-27	-20	-27	-20	-27	-20	-27
P09	-	-168	-	-168	-	-168	-	-168
P10	-	-22	-	-22	-	-22	-	-22
P12	-61	-906	-61	-906	-61	-906	-61	-906
P13	-69	-774	-69	-774	-69	-774	-69	-774

Source: CEPA analysis of daa data and assumptions

As with the HSD results, the eligibility criteria which are based on noise exposure in 2025 lead to the lowest number of people exposed. However, as would be expected, extending eligibility to household exposed to less noise than 55 dB L_{night}, but experiencing an increase in noise exposure relative to what they were experiencing previously, has no effect.

1.4.4. Cost-effectiveness of measures

The tables below show the cost effectiveness of the noise insulation schemes, both in terms of reducing the number of people HSD in 2025, and in terms of reducing the number of people exposed to aircraft levels exceeding the night-time noise priority in 2025. The cost-effectiveness of each noise insulation scheme varies depending on the runway pattern in use.

The cost-effectiveness ratios in the table are presented as the cost per person who is no longer impacted, meaning that a lower cost-effectiveness ratio implies a measure is more cost-effective. The most cost-effective measure under each metric is highlighted in green.

Table J14: Cost effectiveness of insulation schemes (€ per person no longer HSD)

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	663,000	555,000	149,000	136,000	150,000	137,000	140,000	136,000
P02	251,000	126,000	193,000	126,000	198,000	126,000	165,000	126,000
P03	220,000	126,000	165,000	126,000	169,000	126,000	151,000	131,000
P04	-	126,000	-	126,000	-	126,000	-	128,000
P05	-	450,000	-	136,000	-	137,000	-	136,000
P07	524,000	127,000	264,000	127,000	524,000	127,000	224,000	131,000
P08	517,000	388,000	149,000	136,000	151,000	137,000	140,000	136,000
P09	-	161,000	-	131,000	-	131,000	-	132,000
P10	-	459,000	-	147,000	-	149,000	-	140,000
P12	251,000	123,000	197,000	123,000	202,000	123,000	166,000	123,000
P13	239,000	126,000	174,000	126,000	182,000	126,000	155,000	130,000

Source: CEPA analysis of daa data and assumptions

Note: In each row, given the runway pattern, we highlight in green the noise insulation scheme that is most cost-effective

Table J15: Cost effectiveness of insulation schemes (€ per person no longer exposed to night-time noise priority)

Runway use / runway restriction scenario	RSIGS A	RSIGS B	RSIGS C1	RSIGS C2	RSIGS C3	RSIGS C4	RSIGS C5	RSIGS C6
P06	44,000	38,000	296,000	1,035,000	287,000	886,000	988,000	1,520,000
P02	15,000	7,000	21,000	7,000	20,000	7,000	33,000	7,000
P03	13,000	7,000	23,000	8,000	21,000	7,000	37,000	14,000
P04	-	10,000	-	80,000	-	79,000	-	98,000
P05	-	30,000	-	764,000	-	658,000	-	1,216,000
P07	32,000	7,000	48,000	8,000	32,000	7,000	57,000	13,000
P08	32,000	26,000	191,000	574,000	173,000	469,000	630,000	916,000
P09	-	10,000	-	169,000	-	160,000	-	259,000
P10	-	30,000	-	206,000	-	184,000	-	569,000
P12	15,000	8,000	21,000	8,000	20,000	8,000	33,000	8,000
P13	14,000	7,000	24,000	7,000	21,000	7,000	39,000	12,000

Source: CEPA analysis of daa data and assumptions

Note: In each row, given the runway pattern, we highlight in green the noise insulation scheme that is most cost-effective

From these two tables, ANCA has drawn one main conclusion; insulation schemes that are based on 2025 forecast exposure levels are more cost-effective than those that are based on 2022 forecast exposure levels. This are two reasons for this:

- More households are eligible under these schemes, which reduces the overall percentage of costs which are fixed, lowering the cost per person no longer HSD.
- Setting eligibility based on 2022 noise exposure results in the insulation of some households who would have benefitted from reduced noise exposure regardless (due to the background reduction in aircraft noisiness over time).

As a result, ANCA has proposed not proceeding with the noise insulation measures that are based on 2022 noise exposure levels.

1.5. Overall cost-effectiveness

We can now consider the combined effect of changing the runway use / runway restriction pattern and implementing a noise insulation scheme. Here, we also need to consider the impact of changing how the runways are used on existing noise insulation schemes. Changing the runway use scenario changes the numbers of households that are eligible for noise insulation under the existing schemes, which can increase insulation costs for Dublin Airport but also reduce the noise impact on households.

Table J16 shows the change in number of people HSD in 2025 when compared against the FWNM, after changing the runway pattern and insulating households (under one of RNIS, HSIP or RSIGS).

Table J16: Change in number of people HSD in 2025 compared against the FWNM, including impact of changing eligibility of existing insulation schemes

Runway use / runway restriction scenario	Highly Sleep Disturbed			
	B	**C2**	**C4**	**C6**
P06	-1	-123	-105	-181
P02	442	442	442	439
P03	-881	-885	-884	-922
P04	-1,367	-1,656	-1,651	-1,723
P05	-231	-352	-335	-425
P07	65	62	62	35
P08	-810	-924	-902	-993
P09	-1,704	-1,909	-1,898	-2,022
P10	-131	-161	-157	-219
P12	506	506	506	505
P13	-364	-366	-365	-393

Source: CEPA analysis of daa data and assumptions

Under the HSD metric, the most effective combination of measures is Scenario P09 with noise insulation variant C6, which results in just over 2,000 people no longer being highly sleep disturbed. However, this means there are still 34,542 people HSD in 2025.

Under the night-time noise priority metric, however, almost all of the measures are fully effective at reducing the number of people exposed to noise levels over 55 dB L_{night} to 0.

Table J17: Change in number of people exposed to night-time noise priority in 2025 compared against the FWNM, including impact of changing eligibility of existing insulation schemes

Runway use / runway restriction scenario	Night-time noise priority (>55 dB L_{night})			
	B	**C2**	**C4**	**C6**
P06	-16	-16	-16	-16
P02	-16	-16	-16	-16
P03	-16	-16	-16	-16
P04	-14	-14	-14	-14
P05	-16	-16	-16	-16
P07	-16	-16	-16	-16
P08	-16	-16	-16	-16
P09	-16	-16	-16	-16

P10	-16	-16	-16	-16
P12	-16	-16	-16	-16
P13	-16	-16	-16	-16

Source: CEPA analysis of daa data and assumptions

Table J18 and Table J19 below show the cost effectiveness of the combined measures in terms of reducing the number of people HSD and exposed to night-time noise priority. These also account for the additional cost of insulating homes that become eligible under existing schemes, that would not otherwise be eligible in the FWNM. Items highlighted in red are measures that do not have a cost-effectiveness ratio as they perform worse than the FWNM. Items highlighted in green are measures that do not have a cost-effectiveness ratio as they lead to cost savings.

Table J18: Cost-effectiveness per person no longer HSD in 2025, including impact of changing eligibility of existing insulation schemes (€ per person, 2020 prices)

Runway use / runway restriction scenario	RSIGS B	RSIGS C2	RSIGS C4	RSIGS C6
P06	520,000	136,000	137,000	136,000
P02	Worse than FWNM	Worse than FWNM	Worse than FWNM	Worse than FWNM
P03	6,000	7,000	7,000	13,000
P04	4,000	25,000	25,000	29,000
P05	3,000	47,000	43,000	63,000
P07	Worse than FWNM	Worse than FWNM	Worse than FWNM	Worse than FWNM
P08	1,000	17,000	14,000	25,000
P09	0	14,000	13,000	21,000
P10	Cost Savings	18,000	15,000	50,000
P12	Worse than FWNM	Worse than FWNM	Worse than FWNM	Worse than FWNM
P13	11,000	12,000	12,000	21,000

Source: CEPA analysis of daa data and assumptions provided in reporting template

Note: Items highlighted in red are measures that perform worse than the FWNM. Items highlighted in green are measures that lead to cost savings.

Table J19: Cost-effectiveness per person no longer exposed to night-time noise priority in 2025, including impact of changing eligibility of existing insulation schemes (€ per person, 2020 prices)

Runway use / runway restriction scenario	RSIGS B	RSIGS C2	RSIGS C4	RSIGS C6
P06	36,000	1,035,000	886,000	1,530,000
P02	242,000	245,000	242,000	277,000
P03	354,000	385,000	377,000	708,000
P04	363,000	2,987,000	2,942,000	3,644,000
P05	38,000	1,033,000	889,000	1,653,000
P07	325,000	350,000	346,000	580,000
P08	43,000	976,000	797,000	1,562,000
P09	Cost Savings	1,640,000	1,553,000	2,575,000
P10	Cost Savings	178,000	148,000	680,000
P12	333,000	333,000	333,000	346,000
P13	251,000	277,000	260,000	511,000

Source: CEPA analysis of daa data and assumptions

Note: Items highlighted in red are measures that perform worse than the FWNM. Items highlighted in green are measures that lead to cost savings.

Overall, the most cost-effective combination of measures is Scenario P10 with noise insulation variant B. This combination of measures leads to cost savings while reducing the number of people HSD and exposed to a night-time noise priority.

The above tables also show that insulating households exposed to noise exceeding 55 dB L_{night} (noise insulation variant B) is more cost-effective than extending the eligibility to households that experience a substantial increase in noise exposure relative to historical levels (noise insulation variants C2 and C4). It is also more cost-effective than insulating households that are expected to experience more noise than they would if Conditions 3(d) and 5 are retained (noise insulation variant C6),

The Applicant's preferred long-term measure is Scenario P02 with a noise insulation variant B. This results in an increase in the number of HSD people compared to the FWNM, but is relatively cost effective at minimising the number of people exposed to night-time noise priority.

1.6. Operating restrictions

Operating restrictions include measures such as restrictions on certain types of aircraft or periods of time when the number of flights is restricted.

1.6.1. List of measures

In this analysis, ANCA has assessed two operating restrictions, as presented in Table J20 below.

Table J20: Operating restrictions

Measure	Description
Applicant assessed measures	
Permitted Operations	Retail existing restrictions currently due to be introduced on the opening of the new north runway: Condition 3(d) – Runway 10L-28R shall not be used for take-off or landing between 23:30 and 06:59 Condition 5 – The average number of night-time aircraft movements at the Airport shall not exceed 65 per night (between 23:00 and 07:00) when measured over the 92-day modelling period.
DAA Noise Quota Scheme	Annual noise quota limit of 7,990 between the hours of 23:00 and 05:59, with noise related limits on aircraft permitted to operate at night.
Additional measures assessed by ANCA	
ANCA Noise Quota Scheme	Annual noise quota limit of 16,260 between the hours of 23:00 and 06:59, with noise related limits on aircraft permitted to operate at night.

Source: daa

The Noise Quota Scheme creates an annual limit on the volume of noise generated by aircraft during the night period, using the quota count (QC) system. Each aircraft type is given a QC rating depending on how much noise it generates. If there is a risk that the total QC rating of all the night flights flown in a year will breach the quota limit, it will impose an operating restriction. Airlines will either be required to fly a quieter aircraft with a lower QC rating, or not operate at all.

The Applicant proposed a Noise Quota Scheme that would create an annual noise quota limit for 6.5 hours of the night period. The limit was set such that it would not impose any operating restrictions based on the Applicant's forecasts of ATMs and the fleet mix. We assess an additional measure that extends the Noise Quota Scheme for an additional hour to cover the full night period. As we discuss below, the limit has been set such that it would not impose any operating restrictions based on the Applicant's forecasts of ATMs and the fleet mix.

1.6.2. Cost of measures

1.6.2.1 Permitted Operations

The Applicant assessed the cost of the permitted operations scenario to be €1,396m over the period 2022-25, based on their consultant's assessment of the economic impact of the operating restrictions. The Applicant used an economic impact methodology, attempting to value lost economic output as a result of the operating restrictions, estimating:

- the 'direct' loss in economic activity within the aviation sector from fewer flights and fewer passengers;

- ‘indirect’ losses in economic activity incurred by the wider supply chain; and
- ‘catalytic’ losses in economic activity based on the wider relationship between aviation and economic growth.

ANCA does not consider this approach to be robust. The Applicant’s consultants do not appear to have accounted for displacement effects – the idea that less spending on aviation would lead to more spending elsewhere in the economy. Without accounting for these effects, the Applicant’s estimates of the direct and indirect losses are likely to be significantly overstated. Additionally, the Applicant’s approach for assessing the costs of operating restrictions is inconsistent with its treatment of costs elsewhere in the CEA. Needing fewer air traffic controllers as a result of runway closures is treated as cost saving, whereas needing fewer airport and airline staff as a result of operating restrictions is treated as a cost due to lower economic output.

As a result of these deficiencies, which are somewhat inherent in economic impact methodologies, this approach is not commonly used for economic appraisal in Ireland (or globally). We have therefore used a different approach, although we retain the Applicant’s estimate of catalytic losses for our upper bound estimate. ANCA’s approach identifies four key impacts:

- **Loss in value to passengers no longer able to travel** – We estimate this by proxying how much ticket prices would have to rise to reduce demand by enough to meet the capacity constraints introduced by the operating restrictions.
- **Wider losses to the economy from having less connectivity** – There is evidence to suggest that improved air connectivity leads to higher economic growth. However, the precise relationship is highly uncertain. As we do not have detailed flight schedules from the Applicant, we are not able to separately estimate this effect, but we can use the Applicant’s estimate for the ‘catalytic impacts’ of the operating restrictions as our upper bound estimate.
- **Air traffic controller savings from only operating a single runway during the night period** – This was not assessed by the Applicant for the operating restrictions measures, but was assessed for the other measures.
- **Lower profits for airlines from higher airport charges** – As most of Dublin Airport’s other costs are fixed, they will have to spread those costs over a smaller passenger base meaning higher charges for everybody else. This will lead to lower profits for airlines.

The table below shows the reduction in ATMs and passenger volumes under the Permitted Operations scenario. Over the period 2022 to 2026, the Applicant estimates there will be 45,000 fewer flights and 7.1 million fewer passengers as a result of the restrictions placed in Conditions 3(d) and 5.

Table J21: Reduction in ATMs and passenger volumes under the Permitted Operations scenario

	2021	2022	2023	2024	2025	2026	2027
Without operating restrictions							
ATMs (thousands)	133.0	176.0	208.0	229.0	236.0	236.0	236.0
Passengers (millions)	7.9	21.0	26.7	30.8	32.0	32.0	32.0
Permitted Operations							
ATMs (thousands)	133.0	166.0	195.0	219.0	227.0	233.0	236.0
Passengers (millions)	7.9	19.6	24.9	29.3	30.4	31.2	32.0
Reduction as a result of operating restrictions in Permitted Operations scenario							
ATMs (thousands)	-	-10.0	-13.0	-10.0	-9.0	-3.0	-
Passengers (millions)	-	-1.4	-1.8	-1.5	-1.6	-0.8	-

Source: daa

To estimate the loss in value to passengers no longer able to travel, we assume prices have to rise to depress demand enough to meet the new capacity:

- We estimate that the average air fare at Dublin Airport was €115 in 2019, which we take as our best estimate for future air fares.[12]
- Using an estimate for passengers' price elasticity of demand of -0.6,[13] we can work out how much fares would have to rise so that 7.1 million fewer passengers fly over the period 2022 to 2026. This results in an average fare increase of €10.55.
- We then use a rule of thumb called the 'rule of a half' commonly used within transport appraisal, to estimate that each passenger no longer able to travel incurs a loss of half the €10.55 (i.e. €5.28).
- Aggregating this over 7.1 million passengers results in a total loss of €37.5 million.

As the precise relationship between airport connectivity and economic growth is uncertain, we use two estimates for the wider losses to the economy from having less connectivity:

- For our lower-bound estimate, we assume losses are zero.
- For our upper-bound estimate, we use the Applicant's estimate of the catalytic effects and extend it to included losses in 2026. This results in an estimate of €934 million.

[12] We estimate this using average revenue per passenger data from the 2019 annual accounts of Ryanair and Aer Lingus, as the two largest airlines operating from Dublin Airport.

[13] InterVISTAS / IATA (2017) Estimating Air Travel Demand Elasticities. https://www.iata.org/whatwedo/Documents/economics/Intervistas_Elasticity_Study_2007.pdf

We use the same approach as the noise abatement operational procedures to estimate the savings from not needing as many air traffic controllers during the night period, which we estimate to be €2.9 million.

Finally, to estimate the lower profits for airlines from higher airport charges, we need to estimate how much revenue Dublin Airport would lose from serving fewer passengers, which would then need to be recouped through higher airport charges. The average airport charge at Dublin Airport is currently set at €7.58 per passenger,14 which means that 7.1 million fewer passengers would result in €54 million less revenue.

Summing these results in our total cost estimate ranging from €88 million to €1,023 million over the period 2022-26.

1.6.2.2 Noise Quota Schemes

Whether the Noise Quota Scheme will impose a cost will depend on tight the restriction is and the state of technology available to airlines.

- If there is no risk of the quota limit being breached based on existing airline operating plans, there would be no cost to airlines.
- If there is a risk of the quota limit being breached, airlines may choose to shuffle their fleet so that their quietest aircraft are in use during the night period, with noisier aircraft in use during the day period or at other airports. This may impose a cost on airlines in terms of reduced operational efficiency. But fleet shuffling is less likely to be an option for airlines at Dublin Airport as many are based at the airport and, therefore, have less scope for shuffling their fleet.
- If airlines are unable to switch their fleet in order to meet the restrictions, their next option would be to bring forward investment in quieter aircraft. This would present an opportunity cost to airlines.
- If the technology does not exist for airlines to replace their existing fleet, their final option would be to schedule a smaller aircraft, which is typically quieter, or opt not to schedule a flight at that time.

The Applicant's modelling shows that the annual night quota count (i.e. over the period 23:00 to 06:59) will be highest in 2025, at 15,892. This suggests that the 8-hour alternative noise quota limit of 16,260 as suggested by ANCA can be met without imposing any restrictions on how an airline may wish to operate from the airport subject to more restrictive restrictions on aircraft QC from 2030 onwards.

Nevertheless, it is possible that ATM growth increases more quickly than forecast by the Applicant, and/or the Applicant's assumptions around fleet replacement are optimistic. Under such a scenario, there would be a cost to the Noise Quota Scheme.

1.6.3. Effectiveness of measures

As the Balanced Approach requires us to consider operating restrictions only after other alternatives have been fully considered, it is necessary for us to compare the performance of the measures that are operating restrictions against the alternatives. Below, we compare the

[14] Commission for Aviation Regulation (2021) Airport Charges. Available at aviationreg.ie

operating restrictions measures to three other measures that do not include operating restrictions: [15]

- **Most effective measure under the HSD metric.** This is the combination of runway pattern and noise insulation variant that results in the greatest reduction in number of people HSD. Based on our analysis, the most effective measure under the HSD metric is runway pattern P09 with noise insulation variant C6.
- **Most cost-effective measure.** This is the combination of runway pattern and noise insulation variant that results in the most cost-effective outcome under the given metric. We consider this to be runway pattern P10 with noise insulation variant B, based on the analysis in [Section 1.6].
- **The Applicant's preferred measure**, which is runway pattern P02 with noise insulation variant B.
- **A more effective variant of the Applicant's preferred measure.** The Applicant's preferred measure performs worse than the FWNM in terms of reducing the number of people HSD. We therefore consider a variant of this measure that performs better in terms of reducing the number of people HSD – runway pattern P13 with noise insulation variant C6.

Table J22 compares the effectiveness of the measures compared with the FWNM, and shows the number of people that remain HSD or exposed to night-time noise priority following the implementation of the measures

Table J22: Reduction in people impacted in 2025 under different measures

Measure	Number of people no longer impacted compared with FWNM		Number of people impacted following measure	
	HSD	Night-time noise priority	HSD	Night-time noise priority
Permitted Operations	-14,083	-16	22,481	0
The Applicant's Proposed Noise Quota Scheme	0	0	36,564	16
Alternative Noise Quota Scheme	0	0	36,564	16
Most effective measure under HSD metric	-2,022	-16	34,542	0
Most cost-effective measure	-219	-16	36,345	0
The Applicant's preferred measure	442	-16	37,006	0

[15] Note that it was not possible to derive effectiveness measure Permitted Operations Scenario for Significantly Adversely Affected people due to data not being available.

Scenario P13 with noise insulation C6	-393	-16	36,171	0

Source: CEPA analysis of daa data and assumptions

This table shows that the operating restrictions within the Permitted Operations scenario are by far the most effective at reducing the number of people HSD. The other measures do vary in their effectiveness, but the differences between them are relatively small.

1.6.4. Cost-effectiveness of measures

Below, we present the cost-effectiveness of the different measures against out two metrics. Given the uncertainty around the costs imposed by the Permitted Operations scenario, we present the cost-effectiveness as a range.

Table J23: Cost effectiveness of different measures relative to the FWNM (€ per person, 2020 prices)

Measure	HSD	Night-time noise priority
Permitted Operations	6,000 to 73,000	694,000 to 8,032,000
The Applicant's Proposed Noise Quota Scheme	0	0
Alternative Noise Quota Scheme	0	0
Most effective measure under HSD metric	21,000	2,575,000
Most cost-effective measure	Cost savings	Cost savings
The Applicant's preferred measure	Performs worse than FWNM	242,000
	21,000	511,000

Source: CEPA analysis of daa data and assumptions

The table above shows that runway pattern 10 (alternating between using the North Runway and South Runway over the period 00:00 and 06:00) with noise insulation variant B (insulating homes exposed to noise greater than 55 dB L_{night}) is the most cost-effective under both metrics. However, as discussed previously, it does not perform as well against the significantly adversely affected metric which is an aspect of the noise problem identified by ANCA.

The table also shows that when looking at the outcomes targeted by the NAO, particularly the HSD metric, the measure preferred by the Applicant does not perform well. However, it does perform well against minimising the number of people experiencing significant noise changes (i.e. significantly adversely affected).

Scenario P13, in isolation, is one of the most cost-effective runway use and restriction scenarios. When combined with insulation option C6, the combination of measures is not necessarily the most cost effective under the outcomes targeted by the NAO. However, it does achieve an improvement under both outcomes targeted by the NAO, and is likely to perform well when considering the significantly adversely affected metric.

Our lower bound estimate of the cost-effectiveness of the Permitted Operations scenario, suggests it is possible that the restrictions could be more cost-effective than some of the alternatives. But that is assuming the most optimistic outcome in terms of costs.