Source: Irish Deprivation Index, (2016). [Online]. Available from: https://maps.pobal.ie/WebApps/DeprivationIndices/index.html

Figure 7-3: Irish Deprivation Index

7.5.2 Labour Market Indicators

7.5.2.1 Participation Rate and Unemployment

The total size of the labour force across the Airport ED and Dubber ED in 2016 was 7,482. Within the labour force in this area, 711 (7.4%) people were unemployed having lost or given up a previous job. A further 78 people were looking for their first regular job. Of the labour force within this area, 6,693 (60.3%) were in employment.

The labour force participation rate (15-64 years) in the Airport ED (75.1%) and Dubber ED (79.3%) was significantly higher than the recorded rate in Fingal (66.9%), Dublin Regional Authority (63.9%), the Eastern & Midland Regional Assembly (63.3%) and Ireland (61.4%) as a whole.

The unemployment rate (15-64 years) in the Airport ED (8.3%) was significantly lower than the recorded rate in the Dubber ED (12.2%), Fingal (10.3%), Dublin Regional Authority (11.6%), the Eastern & Midland Regional Assembly (12.4%) and Ireland (12.9%) as a whole.

Table 7-8: Labour Force Participation Rate and Unemployment Rate, (2016).

	Airport ED	*Dubber ED*	*Fingal County*	*Dublin Regional Authority*	*Eastern & Midland Regional Assembly*	*Ireland*
	%	%	%	%	%	%
Labour Force Participation Rate	75.1	79.3	66.9	63.9	63.3	61.4
Unemployment Rate	8.3	12.2	10.3	11.6	12.4	12.9

Source: Central Statistics Office (Ireland) (2017), Census 2016.

7.5.2.2 Live Register

The Live Register is used to provide a monthly series of the numbers of people (with some exceptions) registering for Jobseekers Benefit (JB) or Jobseekers Allowance (JA) or for various other statutory entitlements at local offices of the Department of Social Protection.

Table 7-9 shows that the proportion of residents in the Dublin Regional Authority (38.9%) and the Eastern & Midland Regional Assembly (38.6%) on the Live Register for twelve months or more is higher than the national average (35.9%).

Table 7-9: Live register, (2020)

Indicator	*Dublin Regional Authority*		*Eastern & Midland Regional Assembly*		*Ireland*	
	Claimants	%	*Claimants*	%	*Claimants*	%
Claiming for under 12 months	30,942	61.1	56,775	61.4	135,596	64.1
Claiming for over 12 months	19,682	38.9	35,741	38.6	75,896	35.9
Total	**50,624**	-	**92,516**	-	**211,492**	-

Source: CSO, Live Register, (2020).

7.5.2.3 Education and Skills

The working-age residents within the Airport ED are well-qualified. Table 7-10 shows that 37.1% of residents within the Airport ED are qualified to Ordinary bachelors degree / professional qualification and above, which is higher than the recorded rate in Fingal (33.9%), Dublin Regional Authority (36.2%), the Eastern & Midland Regional Assembly (31.9%) and Ireland (28.5%) as a whole.

However, the proportion of working-age residents within the Dubber ED who hold an Ordinary bachelors degree / professional qualification is just 27.1%, significant lower than all other areas presented in Table 7-10.

Table 7-10: Highest level of education completed, (2016)

	Airport ED	*Dubber ED*	*Fingal County*	*Dublin Regional Authority*	*Eastern & Midland Regional Assembly*	*Ireland*
	%	%	%	%	%	%
No formal education	0.5	0.7	1.1	1.3	1.5	1.7
Primary education	2.9	5.0	6.6	9.2	9.8	10.8
Lower secondary	3.9	9.4	11.5	11.6	13.2	14.5
Upper secondary	12.3	17.8	19.6	17.0	18.0	18.5
Technical or vocational qualification	7.5	12.2	9.0	7.5	8.3	8.8
Advanced certificate / Completed apprenticeship	4.1	5.7	5.8	4.6	5.4	5.9
Higher certificate	5.4	5.8	5.7	4.6	4.9	5.0
Ordinary bachelor degree	9.3	8.2	9.1	8.0	7.9	7.7
Honours bachelor degree	12.7	10.9	12.6	13.4	12.0	10.7
Postgraduate diploma or degree	13.4	7.6	11.2	13.3	11.0	9.2
Doctorate (PhD)	1.7	0.4	1.0	1.4	1.1	0.9
Not stated	26.3	16.5	6.7	8.1	7.1	6.4

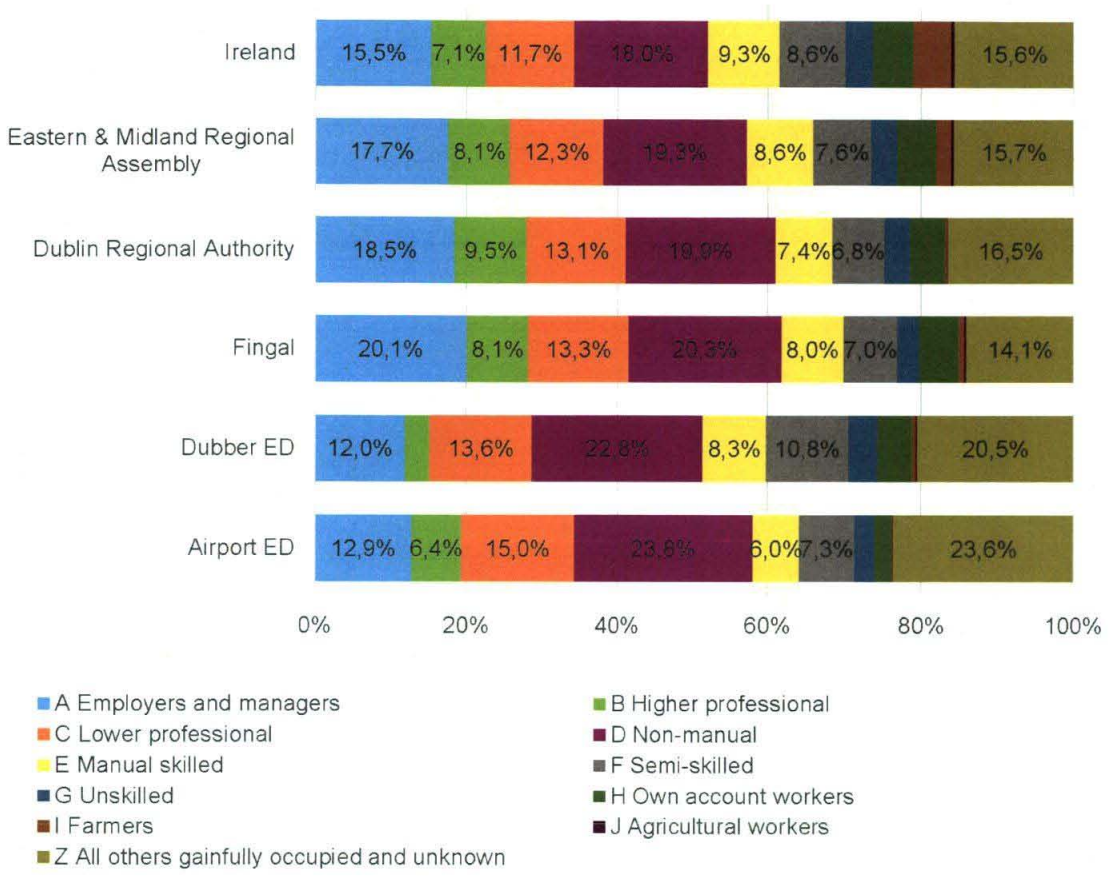
Source: Central Statistics Office (Ireland) (2017), Census 2016.

7.5.2.4 Occupational Profile

Socio-economic group (SEG) classifies the entire population into one of eleven groups based on the level of skill and educational attainment of the occupation (of those at work, unemployed or retired) while all other persons are classified to the socio-economic group of the person in the family on whom they are deemed to be dependent.

Within the Airport ED and Dubber ED, a large proportion of workers are employed within the lower professions or non-manual occupations. Similarly, the Airport ED and Dubber ED have a lower proportion of employers and managers and higher professionals in comparison to the averages for Fingal, the Dublin Regional Authority, the Eastern & Midland Regional Assembly and Ireland as a whole. This can be attributed to the large proportion of workers employed to support the operations of Dublin Airport.

Figure 7-4: Occupational profile by socio-economic group (15+ years) (%), (2016).



Source: Central Statistics Office (Ireland) (2017), Census 2016.

7.5.2.5 Income

Income levels in Fingal are substantially greater than across the country, likely helped by the high-level occupations that the residents in Fingal tend to hold. The median household annual income in Fingal in 2016 was €58,795, comfortably higher than the median rate for Ireland (€45,256). The median household weekly income within the Airport ED and Dubber ED is less than the average for Fingal, but still greater than the average across Ireland – as displayed in Table 7-11.

Table 7-11: Household income, (2016)

Indicator	*Airport ED*	*Dubber ED*	*Fingal*	*Ireland*
Median household annual income (€)	52,482	52,108	58,795	45,256

Source: CSO, Geographic Profiles of Income in Ireland (2016).

7.5.3 Human Health

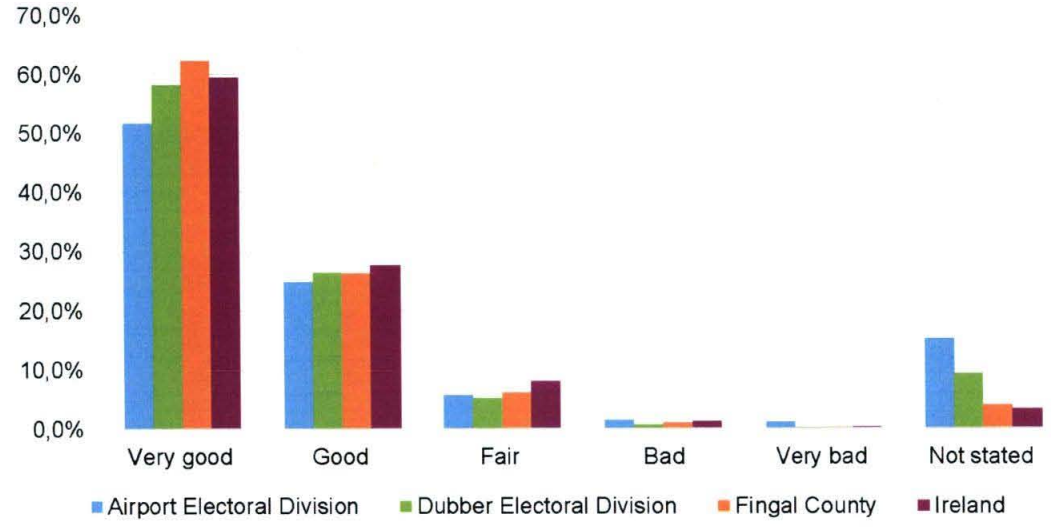
The life expectancies in Dublin and Ireland have been increasing in recent years creating an ageing population, a trend that is currently being experienced across most developed countries. In 2016, male residents in the Dublin Regional Authority were expected to live to 80.1 years whilst female residents were expected to live to 83.4 years, compared to 78.3 years and 82.7 years respectively in 2011 (Central Statistics Office, 2019). The life expectancies in 2016 are broadly in line with the country's averages (79.6 years for males and 83.4 years for females).

The health conditions in Dubber ED, Fingal and across the country are positive, but they appear slightly worse within the Airport ED. In 2016, 89% of the population aged 15 years and over in Fingal County considered

themselves to be in very good or good health, compared to Ireland's average of 88% (Central Statistics Office, 2016). In comparison, around 84% of residents in Dubber ED and 77% of residents in the Airport ED were in very good or good health[4].

It is worth noting that Ireland has the highest self-perceived health status of all EU countries, considerably above the EU average (67%) (DoH, 2018). Only 1% of residents in Dubber ED and Fingal were in bad or very bad health, which is the fourth lowest proportion of the 31 counties and cities across Ireland (Central Statistics Office, 2016). However, this proportion increases to 3% for Airport ED, which is high for the country. Figure 7-5 presents the health conditions in the Airport ED, Dubber ED and Fingal County, compared to the conditions across Ireland.

Figure 7-5: Health conditions for all persons aged 15 years and over (2015)



Source: Central Statistics Office (Ireland) (2017), Census 2016.

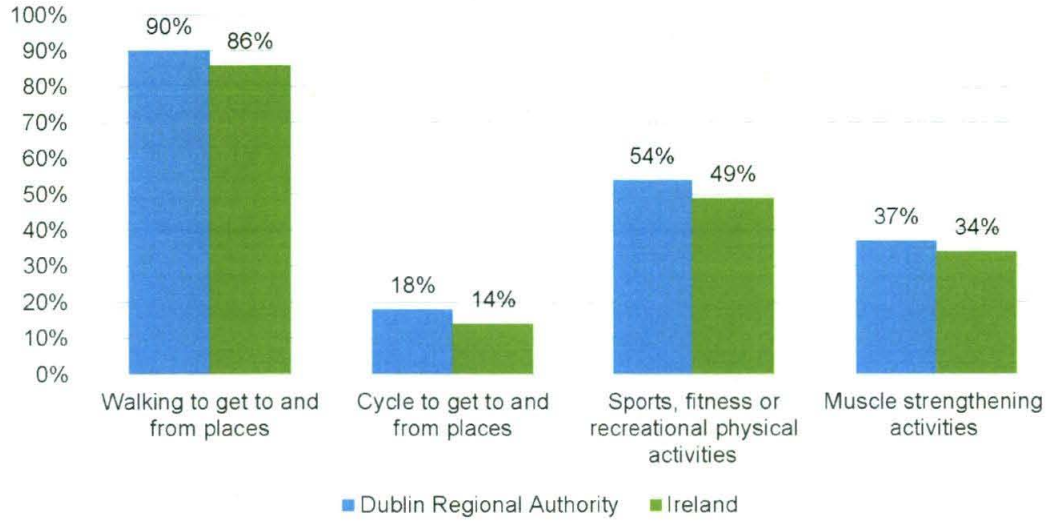
Fewer residents (as a percentage of total population) live with a disability in the Airport and Dubber EDs compared to Fingal and Ireland as a whole. In the 2016 Census, of residents aged 15 and over, 8.3% stated they had a disability in the Airport ED and 7.7% stated this in Dubber ED. These proportions are considerably lower than the averages for Fingal (10.8%) and Ireland (13.5%).

The Census 2016 does not provide further information on health limitations or physical activity data by local area. However, the Irish Health Survey provides further detail on health profiles at a regional level (Central Statistics Office, 2019).

Most residents aged 15 and over in the Dublin Regional Authority (73%) are not limited at all in their daily activities, with 24% limited slightly and only 3% considered to be severely limited. This profile almost matches the national results exactly, where 72% are not limited at all, 24% are limited slightly and 4% are severely limited. However, the residents in the region of Dublin tend to engage in more physical activity than the country's average. Figure 7-6 displays the proportion of residents aged 15 and over undertaking physical activity in the Dublin Regional Authority and Ireland. This highlights that residents in the Dublin Regional Authority are slightly more active across all metrics in comparison to the national averages.

[4] These statistics may not be wholly representative of the health conditions in the Electoral Divisions (ED), particularly the Airport ED, as 15% of respondents in the Airport ED and 9% of respondents in Dubber ED did not state an answer (country's average is 3%).

Figure 7-6: Physical activity undertaken for all persons aged 15 years and over in the Dublin Regional Authority and Ireland (2015)



Source: Centre Statistics Office (Ireland) (2019), Irish Health Survey 2015.

The Irish Health Survey reports the mental health status of residents (aged 15 and over). In 2015, 72% of residents stated they experience no or minimal depression in the Dublin Regional Authority, which was marginally lower than across Ireland (74%). The full mental health statistics for Dublin Regional Authority and Ireland are shown in Table 7-12, which indicates on the whole residents in Dublin experience similar levels of depression as residents across the county.

Table 7-12: Mental health status for all persons aged 15 and over

Mental health indicator	*Dublin Regional Authority*	*Ireland*
None to minimal depression	72%	74%
Mild depression	19%	18%
Moderate depression	6%	5%
Moderately severe or severe depression	3%	3%

Source: Central Statistics Office (Ireland), Irish Health Survey 2015.

There are several healthcare facilities in the surrounding area to Dublin Airport. The nearest of which is located within the Airport grounds, Medmark Dublin Airport Hospital, which provides occupational healthcare to residents in the area. Beaumont Hospital Dublin is the closest major hospital facility, located around 6km south of the Airport and easily accessible following the M1 South from the Airport. The Beaumont Hospital is a large facility, with 669 available inpatient beds (the third most of any hospital in Ireland) and 159 available day beds (most of any hospital in Ireland) (Department of Health, 2019). On average, across the Dublin Regional Authority, there are six GP consultations per person per year; this is the same as the country's average.

7.5.4 Local Community Facilities and Land Uses

7.5.4.1 Local Community Facilities and Land Uses

The area surrounding Dublin Airport is made up of several local communities which include numerous residential areas and community and recreational facilities such as open spaces and parks. Within the immediate vicinity of the airport, there is a cluster of community facilities. This includes the ALSAA Sports Centre, Swords Rugby Club, Kealy's public house and The Coachman's Inn; all of which are located along the R132. Approximately 500 metres to the south of these facilities is Dardistown Cemetery. North west of the airport is the St Margaret's Golf & Country Club and the St Margaret's GAA Club. North east of the airport, directly east of the E132 is the Halpenny Golf Driving Range. Immediately north of the Airport is the Forrest Little Golf Club.

To the immediate west of the airport boundary, located on the R108 is the Boot Inn public house. Directly to the south of the airport beyond the Blue Long Stay Car Park is the Silloge Park Golf Club, Na Fianna GAA Club, Ballymun Kickhams GAA Club and Starlights GFC.

Although strategic land-use planning means there are a lot fewer residential developments within close proximity to Dublin Airport in comparison to other airports of a similar size, there are a number of residential properties located to the west of the airport along Dunbro Lane. Beyond these is the community of Saint Margaret's. In addition to numerous residential dwellings, the village is home to St Margaret's Church and St Margaret's National Primary School.

The largest town within the surrounding area is Swords which is located around 5km north of Airport. Swords contains numerous community facilities, businesses, leisure and residential assets.

There are several villages located further to the east of the Airport towards the coast. This includes the suburbs of The Baskins (2.5km) and Kinsealy (3.5km). Further east towards the Irish Sea are the coastal towns of Malahide (5.5km) and Portmarnock (6.5km) which contain numerous community and recreational facilities. Several golf courses are located around Malahide and along the western coastline, including Malahide Golf Club (6.0km) and Portmarnock Hotel and Golf Links (7.0km).

7.5.4.2 Dublin Airport Community Fund

Dublin Airport, through the Dublin Airport Community Fund, provides support for sports and recreation, social inclusion and community development, health and well-being, culture and heritage, and environment and sustainability. Established in 2017, the €10 million Dublin Airport Community Fund has an annual investment of €400,000 over a 25-year period (WHO, 2020).

The Dublin Airport Community Fund supports community-led projects in 13 eligible areas[5] located in the immediate vicinity of Dublin Airport where communities are situated under flight paths (Barton, H. and Tsourou, C, (2000). The design of the Dublin Airport Community Fund, both in terms of geography and the type of activities which are being supported, was agreed following consideration of detailed feedback from the Northern Runway's second public consultation process in 2016.

All applications are independently assessed by a panel based on the project's positive contribution to local communities. To date, over 480 local community projects have shared over €1 million of allocations from the Dublin Airport Community Fund.

7.6 Environmental Design and Management

There are a number of measures already in place at Dublin Airport that reduce or mitigate the noise effects of aircraft operations. As described in Section 13.5 of ***Chapter 13. Air Noise and Vibration*** and Section 14.5 of ***Chapter 14. Ground Noise and Vibration***, these include:

- Reduction of noise at source;
- Land use planning and management (noise zones, residential sound insulation schemes, the schools sound insulation scheme, and the dwelling purchase scheme);
- Operational procedures; and
- Operating restrictions.

7.7 Assessment of Effects and Significance

7.7.1 Effects During Operation of Proposed Relevant Action

7.7.1.1 Amenity and Local Communities

Noise and Vibration

The noise and vibration impacts associated with the proposed Relevant Action have been considered in ***Chapter 13. Air Noise and Vibration*** and ***Chapter 14. Ground Noise and Vibration*** using two European noise metrics,

[5] Ballymun, Cloghran, Forrest Little, Greater Baskin, Hollystown, Malahide, Portmarnock, Rolestown, Santry, St. Margarets, Swords, The Ward, Tyrrelstown.

one which considers the level of activity over a 24-hour period metric (with penalties applied for noise during the evenings and overnight)[6] and one which considers the level of activity overnight[7].

With regards to air noise and vibration impacts associated with the proposed Relevant Action, a package of existing and proposed sound insulation schemes is offered, and will continue to be offered as part of this application by Dublin Airport to deliver improvements in internal noise levels experienced by residential and community facilities. This assessment considers the residual significant effects after allowing for the benefit of the existing and proposed sound insulation schemes.

Using the 24-hour period metric to assess residential receptors as set out in ***Chapter 13. Air Noise and Vibration***, 2,110 people are assessed as having a residual significant beneficial effect and 10 people are assessed as having a residual significant adverse effect as a consequence of the implementation of the proposed Relevant Action. Residential receptors close to flight paths to the west of the existing South Runway or close to flight paths from the crosswind runway typically are forecast to see reductions in noise level, whereas the opposite is true for receptors closer to flight paths to the west of North Runway.

Using the overnight metric to assess residential receptors as set out in ***Chapter 13. Air Noise and Vibration***, 1,125 people are assessed as having a residual significant beneficial effect and 11,756 people are assessed as having a residual significant adverse effect. As above, the majority of the residual significant adverse effects are expected to be experienced within close proximity to the flight paths from the North Runway.

The impact of noise and vibration on community facilities is also considered within ***Chapter 13. Air Noise and Vibration.*** The assessment considers, schools, residential healthcare facilities and places as worship as high sensitivity receptors. Receptors with a lower sensitivity to noise, such as open spaces and recreation grounds, have not been considered as part of the air noise and vibration assessment. There are no significant noise and vibration effects reported on schools, residential health care facilities or places of Worship[8].

As set out in ***Chapter 14. Ground Noise and Vibration***, no residential receptors are expected to experience significant effects, either adverse or beneficial, using the 24-hour period metric.

Using the overnight metric to assess residential receptors as set out in ***Chapter 14. Ground Noise and Vibration***, no people are assessed as having a significant beneficial effect and 34 people are assessed as having a significant adverse effect. With the residual situation with Apron 5H and the ebenfit of mitigation measures, there would be 3 people assessed as having a significant beneficial effect and 12 people assessed as having a significant adverse effect.

The impact of noise and vibrations on community facilities is also considered within ***Chapter 14. Ground Noise and Vibration***. The assessment considers dwellings, schools, residential healthcare facilities and places as worship as high sensitivity receptors. Receptors with a lower sensitivity to noise, such as open spaces and recreation grounds, have not been considered as part of their assessment. There are no schools or places of worship above the thresholds for significance, and one residential healthcare facility above the threshold.

Air Quality

In regard to emissions as set out in ***Chapter 10. Air Quality***, the proposed Relevant Action will not result in any significant change to the local air quality environment (NO_2, PM_{10} and $PM_{2.5}$) or odour as a result of the proposed change in aircraft movements. More specifically, the proposed Relevant Action will not result in any receptors exceeding European standards or the upper Irish air quality thresholds. Therefore, there is little risk of any exceedance of the environmental air quality assessment levels considered for the protection of human health for residents or users of community facilities.

Assessment

The amenity and local communities assessment considers the assessment findings from air quality, air noise and vibration, and the ground noise and vibration assessments. Sensitivity of affected local residents is assessed to be high while the impact is assessed as medium given the number of dwellings affected. Some residents will benefit

[6] L_{den}, which takes into account the annual activity throughout the 24-hour period, with a 5 dB penalty applied to noise in the evening (19:00-23:00) period and a 10 dB penalty applied to noise in the night (23:00-07:00) period. The key effect linked with this metric is annoyance.
[7] L_{night}, which takes into account the annual activity during the night (23:00-07:00) period. The key effect linked with this metric is sleep disturbance.
[8] It should be noted that only residential healthcare facilities are highly sensitive to noise at night. Schools and places of worship are not expected to be used during the hours specified in the overnight metric.

from the proposed Relevant Action whilst others will experience significant effects from air and ground-borne noise and vibration.

On the basis of the number of residents adversely impacted by air noise and vibration, the effect on amenity and local communities from a population and human health perspective is assessed to be **permanent moderate adverse (significant)**.

7.7.1.2 Human Health and Well-being

This section summarises the impact of the proposed Relevant Action on human health and well-being, structured by health determinants as set out in *London HUDU Rapid Health Impact Assessment Tool* (London Healthy Urban Development Unit, 2019).

Air quality, noise and neighbourhood amenity

As set out in Section 7.4, the quality of the local environment can have a significant impact on physical and mental health. Pollution caused by aviation and commercial activity can result in poor air quality, noise nuisance and vibration. Poor air quality is linked to incidence of chronic lung disease (chronic bronchitis or emphysema) and heart conditions and asthma levels of among children and young people. Noise pollution can have a detrimental impact on health resulting in sleep disturbance, cardiovascular and psycho-physiological effects. Good design and the separation of land uses can lessen noise impacts.

An assessment of the likely significant effects of air quality as a result of the proposed Relevant Action has been presented in ***Chapter 10. Air Quality***.

In regard to emissions, the proposed Relevant Action will not result in any significant change to the local air quality environment (NO_2, PM_{10} and $PM_{2.5}$) or odour as a result of the proposed change in aircraft movements. More specifically, the proposed Relevant Action resulted in no receptors being predicted to exceed European standards or the upper Irish air quality thresholds. Therefore, there is little risk of any exceedance of the environmental assessment levels considered for the protection of human health.

Noise pollution, both as a result of air noise and vibrations and ground noise and vibrations, can have a detrimental impact on health resulting in sleep disturbance, cardiovascular and psycho-physiological effects.

An assessment of the likely significant effects of air noise and vibrations as a result of the proposed Relevant Action has been presented in ***Chapter 13. Air Noise and Vibration***. As detailed in sections 0 to 0, some residents benefit from lower noise levels whilst some residents will be impacted adversely by higher noise levels. There are no significant noise and vibration effects reported on schools or residential health care facilities. Whilst it is accepted that there may be some degree of annoyance from noise to users of open space and nature, this will be commonly for short periods of time when people are passing through the open spaces and nature.

An assessment of the likely significant effects of ground noise and vibrations as a result of the proposed Relevant Action has been presented in ***Chapter 14. Ground Noise and Vibration.*** As detailed in sections 0 to 0, some residents are impacted adversely by higher noise levels. There are no significant noise and vibration effects reported on schools and residential healthcare facilities. Whilst it is accepted that there may be some degree of annoyance from noise to users of open space and nature, this will be commonly for short periods of time when people are passing through the open spaces and nature.

Given the number of people assessed as being adversely residually significantly affected within ***Chapter 13. Air Noise and Vibration***, the impact of the proposed Relevant Action on air quality, noise and neighbourhood amenity as a determinant of human health and well-being is assessed to be **negative (-).**

Climate change

An assessment of the likely significant effects on greenhouse gas (GHG) emissions as a result of the proposed Relevant Action has been presented in ***Chapter 11. Climate and Carbon***.

The GHG assessment study area considers all GHG emissions from fuel used by aircraft during the LTO cycle (i.e. approach/landing, taxiing, take-off and climb to 3,000 feet). It is stated that by 2025, the proposed Relevant Action is estimated to represent 333,474 tonnes of CO_2, an increase of 12,206 tonnes of CO_2 in comparison to the permitted operations.

The impact of the proposed Relevant Action has been compared with Ireland's projected National Emissions Inventories for each of the assessment years (under the With Additional Measures scenario) to determine the level

of significance. As the GHG emissions associated with the proposed Relevant Action do not represent ≥1% of the projected National Emissions Inventory for either of the assessment years, GHG emissions are considered to be of minor significance.

The proposed Relevant Action is not likely to significantly affect significant ecological features during operation as a result of light or surface water pollution because there would be no additional lighting or surface drainage amendments relative to the consented (and amended in 2020) planning permission for the North Runway.

Therefore, impact of the proposed Relevant Action on climate change as a determinant of human health and well-being is assessed to be **neutral** (0).

7.8 Additional Mitigation Measures

7.8.1 Mitigation During Operation of Proposed Relevant Action

No additional mitigation measures related to Population and Human Health are anticipated to be required during the operation of the proposed Relevant Action.

This said, Dublin Airport will continue to provide support for community-based projects associated with sports and recreation, social inclusion and community development, health and well-being, culture and heritage, and environment and sustainability through the Dublin Airport Community Fund. Established in 2017, the €10 million Dublin Airport Community Fund will continue to provide up to €400,000 of investments annually over a 25-year period.

In addition to mitigation measures already in place at Dublin Airport, daa are also proposing a number of measures in relation to the air noise and vibration effects. Of relevance to population and human health is the proposal to provide eligible dwellings with a grant to pay for sound insulation works based on their night-time air noise level.

Further details of all mitigation measures relating to air noise and vibrations are presented in ***Chapter 13. Air Noise and Vibration.***

7.9 Residual Effects and Conclusions

As part of the assessment of impacts on population, the overall classification and significance of each effect has been assessed across the study area. A summary of the potential effects on population is identified in Table 7-13.

Table 7-13: Population Summary of Potential Effects

Description of Effect	*Sensitivity of Receptor*	*Nature of Effect / Geographic Scale*	*Magnitude of Impact*	*Initial Classification of Effect (with embedded mitigation)*	*Additional Mitigation*	*Residual Effect Classification and Significance*
Operation						
Amenity and Local Communities	High	Permanent / Local	Medium	Moderate Adverse	None	Moderate Adverse (significant)

As part of the assessment of impacts on human health, the overall classification for each health determinant has been assessed across the study area. A summary of the potential effects on human health is identified in Table 7-14.

Table 7-14: Human Health Summary of Potential Effects

Health Determinant	*Potential Health Impact*	*Additional Mitigation*	*Residual Effect Classification*

Operation

Air Quality, Noise and Neighbourhood Amenity	Negative (-)	None	Negative (-)
Climate Change	Neutral (0)	None	Neutral (0)

Chapter 08: Major Accidents and Disasters

08

8. Major Accidents and Disasters

8.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) describes the findings of an assessment of the likely significant effects of the proposed Relevant Action associated with the risks to third parties arising from aircraft crash.

The assessment take account of the requirement in Annex IV of the EIA Directive for "*A description of the likely significant effects of the proposed project on the environment resulting from, inter alia: (d) the risks to human health, cultural heritage or the environment (for example due to accidents or disasters)*" and the reference in point 8 of the Annex: "*A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies*".

The assessment also considers the effects of the following items of risk:

- Bird strike;
- Wake vortex; and
- Fuel dumping.

There is essentially no material difference between the permitted / constrained and proposed / unconstrained operations in respect of the three topics above. However, for completeness, a summary of each and the existing controls is provided in Sections 8.9 to 8.11 of this chapter. The primary focus of this chapter is therefore on the first of the above issues: the risk to third parties and the environment arising from aircraft crashes.

Aircraft crashes are very rare events but those that do occur take place predominantly during take-off and landing, along flight paths and close to the ends of runways. The risks to members of the public that live and work in these areas can therefore be expected to be elevated to some extent above the background to which people in general are exposed.

The proximity of populated areas to those areas along flight paths and close to the runway ends where the crash risk is more concentrated, and the associated risks to third parties, are therefore potential concerns for any airport development or operational change proposal. Given established land use practices, such risks cannot be eliminated completely and must therefore be tolerated in return for the benefits of air transport. In practice, in comparison with the situations encountered more generally in Europe and elsewhere, there are generally fairly limited areas of existing development in locations subject to elevated risks along flight paths at Dublin Airport. Nevertheless, it is appropriate to provide a thorough account of the implications of the proposed Relevant Action for the risks to third parties arising from aircraft crashes.

This assessment and EIAR chapter has been produced by Eddowes Aviation Safety Limited.

8.2 Legislation and Planning Policy Context

8.2.1 National Legislation

The primary legislation relating to aviation safety in the Republic of Ireland is set at EU level in accordance with Regulation No 1139/2018 on common rules in the field of civil aviation which includes the establishment of the European Aviation Safety Agency (EASA). This regulation defines the framework through which the standards and recommended practices of the International Civil Aviation Organisation (ICAO), which govern international civil aviation world-wide, are adopted across the EU. In the case of airports, Regulation No 139/2014, as amended by Regulation No 161/2017 and Regulation No 401/2018, establishes the basis for licensing of aerodromes by reference to defined certification specifications which identify the technical standards adopted by EASA, indicating means to show compliance with the framework regulation and its Implementing Rules. Licensing of aerodromes

in accordance with these technical standards ensures that international airports such as Dublin Airport provide safe environments for the operation of the types of aircraft that they are intended to serve. Further regulations apply to the operation of aircraft and to air traffic management services to ensure that all elements of the system provide for safe and efficient air transport. These requirements are implemented at national level by the Irish Aviation Authority (IAA).

Whilst the safety framework identified above is intended primarily to provide for the safety of aircraft and their occupants, it will also support the safety of those living and working in the vicinity of airports by ensuring that aircraft crashes are very rare events. Nevertheless, as has already been noted above, although aircraft crashes are very rare events, the majority occur along flight paths and close to the runway ends where the crash risk is more concentrated, as demonstrated by the detailed technical analysis that underpins the models employed to support the assessment of crash risk described later in this chapter. Whilst the ICAO and EASA technical specifications for the physical characteristics of aerodromes provide a safe operating environment for aircraft, they do not make any specific provisions for the protection of third parties. Guidance in relation to airport planning supporting the implementation of the standards recognises that third-party risk is an important issue in decision-making on airport development. No specific aerodrome design prescriptions relating to this issue are provided in the standards. However, the guidance advises that specific methodologies can be developed by States and used to define dedicated land use policy controls.

Within the above international regulatory framework for aviation safety, the Republic of Ireland is one of a limited number of countries that has developed specific land use controls to address third party risk, as discussed below.

8.2.2 National Planning Policy

In 2003, the Department of Transport and the Department of Environment, Heritage and Local Government (DoEHLG) commissioned a study (ERM, 2005) into Public Safety Zones (PSZs) at Ireland's three principal airports; Cork, Dublin, and Shannon (hereafter referred to as the ERM Report). The study resulted in the recommendation that a policy for land-use planning control be adopted in areas located in the vicinity of runway ends that are subject to higher levels of risk. The two primary elements of this policy recommendation were as follows:

- To prevent further development within inner PSZs, defined by the limits of the area subject to an individual risk of 1 in 100,000 per year, but to allow existing developments to remain.
- To allow existing developments to remain within the outer PSZs, defined by the limits of the area subject to an individual risk of 1 in 1,000,000 per year but prevent high density housing development, and the building of schools, hospitals and facilities attracting large numbers of people.

The concept of individual risk that underpins these recommendations is explained further in Section 9.3 and, in particular, in paragraph 9.3.23 which identifies the assessment criteria for evaluation of impact significance.

As yet, guidelines for the implementation of this PSZ policy recommendation have not been issued by the Department of Housing, Local Government and Heritage. However, the general principles behind the policy are adopted at the local planning level, as described further below.

However, it should be recognised that the PSZ approach to the control of new development in the vicinity of airports does not explicitly address the issues associated with a new development within an established built environment. These are two distinct development control issues and the assessment of the proposed Relevant Action requires consideration of the latter one relating to impacts on existing development. In that context, the inner and outer PSZs, as determined for the operations foreseen for the current application, identify areas that are subject to identified levels of risk and establish an objective framework for the consideration of the significance of risk impacts. Thus, whilst not directly relevant to the evaluation of the proposed Relevant Action, PSZ policy provides a useful reference point.

8.2.3 Local Planning Policy

Provisional PSZs, based on the 1 in 100,000 per annum and 1 in 1,000,000 per annum individual risk contours, were identified for Dublin Airport as part of the 2003 DoEHLG study. These provisional PSZs, shown in Figure 8-1, were based on an assumed maximum capacity scenario, involving the equal use of the two parallel runways in mixed mode. They are therefore conservative and cover larger areas than those required to meet the identified PSZ policy objective for the anticipated operations considered in this assessment.

The developing PSZ policy approach was first recognised formally in local planning policy in 2005 under the Fingal County Development Plan 2005 – 2011 (FCC, 2005). This plan describes the background to PSZ policy, stating that "the purpose of Public Safety Zones is to protect the public on the ground from the small but real possibility

that an aircraft might crash in a populated area" and that "a Public Safety Zone is used to prevent inappropriate use of land where the risk to the public is greatest." In that context, the County Development Plan identifies a commitment to implement the policies to be determined by Government in relation to Public Safety Zones for Dublin Airport under Policy TP19. The County Development Plan also identified a more general requirement under Strategy DAS3 "to promote appropriate land use patterns in the vicinity of the Airport and of the flight paths serving the Airport, having regard to the existing and anticipated noise, safety and environmental impacts of aircraft movements" which is consistent with Policy TP19. Whilst noting that the definition of the extent of PSZs and the associated land use restrictions were awaiting a decision by Government on the Draft PSZ Study the County Development Plan identified the draft zones determined in the 2003 DoEHLG study on the Development Plan maps. These elements of policy have been retained in subsequent County Development Plans (FCC, 2011) & (FCC, 2017), including the current County Development Plan 2017-2023, as described further in the following section.

The draft PSZs were also employed to support the consideration of the safety impacts of the proposals for the Northern Runway during the original planning process (F04A/1755 & PL06F.217429) (ABP, 2006). Clarification concerning the interpretation of the status of PSZs by Fingal County Council was provided at the oral hearing when it was stated that the Council was taking the view that a cabinet decision was made to adopt the ERM report in principle. As such, the relevant recommendations in terms of restrictions on development were being followed by the planning authority.

8.2.3.1 Fingal Development Plan 2017-2023

In accordance with the above discussion, the County Development Plan 2017-2023 identifies the following objectives in relation to land use controls and public safety in the vicinity of Dublin Airport:

- Objective DA13: Promote appropriate land use patterns in the vicinity of the flight paths serving the Airport, having regard to the precautionary principle, based on existing and anticipated environmental and safety impacts of aircraft movements.
- Objective DA14: Implement the policies to be determined by the Government in relation to Public Safety Zones for Dublin Airport.

8.2.4 Other Relevant Policy, Standards and Guidance

In addition to the standards applicable to development control in the vicinity of airports under PSZ policy to address risk associated with aircraft crash events, the Health and Safety Authority (HSA) provides guidance (HSA, 2010) on the assessment and management of other potentially hazardous activities in the Republic of Ireland, more specifically in the context of the regulation of Control of Major Accident Hazard (COMAH) sites and land-use planning in their vicinity. Whilst airport aircraft related operations are not covered by the COMAH Regulation, the nature of the hazard associated with an aircraft crash is similar in some respects to that associated with COMAH sites in so far as both may give rise to periodic accidental events causing multiple fatalities. The approach set out by the Health and Safety Authority is consistent with that adopted more widely in Europe and elsewhere. It reflects the recognition that risks in modern industrial society cannot be eliminated entirely in the context of the existing development framework and so may need to be tolerated in return for the benefits associated with them, provided that they are sufficiently small and managed so as to be as low as reasonably practicable, as summarised broadly in UK guidance (UK HSE, 2001).

The HSA guidance describes requirements for the rigorous and systematic quantitative assessment of major accidents and disasters and the use of quantitative risk criteria for evaluating risk significance and acceptability. As well as identifying individual risk criteria, conceptually similar to those adopted under PSZ policy, the HSA guidance identifies "societal risk" criteria that provide a basis for assessing the significance of periodic accidents that may give rise to multiple fatalities. This broader guidance has been employed to support the establishment of an objective framework for evaluation of the risks associated with operations at Dublin Airport.

8.3 Assessment Methodology

This section of this EIAR chapter describes the approach to the assessment of the risks to third parties arising from aircraft crash associated with the proposed Relevant Action, covering the following:

- Information sources that have supported the preparation of this chapter;
- Details of supporting consultation that has been undertaken;
- The methodology behind the assessment, including the criteria for the determination of the scale of impacts and the magnitude of change from the identified 'baseline' conditions for the parallel runway system from

the start of its operation: ie a comparison between the 2022 and 2025 permitted / constrained and proposed / unconstrained scenarios;

- An explanation as to how the identification and assessment of potential third party risk impact effects has been reached; and
- The significance criteria and terminology for the assessment of residual risk impacts to people within the vicinity of the airport and with consideration to ecological designated sites.

The key characteristics of the proposed Relevant Action that define the basis for the assessment of potentially significant third party risk impacts are as follows:

- The runway layout, in particular the runway end locations that provide the reference points for the relevant take-off and landing operations;
- Flight paths to and from the runways that define the areas over which aircraft fly and hence where the crash risk may be elevated above the wider background levels;
- The fleet mix of aircraft operating under the scenarios identified for assessment and the annual number of movements of each aircraft type which determine the scale of the risk, in accordance with the risk model that identifies crash rates from the historical accident record that are dependent upon the different aircraft types concerned and the consequences of ground impacts that are similarly dependent upon the aircraft types, according to their size.

The assessment has employed equivalent assumptions in respect of these characteristics to those used in the noise assessment in this EIAR (*Chapter 13: Air Noise and Vibration*, and *Chapter 14: Ground Noise and Vibration*). It is based on forecast operations for the permitted / constrained and proposed / unconstrained operations in 2022 and 2025, at night time. The future year of 2022, rather than the current year of 2020, has been selected on the basis that this is expected to be the first year when North Runway is expected to be operational and this is considered to provide a more appropriate reference point than a nominal year covering operations from the existing South Runway and Crosswind Runway only. Further details of the relevant assumptions are provided in the technical appendix to this chapter.

8.3.1 Methodology for Determining Baseline and Proposed Operational Effects

The risks associated with civil aviation are well-established on the basis of considerable operational experience worldwide over a substantial period of time. Whilst crashes may be considered rare at any given airport and within any limited time period, reference to the wider international accident record over an extended time period provides an effective basis for characterising this risk. It is evident from that experience that the primary hazard requiring attention in the context of the proposed Relevant Action relates to aircraft crash that might affect people living and working in the vicinity of the airport.

Site-specific risks to the public in the vicinity of airports can be estimated quantitatively by using an empirical modelling approach, based on historical accident data that characterises risk by reference to three key parameters as follows:

- The likelihood or probability (frequency per annum) of an aircraft crash occurring during take-off or landing operations, anywhere in the vicinity of an airport, having regard to the number of movements and the inherent reliability of different aircraft types, as determined from the available crash statistics;
- The probability of impact at any specific location at or near an airport relative to the runway ends and the flight paths beyond them, as described by the crash location distribution, determined by reference to crash locations in the historical accident data set;
- The severity of the consequences of an impact on the ground, according to the size of the aircraft concerned and again determined by reference to the historical accident data set.

The model provides estimates for the first factor on the basis of the crash rates derived for different aircraft types (e.g. civil passenger jet aircraft, civil passenger turboprop aircraft, business jet aircraft, jet and turboprop cargo aircraft) from the recent historical accident record. The model identifies different crash rates for take-off and landing operations. Based on the crash rates per movement for each aircraft type and the anticipated annual number of movements at Dublin Airport, the model provides an estimated annual crash rate for those operations.

The model provides estimates for the second factor by using generic crash location distribution functions that are determined for the observed historical distribution for civil aircraft accidents involving aircraft types that are generally representative of those operating at Dublin Airport.

The historical accident record demonstrates a relationship between the severity of crash consequences and the size of aircraft involved from which an empirical model relating the area affected to the take-off weight of the aircraft concerned has been derived to address the third factor. The crash consequences for the anticipated operations at Dublin can therefore be expected to cover a range of severities. The empirical crash consequence model is used to estimate the severities of these accident consequences by reference to the aircraft types and the associated size characteristics of aircraft within the anticipated fleet mix.

The modelling approach employed in the current assessment is essentially that identified by the UK Department for Transport (Department of Transport, 1997 and NATS, 2000) for the support of Public Safety Zone policy and adopted also in the DoEHLG PSZ study. No equivalent model has been developed in the Republic of Ireland and, given the time and effort that would be required to develop one, the adoption of the available UK DfT model represents a cost-effective practical solution. The technical details of the model are described further in the Technical Appendices supporting the EIAR.

In accordance with the outline provided in paragraph 9.3.2, key inputs required to support the above modelling approach are therefore as follows:

- The geometrical characteristics of the runway layout, in particular the runway end locations that provide the reference points for the relevant take-off and landing operations, and the associated flight paths to and from the runways that define the areas over which aircraft fly;
- The fleet mix of aircraft operating under the scenarios identified for assessment and the annual number of movements of each aircraft type which determine the scale of the risk.

The baseline operational impacts have been assessed on the basis of forecast operations for two reference years, 2022 and 2025, under the assumption that the current noise related operating restrictions continue to apply. All modelled scenarios employ forecast operations based on the assumption that the current 32 mppa limit on terminal capacity applies. Given that terminal capacity limit and the current global decline in air travel due to the Covid-19 pandemic, a relatively moderate growth in aircraft movements is forecast between 2022 and 2025 and the overall difference in forecast aircraft movements between the permitted / constrained scenario and those with the proposed / unconstrained scenario are relatively small.

Aircraft routes are defined according to international standards for the design of instrument flight procedures that ensure the safe separation of aircraft in flight, having further regard to the objective of minimising noise impacts on neighbouring communities. The use of noise preferential routes that avoid flight over populated areas where practicable will assist in minimising the third party risk impacts.

The mode of operation of the parallel runway system is a further relevant consideration. Preferential use of one or other runway for take-off or landing under either easterly or westerly operations, according to wind conditions can further limit the impacts on sensitive receptors. In the context of the Regulation 598 noise management requirements, extensive noise assessments have been undertaken [further details are provided in *Chapter 13: Air Noise and Vibration*, and *Chapter 14: Ground Noise and Vibration]* to identify the mode of operation that can minimise noise impacts, whilst meeting the anticipated demand for take-off and landing operations. The detailed operational specifications that have been developed through these noise assessments have been employed as the basis for the third party risk assessments.

Further details concerning the assumptions in the model and the relevant operational assumptions are provided in the Technical Appendices supporting the EIAR.

8.3.2 Study Area

The study area has been defined essentially as that area across which the scale of the risks to third parties arising from aircraft crash is sufficient to be considered potentially significant, when judged against the criteria described further below. A risk level above 1 in a million per annum has been identified as the appropriate criteria for the identification of a potentially significant risk of fatality for an individual. The primary study area in respect of individual risk was therefore defined to extend to at least the limit of the 1 in a million per annum individual risk contours for the different operational scenarios, as discussed in further detail in Sections 9.4 and 9.5. In order to provide an effective description of elevated risk levels along all flight paths, the study area was selected to extend out to beyond the limits of the 1 in a million per annum individual risk contours.

For societal risk estimation, the study area extends to a distance of 16 km laterally from the runway extended centrelines of the Southern Runway (Runway 10R-28L) and to a longitudinal distance of 18 km beyond and behind the Runway 10R Threshold. The mathematical functions that are employed for the estimation of risk as a function of location relative to flight paths identify crash probabilities that decrease progressively with increasing distance from the line of the flight paths and increasing distance from the runway ends. For mathematical functions of this sort, some residual element of risk will be identified to be located beyond any defined area extending out to any given distance from the runway. It is therefore impractical to define an area that encapsulates all of the risk predicted by these mathematical functions. Adoption of the area identified accounts for all but a few percent of the risk identified by the model functions and this area covers the vast majority of the areas of development where there would be a risk of fatalities in the event of an aircraft crash. The selection of this study area represents a pragmatic balance that will therefore ensure that reliable societal estimates are provided in return for a practical level of assessment effort.

In the context of the EIA, the sensitive receptors in the study area are the people living and working across it. The risks vary according to the precise location of sites relative to the runway ends and flight paths. The locations where people may be present and the numbers of individuals at each of the occupied locations was identified primarily by reference to the Q2 2019 An Post GeoDirectory, in accordance with the approach employed for the noise assessment. This approach identified individual residential development locations and community buildings within three categories: education, healthcare and religious buildings.

Consideration has also been given to the risk associated with a major accident or disaster occurring close to or in the vicinity of ecologically sensitive areas within the study are. Further details of which are provided in *Chapter 14: Biodiversity.*

For the purposes of the third party risk assessment, business premises that were identified through the Q2 2019 An Post GeoDirectory not included in the noise assessment were also considered on the basis of location, numbers present and periods of occupancy. The characterisation of these areas of development was supported by the review of Google Earth satellite images. The assessment also included consideration of risks to occupants within the airport terminal complex, taking account of the numbers working at the airport and the anticipated passenger throughput.

The specifications for distribution of people across the study area and the basis on which they were derived are described in further detail in the Technical Appendices supporting the EIAR.

8.3.3 Significance Criteria

Two distinct measures are available for characterising the risks estimated by airport-related crash risk models, as follows:

- Individual Risk: the annual probability of fatality for a hypothetical resident present at any given location relative to the runway threshold and flight path to and from it;
- Societal Risk: the annual probability of accidents causing any given number of fatalities in any particular area of development, taking account of the nature of the development, in particular the density of occupancy.

Both measures have been employed in this assessment. They are routinely employed in the assessment of the risks associated with other potentially hazardous facilities, within the Republic of Ireland (HSA, 2010 and ERM, 2005) and internationally (HSE, 2001).

Individual risk is the measure employed for the definition of PSZs. Public Safety Zone policy is a land-use planning tool for controlling new residential and other development in the vicinity of existing airport infrastructure. Certain land-uses are restricted in areas subject to a defined quantitative level of risk or more, on the basis that it is considered cost-beneficial to forego the development potential of the land, which involves a lost opportunity cost, in return for the benefit of reducing the risk of people on the ground being killed in areas along flight paths that are subject to elevated levels of risk. The individual risks are characterised in terms of a set of risk contours, representing the limit of the area subject to a defined level of risk.

Risk contours for three different levels of risk are typically employed in the assessment of individual risk, as follows:

- A risk of 1 in 10,000 per annum, considered to be a relatively high risk and at the limit of what is considered to be an acceptable level of risk exposure for members of the public;

- A risk of 1 in 100,000 per annum, considered to be a risk that is of potential concern but one that can nevertheless be considered acceptable in return for the economic benefits derived from the activity giving rise to the risk, provided that the risk is managed so as to be as low as reasonably practicable;
- A risk of 1 in a million per annum, considered to be a low risk that is a generally acceptable level of exposure for members of the public.

These identified risk levels provide a well-defined set of internationally recognised quantitative criteria for the evaluation of risk impact significance. In addition to the risk levels themselves, the relative numbers of people exposed to these risk levels provide a further criterion for evaluation of risk significance. Having regard to the established practice in the Republic of Ireland and elsewhere, criteria for assessing the significance of individual risk impacts have been developed in the format recommended in Section 3: Page 53 of the EPA Guidelines (EPA, 2017). These individual risk criteria for the identified descriptors of impact significance, summarised in Table 8-1, have been employed for the assessment of the impacts of operations at Dublin Airport. They are based on professional judgement concerning the alignment of the established safety standards and terminology with the framework identified in EPA guidelines.

Table 8-1 Assessment Criteria for Individual Risk Significance

Significance of Impact	Topic Specific Criteria
Negligible[1]	Individual fatality risk < 1 in 1,000,000 per annum
Slight Effects	1 in 1,000,000 per annum < Individual fatality risk < 1 in 100,000 per annum Low numbers (up to a few tens) of people exposed
Moderate Effects[2]	1 in 1,000,000 per annum < Individual fatality risk < 1 in 100,000 per annum High numbers (hundreds to thousands) of people exposed, Or 1 in 100,000 per annum < Individual fatality risk < 1 in 10,000 per annum Low numbers (up to a few tens) of people exposed
Significant Effects	1 in 100,000 per annum < Individual fatality risk < 1 in 10,000 per annum High numbers of people exposed
Very Significant Effects	Individual fatality risk > 1 in 10,000 per annum Low numbers (up to a few tens) of people exposed
Profound Effects	Individual fatality risk > 1 in 10,000 per annum High numbers (hundreds to thousands) of people exposed

Note 1: The term "negligible" is typically employed in safety regulation for risk levels that are below regulatory concern and this category can be considered to equate essentially with the "Not significant" and "Imperceptible" impact significance categories identified in EPA guidance.
Note 2: There will be some overlap between scenarios meeting the criteria identified for "moderate effects", according to the level of risk within the identified bands and the numbers of people exposed.

Individual risks for airport operations were estimated as part of the (DoEHLG) study (ERM, 2003) into Public Safety Zones. These risk estimates provide a further potentially useful reference scenario for evaluation of the risk impacts predicted as a result of the proposal to change permitted operations.

Whilst the identified individual risk criteria that underpin PSZ policy in the Republic of Ireland can provide some insight into the extent to which people living and working in the vicinity of Dublin Airport are exposed to the risk of aircraft crash, the individual risk measure does not effectively characterise the true nature of the risk. PSZ policy is concerned with the control of new development near existing airports and the use of individual risk criteria in that context is entirely appropriate. However, the current assessment is concerned with determining the impact of airport operations on existing development which is a distinct question. For these purposes, the aircraft crash risk is better represented as a periodic event that may lead to multiple fatalities, where the number of fatalities will depend on the density of occupation of the crash site and size of the aircraft concerned. This sort of scenario can be characterised more effectively in terms of the "societal risk", characterised quantitatively in terms of the estimated frequency of accidents, *f(N)*, leading to a defined number of fatalities, *N*. Societal risk estimates typically take account of the wide range of potential outcomes of an accident from the more common scenarios involving relatively few fatalities to less common ones involving larger numbers of fatalities.

Specific quantitative criteria for evaluating the significance of societal risks in the Republic of Ireland have been identified (HSA, 2010) in the context of the regulation of Control of Major Accident Hazard (COMAH) sites and land-use planning in their vicinity. Whilst the operation of aircraft at and in the vicinity of an airport are not covered by the COMAH regulations, the nature of the hazard associated with an aircraft crash is similar in some respects to

the operation of facilities that are in so far as both may give rise to periodic accidental events causing multiple fatalities. In common with COMAH sites, operation of the airport provides a clear tangible economic benefit that must be balanced against the risk associated with operation. In the absence of any societal risk criteria developed specifically for airport operations, reference has been made to these available criteria which can be seen to have been developed to address a broadly equivalent issue. These criteria are defined by reference to a "Scaled Risk Integral" (SRI) representing the sum over all scenarios of the accident frequency, *f(N)*, multiplied by the number of fatalities, *N*.

The risk integral is defined as:

$$SRI = \sum_{1}^{Nmax} f(N).N^{a}$$

In this expression, *f(N)* is the frequency of events leading to *N* fatalities (in units of casualties per million years), and '*a*' is a constant. For the assessment of COMAH (Seveso) establishments, the Health and Safety Authority guidance identifies the use of a value of $a = 1.4$, and the scale of the risk as measured by the risk integral can be judged against criteria of 2,000, identified as "broadly acceptable" in the wording of the guidance and 500,000, identified as "significant" in the wording of the guidance. In order to define quantitative criteria corresponding with the range of impact significance descriptions, in accordance with the approach identified for individual risk in Table 8-1, an SRI score of 2,000 has been equated with the upper limit of the "Not Significant" band whilst an SRI score of 500,000 has been equated with the lower limit of the "Significant Effects" band. A factor of approximately 16 between the upper and lower limits of each band is found to provide for the required subdivisions across that range and the societal risk significance criteria identified in Table 8-2 are determined on that basis. These societal risk criteria for the identified descriptors of impact significance have been developed, based on professional judgement, to set the standards identified in Health and Safety Authority guidance (HSA, 2010 in a framework consistent with the EPA Guidelines (EPA , 2017).

Table 8-2 SRI Assessment Criteria for Societal Risk Significance

Significance of Impact	Topic Specific Criteria
Negligible	Societal Risk Index (SRI) < 2,000
Slight Effects	2,000 < Societal Risk Index (SRI) < 32,000
Moderate Effects	32,000 < Societal Risk Index (SRI) < 500,000
Significant Effects	Societal Risk Index (SRI) > 500,000

The Health & Safety guidance (HSA, 2010) states (Section 2.2, page 11) that the SRI is used "*to provide a rapid initial assessment of the societal risk*" and that "*it must be emphasised that a full consideration of the FN curve is probably a more robust approach.*" The more robust approach through consideration of the FN curve, based on estimates for the frequency, F, of events that cause N or more casualties, has been adopted in this assessment. The guidance further states that "*there is ongoing debate as to whether scale aversion should be included at all in societal risk measures for land use planning, and so such risk integrals are only used as screening aids.*" Both of these approaches have been applied here and it is found that they lead to comparable conclusions concerning the significance of the impacts associated with the currently permitted and proposed future operations.

The choice of the value of the constant, *a*, determines the extent to which the possible greater aversion to accidents involving larger numbers of fatalities is factored into the evaluation of the risk significance. In the UK, the identified quantitative criteria (UK HSE 1989; 1992; Health and Safety Commission, 1991) for assessing the risks associated with major accidents and disasters have typically not adopted an aversion factor, corresponding with a value for the constant, $a = 1$. The most recent UK Health and Safety Executive guidance (UK HSE, 2001) identifies an event giving rise to 50 or more deaths with a frequency of more than 1 in 5,000 years as one that should be regarded as intolerable where there is a choice whether to accept the risk or not. The selection of that criterion takes some account of the aversion to events leading to large numbers of fatalities. The proposed Relevant Action has been assessed against these available quantitative criteria. These criteria have been developed by reference to the risks associated with a wide range of industrial and other activities. Whilst not developed specifically by reference to the risks associated with airport operations, they are considered to be of general utility for the assessment of the significance of societal risk and provide useful reference points in the current context.

8.3.4 Limitations and Assumptions

As outlined earlier in Section 8.3, the assessment is based on an empirical model that was developed by reference to recent historical accident data which provides generic insight into the likelihood of aircraft crashes, the likely locations of events in relation to flight paths and the impact consequences on the ground. Future risks associated with operations at Dublin Airport are estimated on the basis of forecasts for future operations, in terms of the numbers of aircraft movements following the available departure and approach paths to the three runways and the aircraft types involved. There will inevitably be limitations to the reliability of any quantitative risk model of this type due to inherent uncertainties in the model itself and the forecasts for future operations. Careful consideration has been given to the possible limitations of the modelling approach employed, as set out in Appendix A8. It has been concluded that this modelling approach is consistent with current best practice and provides a sound basis for assessing the implications for public safety of the proposed Relevant Action.

8.3.5 Methodology for Determining Construction Effects

As the proposed Relevant Action will result in no changes to the design or construction of the North Runway, there will be no changes to the physical infrastructure of the North Runway. On that basis, the assessment of construction phase impacts on the identified major accidents and disasters has been scoped out of the EIAR.

8.4 Baseline Conditions

8.4.1 2022 Individual Risk

The predicted baseline in respect of the individual risk impacts in 2022, after the North Runway has been constructed and is operational, i.e the permitted / constrained scenario, is summarised by the contour plots shown in Figure 8-1. The 1 in 10,000 per annum upper risk contours for both ends of all three runways are contained entirely within the airport boundary. A substantial proportion of the total area of the 1 in 100,000 per annum risk contours (82%) is also contained within the airport boundary. The length and area characteristics of these contours are summarised in Table 8-3 which also summarises the number of residential properties located within the contours and the number of commercial properties, excluding those within the Airport Campus buildings.

Table 8-3 2022 Permitted Operations Individual Risk Contour Characteristics

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
1 in 100,000 per annum individual risk contour						
Distance from Runway end	1,471	2,593	1,605	1,096	35	125
Distance outside airside limit	425	1,608	912	760	0	0
Total area (hectares)[1]	12.29	26.87	18.05	6.95	N/A	N/A
Area outside airside limit (hectares)	2.18	10.49	6.99	4.55	-	-
Number of dwellings[2] inside	0	0	0	0	0	0
Commercial sites inside	0	0	0	1	0	0
1 in 1,000,000 per annum individual risk contour, excluding 1 in 100,000 contour						
Distance from Runway end	4,747	10,839	6,024	2,818	688	861
Distance outside airside limit	3,701	9,854	5,331	2,482	433	607
Total area (hectares)[3]	57.73	274.73	172.45	31.79	N/A	N/A
Number of dwellings inside[4]	0	85	17	3	0	0
Commercial sites inside[5]	3	9	5	2	0	0

Note 1: The area identified for the 1 in 100,000 per annum risk contour includes a small contribution from the 1 in 10,000 per annum risk contour. Due to the nature of the overlap between the contours for the cross runway with the other two runways and the limited size of these contours, no attempt has been made to estimate the areas of the cross runway contours.

Note 2: The count of dwellings in this assessment includes residential properties for which the available building inventory identifies both residential and commercial use and where the commercial use is relatively small scale. Counts include a small number of developments evident on satellite images which are not listed in the available building inventory some of which may not be currently in use. Judgements on use categories have been made on the basis of the satellite images.

Note 3: The area identified for the 1 in 1,000,000 per annum risk contour excludes the element within the 1 in 100,000 per annum risk contour.

Note 4: In addition to the dwellings located within the contours beyond the runway ends, there are several residential properties located within the 1 in 1,000,000 per annum risk contour between the thresholds of the Southern Runway but none elsewhere between the thresholds.

Note 5: This count excludes commercial facilities within the Airport Campus and dual residential/commercial use sites which are identified in the dwellings count. Some identified sites accommodate multiple enterprises.

A desktop review of the land-uses in the areas covered by the 2022 future baseline 1 in 100,000 per annum individual risk contours has been carried out with the assistance of the available satellite imagery and other data sources. The key findings of the review are as follows:

- ***South runway, eastern end:*** The contour extends approximately 1,608 m from the airport operational boundary, crossing the R132 dual carriageway and the M1 motorway. The majority of the land within the contour outside the airport operational boundary is open fields with scattered trees. The contour encroaches slightly on an area of car parking and also two football pitches within the ALSAA Sports Complex. There are no commercial or residential properties within this contour.
- ***South runway, western end:*** The contour extends approximately 425 m from the airport operational boundary, crossing the R122 single carriageway road that is located immediately to the west of the airport boundary. Land within the contour located further to the west is entirely open fields. There are no commercial or residential properties within this contour.
- ***North runway, eastern end:*** The contour extends approximately 760 m from the airport operational boundary, mostly across open fields. At its eastern extremity, the contour crosses the R132 dual carriageway at a roundabout. There is a single apparent commercial site within the contour shown on the satellite images but this site is not listed in the available buildings inventory. There are no residential properties within this contour.
- ***North runway, western end:*** The contour extends approximately 912 m from the future airport operational boundary, mostly across open fields with trees. The contour crosses the L3132 Dunbro Lane and Kilreesk Lane, immediately to the west of the airport boundary. There are no commercial or residential properties within this contour.
- ***Cross runway:*** The 1 in 100,000 per annum risk contours for this runway are contained entirely within the airport boundary, due to the low forecasted number of movements.

The 2022 baseline 1 in 1,000,000 per annum individual risk contours cover a substantially larger area than the 1 in 100,000 per annum individual risk contours. The sizes of the contours are summarised in Table 8-3. The desktop review of land-use reveals that the majority of the additional areas covered by the 1 in 1,000,000 per annum contours compared with the 1 in 100,000 per annum contours are open fields. However, there are some developed areas within the contours that merit some specific comment. The key findings of the review in this respect are as follows:

- ***South runway, eastern end:*** The contour extends approximately 9.9 km from the airport operational boundary, slightly beyond the coast to the south of Portmarnock, crossing the R132 dual carriageway and the M1 motorway. Closer to the runway on the north side, it encompasses some aircraft stands and other airport-related facilities. Immediately to the east of the R132 on the north side of the runway extended centreline, prior to reaching the M1 motorway, the contour contains some commercial sites within the Airport Campus, including car rental facilities, and the ALSAA Sports Centre (located outside the airport). To the south, at Dardistown, there are several commercial properties and two residential properties and an area of airport long-term car parking within the contour. Immediately to the east of the M1 motorway, the contour includes several football pitches (Athletic Union League). The remainder of the land within the contour beyond that point is agricultural land comprising of open fields with scattered trees but includes also a small number of isolated residential properties. The key exception to that is at Drumnigh Wood, Portmarnock where the contour includes approximately 50 hectares of residential development, including approximately 60 residential properties. A total of 85 residential dwellings are identified as being located within this contour. Further to the east by the coast, a narrow strip of this contour crosses a golf course, part of the Portmarnock Hotel and Golf Links Complex.
- ***South runway, western end:*** The contour extends approximately 3.7 km from the airport operational boundary, crossing a number of roads, including the N2 dual carriageway and three small light industrial/commercial sites. Otherwise, the land within the contour is open fields and contains no residential development.
- ***North runway, eastern end:*** The contour extends approximately 2.5 km from the current airside boundary, mostly across open fields but also across a number of roads, including the M1 motorway. To the south of the roundabout along the R132 dual carriageway the contour encroaches partly into a small area of mixed

residential/commercial development. It includes a second commercial site on the north side of the runway extended centreline and two other residential properties.

- ***North runway, western end:*** The contour extends approximately 5.3 km from the anticipated future operational airside boundary, mostly across open fields with trees. The contour crosses a number of roads, including the M2 motorway. There are a number of scattered residential developments in this area and the contour includes a total of 17 residential dwellings and 5 commercial sites.
- ***Cross runway:*** The 1 in 1,000,000 per annum risk contours are shorter compared with those for the other runways but, unlike the 1 in 100,000 per annum risk contours, extend outside the airside operational boundary. To the south, the contour extends into a car park, Quickpark at Dublin Airport. To the north, the contour covers open ground, extending across some minor roads (R108 and L3132, Naul Road), but excludes residential or other development.

For the currently permitted operations under the forecasts for 2022, there are no residential properties located within the 1 in 100,000 per annum contours for all runways. In total, 105 residential properties are identified as being located between the limits of the 1 in 100,000 and 1 in 1,000,000 per annum contours in 2022. There is a single apparent commercial site within the 1 in 100,000 per annum contours. There are 19 non-airport commercial sites between the limits of the 1 in 100,000 and 1 in 1,000,000 per annum contours, some of which accommodate multiple small enterprises. None of these are major employment sites holding large numbers of people. This contour contains further commercial sites within the Airport Campus.

8.4.2 2025 Individual Risk

The predicted baseline in respect of the individual risk impacts for the permitted / constrained scenario in 2025 is summarised by the contour plots shown in Figure 8-2. The key characteristics of the contours are summarised in Table 8-4. These contours are quite similar to those described for the 2022 permitted / constrained operations. They are marginally longer and broader, covering a correspondingly slightly larger area, as summarised in Table 8-4. This slight increase in contour size reflects the small increase in forecast movement numbers expected between 2022 and 2025 under the current permission.

There is no change in the number of properties within the North or South Runway 1 in 100,000 per annum contours between the 2022 and 2025 permitted operations scenarios. As for the 2022 permitted operations scenario, there is a single commercial site at the eastern end of the North Runway within the 2025 permitted operations 1 in 100,000 per annum contour. There is a predicted minor increase in the number of residential properties within the 1 in 1,000,000 per annum contours from 105 in 2022 to 111 in 2025. There is no change in the number of commercial sites within the 1 in 1,000,000 per annum contours in 2025 compared to the 2022 permitted operations.

The risk estimates made for the 2025 scenario are based on the assumption that aircraft crash rates remain the same as those determined according to the recent historical accident record that have also been applied to the 2022 baseline risk estimates which are outlined in the technical appendix to this chapter. In practice, there is clear evidence over a period of many decades, including recent years, for a continuing decline in aircraft crash rates. Statistical studies undertaken in relation to a previous new runway development programme at Frankfurt (Frankfurt Airport, 2003) have indicated an annual reduction, year-on-year, of around 0.732% for commercial air transport movements in so called "first world" countries that operate to the highest safety standards. Over a period of 3 years from 2022 to 2025, this yearly improvement in the safety record represents a decrease in the crash risk by 2.2%. If this anticipated improvement in the safety performance is factored into the risk estimates for 2025, very little change in the 2025 contours compared with the 2022 baseline is to be expected. Given the common standards employed in aviation and the common operators involved, this safety performance is considered to be indicative of operations at any major international airport in the region concerned and to be as representative of Dublin operations as it is of those at Frankfurt. Whilst rates of improvements have slowed since the major gains achieved in the earlier years of commercial civil aviation the recent trends in the historical accident record indicate that the current safety practices will continue to provide some improvement in safety into the future.

Table 8-4 2025 Permitted Operations Individual Risk Contour Characteristics

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
1 in 100,000 per annum individual risk contour						
Distance from Runway end	1,499	2,674	1,659	1,127	37	131

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
Distance outside airside limit	453	1,689	966	791	0	0
Total area (hectares)[1]	12.69	28.29	19.04	7.40	N/A	N/A
Area outside airside limit (hectares)	2.38	11.29	7.54	4.88	-	-
Number of dwellings[2] inside	0	0	0	0	0	0
Commercial sites inside	0	0	0	1	0	0
1 in 1,000,000 per annum individual risk contour, excluding 1 in 100,000 contour						
Distance from Runway end	4,834	11,060	6,230	2,917	716	887
Distance outside airside limit	3,788	10,075	5,537	2,581	461	633
Total area (hectares)[3]	59.17	288.25	183.90	33.54	N/A	N/A
Number of dwellings inside[4]	0	90	18	3	0	0
Commercial sites inside[5]	3	9	5	2	0	0

For explanatory notes 1 to 5, see Table 8-3.

8.4.3 Societal Risk

The societal risk impacts have been determined by consideration of the full range of accident scenarios involving aircraft of different sizes from the fleet mix anticipated for the permitted operations and impacts in different locations with different densities of occupation. This approach provides for the determination of the probability of accidents giving rise to a defined number of fatalities from one up to the maximum number estimated for a crash of the largest aircraft type into an area with the highest density of occupation. Societal risks were estimated separately for:

- Airport campus sites;
- all other sites; and
- for all sites combined.

These estimates were characterised by means of a number of quantitative risk measures, as follows:

- The overall frequency of accidents causing fatalities;
- The average number of fatalities involved;
- The expectation value, representing the average number of fatalities per annum;
- The Scaled Risk Integral Index (SRI), as employed in land-use planning in the vicinity of major hazard (COMAH) sites;
- FN curves for the full range of accident frequencies and consequences.

These risk estimates are summarised in Table 8-5 and the FN curve is shown in Figure 8-3.

Taking account of the distribution of accident locations, which are concentrated along the runway centreline and more towards the runway ends and having regard to the locations of properties around the airport, the vast majority of accidents are expected not to give rise to any third party fatalities. For the 2022 permitted operations, the probability of an aircraft crash accident affecting third parties is estimated to be 0.00106 per annum, or 1 in 947 years. For sites outside the Airport Campus, that value is slightly lower at 1 in 966 years. The average number of third party fatalities per crash event that is expected to lead to at least one third party fatality is estimated to be around 22. For sites outside the Airport Campus, the average number of fatalities per crash is estimated to be around 17. These estimates for the average number of fatalities and event frequency represent an expectation value of 1 fatality in every 42 years for all sites and 1 fatality in 56 years for non-airport sites outside the Airport Campus, on average.

For the 2025 permitted operations, summarised in Table 8-5, the societal risk is predicted to increase broadly in line with the 4.5% increase in the movement numbers and 2% increase in the average destroyed area. As can be seen from the FN curve shown in Figure 8-3, there is very little difference in the two cases with the exception of a marginal increase in probability of the high N fatality events which can be attributed to the slight increase in the average destroyed area in 2025 compared with 2022 resulting in slightly higher fatality predictions for on airport campus accidents. The expectation value for 2025 permitted operations is 6.8% higher than the 2022 baseline

expectation value and the SRI score is 10% higher than the 2022 baseline SRI score. In accordance with the earlier discussion in relation to the 2025 individual risk estimates, the frequency of crash events in 2025 would reduce by 2.2% if the anticipated improvement in safety performance with time is taken into account, leading to a 2.2% reduction in the expectation value and in the frequency of all events identified in the FN curve.

Table 8-5 2022 and 2025 Permitted Operations Societal Risk Estimate Summary

Scenario	Rate of Fatality Accidents		Average fatalities	Expectation Value		SRI
	Per Annum	Return period / years		Per Annum	Return period / years	
2022 Permitted						
All Sites	1.06×10^{-3}	947	22.3	2.35×10^{-2}	42	148,752
Non-airport sites	1.04×10^{-3}	966	17.3	1.79×10^{-2}	56	85,564
Airport Campus	2.03×10^{-5}	49,272	275.9	5.60×10^{-3}	179	63,188
2025 Permitted						
All Sites	1.09×10^{-3}	919	23.0	2.51×10^{-2}	40	163,574
Non-airport sites	1.07×10^{-3}	937	17.6	1.88×10^{-2}	53	90,188
Airport Campus	2.09×10^{-5}	47,737	299.8	6.28×10^{-3}	159	73,387

8.5 Proposed Operations

8.5.1 2022 Individual Risk

The individual risk impacts in 2022 for the proposed / unconstrained scenario are summarised by the contour plots shown in Figure 8-4. The key parameters of the contours are summarised in Table 8-6.

The individual risk contours for the proposed / unconstrained operations in 2022 are quite similar to those for the permitted / constrained operations for that year but slightly larger. As for the 2022 permitted operations scenario, there are no residential or commercial properties inside the 1 in 100,000 per annum risk contour associated with the South Runway for the 2022 proposed operations scenario. Whilst there is a slight increase in the length of the 1 in 100,000 per annum risk contour associated with the North Runway for 2022 proposed operations at the west end, no change to the number of residential properties contained within it is observed. A single commercial property is located within this contour for the 2022 proposed operations, as is the case for 2022 permitted operations.

There is a predicted minor increase in the number of residential properties within the 1 in 1,000,000 per annum contours to 109 for 2022 proposed operations compared with the estimate of 105 for 2022 permitted operations. The number of commercial properties within this contour for 2022 proposed operations reduces by one to 18, compared with the estimate for 2022 permitted operations due to a slight narrowing of the contours at the east end of the North Runway.

Table 8-6 2022 Proposed Operations Individual Risk Contour Characteristics

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
1 in 100,000 per annum individual risk contour						
Distance from Runway end	1,483	2,649	1,636	1,033	36	131
Distance outside airside limit	437	1,664	943	697	0	0
Total area (hectares)[1]	12.28	27.90	18.67	6.23	N/A	N/A
Area outside airside limit (hectares)	2.26	11.01	7.32	3.85	-	-
Number of dwellings[2] inside	0	0	0	0	0	0
Commercial sites inside	0	0	0	1	0	0

1 in 1,000,000 per annum individual risk contour, excluding 1 in 100,000 contour

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
Distance from Runway end	4,778	10,968	6,061	2,804	704	878
Distance outside airside limit	3,732	9,983	5,368	2,468	449	624
Total area (hectares)[3]	56.90	284.39	179.71	30.57	N/A	N/A
Number of dwellings inside[4]	0	89	18	2	0	0
Commercial sites inside[5]	3	9	5	1	0	0

For explanatory notes 1 to 5, see Table 8-3.

8.5.2 2025 Individual Risk

The individual risk impacts in 2025 for proposed / unconstrained operations are summarised by the contour plots shown in Figure 8-5. The key characteristics of the contours are summarised in Table 8-7. As for the three other scenarios, there is one commercial property within this contour for the 2025 proposed operations case and no residential properties.

With the increase in size of the 1 in 1,000,000 per annum contour predicted for the 2025 proposed operations scenario, the estimated number of dwellings inside this contour is estimated to increase to 114, compared with 111 estimated for permitted operations in 2025.

Table 8-7 2025 Proposed Operations Individual Risk Contour Characteristics

Contour Feature	South Runway		North Runway		Cross Runway	
	West end	East end	West end	East end	North end	South end
1 in 100,000 per annum individual risk contour						
Distance from Runway end	1,534	2,784	1,716	1,093	39	138
Distance outside airside limit	488	1,799	1,023	757	0	0
Total area (hectares)[1]	12.91	29.95	19.99	6.91	N/A	N/A
Area outside airside limit (hectares)	2.60	12.19	8.06	4.38	-	-
Number of dwellings[2] inside	0	0	0	0	0	0
Commercial sites inside	0	0	0	1	0	0
1 in 1,000,000 per annum individual risk contour, excluding 1 in 100,000 contour						
Distance from Runway end	4,955	11,333	6,368	2,950	748	917
Distance outside airside limit	3,909	10,348	5,675	2,614	493	663
Total area (hectares)[3]	59.59	304.19	196.09	32.96	N/A	N/A
Number of dwellings inside[4]	0	90	19	3	0	0
Commercial sites inside[5]	3	9	7	2	0	0

For explanatory notes 1 to 5, see Table 8-3.

8.5.3 Societal Risk

Societal risk estimates have been made for the 2022 and 2025 proposed / unconstrained operations, following the same approach employed for the assessment of the 2022 permitted / constrained operations. The risk estimates are slightly larger for these two cases, compared with those for permitted operations, in accordance with the increased movement numbers for these scenarios. These risk estimates are summarised in Table 8-8 and the FN curves are shown in Figure 8-6.

Table 8-8 2022 and 2025 Proposed / Unconstrained Operations Societal Risk Estimate Summary

Scenario	Rate of Fatality Accidents		Average fatalities	Expectation Value		SRI
	Per Annum	Return period / years		Per Annum	Return period / years	
2022 Proposed						
All Sites	1.07×10^{-3}	938	22.5	2.40×10^{-2}	42	153,503
Non-airport sites	1.05×10^{-3}	957	17.3	1.81×10^{-2}	55	86,355
Airport Campus	2.09×10^{-5}	47,939	282.7	5.90×10^{-3}	170	67,148
2025 Proposed						
All Sites	1.15×10^{-3}	872	22.8	2.61×10^{-2}	38	172,205
Non-airport sites	1.12×10^{-3}	889	17.2	1.93×10^{-2}	52	92,473
Airport Campus	2.25×10^{-5}	44,435	301.7	6.79×10^{-3}	147	79,731

8.6 Environmental Design and Management

A considerable amount of effort is directed towards ensuring that civil aviation is as safe as is reasonably practicable. The primary driving force for these efforts is, of course, the protection of passengers and crew and the material assets of aircraft operators. The very high safety standards of the aviation industry, combined with appropriate land-use planning controls, provide for low risks to third parties in the vicinity of airports. There are limits to the extent to which those risks can be further mitigated since risks cannot be eliminated entirely from aircraft operations which take place within an established pattern of land use around the airport and along flight paths.

Some mitigation will be provided by the mode of operation of the parallel runway system at Dublin Airport once operational. The current permission (baseline scenario) is subject to a condition that when winds are westerly, Runway 28L (South Runway) shall be preferred for arriving aircraft and when winds are easterly, Runway 10R (South Runway) shall be preferred for departing aircraft. When winds are westerly, the use of either Runway 28L (South Runway) or 28R (North Runway) shall be as determined by air traffic control, as is the case for the use of either Runway 10L (North Runway) or 10R (South Runway) for arriving aircraft when winds are easterly. In practice, given the identified preferential use of the South Runway, there are a higher proportion of departures from Runway 28R (North Runway) during westerly operations and of arrivals at Runway 10L (North Runway) during easterly operations. This mode of operation is adopted as it is seen to result in the least impact on local communities, primarily in respect of aircraft noise, having regard also to the prevailing wind conditions and the related implications for runway direction. A mode of operation that minimises noise impacts will similarly minimise third party risks by virtue of the fact that it will minimise flights over areas where more people are present and focus operations where the least number of people can be expected to be affected.

8.7 Assessment of Effects and Significance

8.7.1 2022 Permitted / Constrained Operations Baseline

The individual risk impacts associated with the 2022 baseline for permitted / constrained operation, as described in Section 8.4, are determined to fall around the border between the "slight effects" and "moderate effects" category, on the basis of the relatively low numbers of people exposed to an individual fatality risk between 1 in 100,000 per annum and 1 in 1,000,000 per annum. Based on the identified number of 105 residential properties within this contour and limited number of relatively small commercial sites outside the airport campus (19) within this contour, a few hundred people can be expected to be exposed to these levels of risk. Only one commercial site is found to be located within the 1 in 100,000 per annum risk contour. Given the generally sparse and distributed nature of the development, this total number of residents would not be at risk from any single accident and, as discussed in further detail in the societal risk assessment, the numbers of fatalities associated with a single crash event are expected to be quite limited. For the larger number of road users that pass through the areas covered by the contours, the individual fatality risk is less than 1 in 1,000,000 per annum and the risk falls into the "negligible" category.

When judged against the identified UK societal risk criteria (UK HSE, 2001; 1989; 1992; Health and Safety Commission, 1991), the risks associated with the 2022 permitted operations can be seen to be above the level where the risks would be considered to be negligible but below the "scrutiny level" at which risks would be considered to be significant and requiring specific regulatory scrutiny. The risk can therefore be seen to be within the "moderate effects" category when judged against the UK societal risk criteria, a finding that is consistent with SRI impact significance.

8.7.1.1 2025 Permitted / Constrained Operations

When assessed against the criteria identified in Table 8-1, the individual risks associated with the 2025 permitted operations are determined to fall around the border between the "slight effects" and "moderate effects" category on the basis of the low numbers of people exposed to an individual fatality risk between 1 in 100,000 per annum and 1 in 1,000,000 per annum. Compared with the 2022 baseline, the increased contour size is expected to increase the number of residential dwellings within this contour slightly from 105 to 111. However, the number of commercial sites remains the same at 19. Nevertheless, the overall risk categorisation remains essentially the same as for the 2022 permitted operations.

For the 2025 permitted operations, summarised in Table 8-4, the societal risk is predicted to increase broadly in line with the increase in the number of movements. As can be seen from the FN curve shown in Figure 8-3, the increase is only noticeable for the lower probability, higher fatality events associated with accidents on the airport campus. Nevertheless, the risk remains in the "moderate effects" category when judged against the UK societal risk criteria. The SRI score determined for 2025 permitted operations is also within the "moderate effects" category identified in the societal risk significance assessment criteria.

8.7.1.2 2022 Proposed / Unconstrained Operations

The estimated individual risks associated with the 2022 proposed operations are very similar to those identified for the 2022 permitted operations and 2025 permitted operations: i.e. around the border between the "slight effects" and "moderate effects" category on the basis of the low numbers of people to an individual fatality risk between 1 in 100,000 per annum and 1 in 1,000,000 per annum. The contour size increases slightly, compared with the 2022 baseline, and the number of residential dwellings within this contour is expected to increase from 105 to 109 and the number of commercial sites is found to reduce by 1 due to a subtle narrowing of the contours at the east end of the North Runway . Therefore, the overall risk categorisation remains essentially the same as that for the 2022 permitted operations.

The estimated societal risks associated with the 2022 proposed operations are very similar to the 2022 permitted operations and 2025 permitted operations: i.e. the "moderate effects" category applies.

The estimated risks to ecological designated sites with the 2022 proposed operations are in the same order of magnitude to the 2022 permitted operations and 2025 permitted operations and therefore the anticipated change in effects is not considered significant. Further details of the risk to Ecologically sensitive sites is provided within *Chapter 15: Biodiversity (Terrestrial)*.

8.7.1.3 2025 Proposed Operations

When assessed against the criteria identified in Table 8-1, the individual risks associated with the 2025 proposed operations are determined to fall around the border between the "slight effects" and "moderate effects" category on the basis of the low numbers of people to an individual fatality risk between 1 in 100,000 per annum and 1 in 1,000,000 per annum. The contour size is expected to increase slightly, compared with the 2025 permitted case. However, the number of residential dwellings within this contour is expected to increase by only 3 to 114, and the number of commercial sites is expected to increase slightly from 19 to 20. Therefore, the overall risk categorisation remains essentially the same as that for the 2025 permitted operations.

For the 2025 proposed operations, summarised in Table 8-8, the societal risk is predicted to increase broadly in line with the increase in the number of movements. As can be seen from the tabulated risk estimates and the FN curve shown in Figure 8-6, the increase in risk is relatively minor and only noticeable for low probability, high fatality events. Therefore, the risk for this scenario remains in the "moderate effects" category when judged against the UK societal risk criteria. The SRI score determined for 2025 proposed operations is also within the "moderate effects" category identified in the societal risk significance assessment criteria.

The estimated risks to ecological designated sites with the 2025 proposed operations are in the same order of magnitude to the 2025 permitted operations and 2025 permitted operations and therefore the anticipated change in effects is not considered significant. An assessment of effects of the proposed Relevant Action is provided in *Chapter 15: Biodiversity*.

8.7.1.4 Permitted/Constrained and Proposed/Unconstrained Operations Comparison.

The scale of the increase in risk estimated for the different operational scenarios considered is best evaluated numerically by reference to the expectation value associated with the societal risk. It is also useful to consider more specifically the risk to third parties outside the airport campus when assessing the significance of risk impacts. It is common practice in risk management decision making to place more weight on the involuntary risks to which third parties are exposed than to the voluntary risks to those working at or using a facility that are gaining a direct benefit from it.

Quantitative risk comparisons between different operational scenarios are presented in Table 8-9. The first key point to note from the risk comparisons shown in the table is that an overall increase in risk, as measured in terms of the expectation value, by around 3% is expected due to the anticipated evolution of activity under the permitted operations between 2022 and 2025. That overall risk increase is associated with a broadly similar increase in the number of aircraft movements over that period but is offset slightly due to the effect of the changes in the fleet mix on the crash rate per annum. The risk increase for non-airport sites is estimated to be 3.1% which is again similar to the increase in the crash rate per annum. A similar risk increase is predicted between these two scenarios for airport sites.

Table 8-9 Between Scenario Societal Risk (Expectation Value) Comparisons

Measure	2022 permitted to 2025 permitted	2022 permitted to 2022 proposed	2025 permitted to 2025 proposed
Movement number increase	4.5%	2.6%	3.4%
Crash rate per million movements increase	-1.3%	-0.8%	2.9%
Crash rate per annum increase	3.2%	1.9%	6.3%
Non-airport sites risk increase	3.1%	0.9%	5.4%
Airport sites risk increase	3.2%	2.8%	7.4%
All sites risk increase	3.1%	1.0%	5.4%

Risk increases following broadly similar patterns are estimated for the comparisons between 2022 permitted and 2022 proposed operations and between 2025 permitted and 2025 proposed operations. The risk increase of 1% between 2022 permitted and 2022 proposed operations that is predicted is slightly lower than the 2.6% increase in movement numbers, partly due to a reduction in the average crash rate per movement. For the comparison between the 2025 permitted and 2025 proposed scenarios a similar pattern is observed. Again, the estimated risk increase of around 5.4% between these two scenarios, compared with the 3.4% increase in movement numbers can be expected to arise from changes in other factors that influence the magnitude of the risk, including a 3% increase in the average crash rate per movement,

When set against the current level of risk to non-airport sites and the anticipated increase of around 3% that is estimated for the evolution of the permitted operations between 2022 and 2025, the additional 5.4% increase that is estimated up to 2025 for the proposed operations can be seen to be small when set in the context of the increased level of activity that would be supported by the change.

8.8 Residual Effects and Conclusions

The assessment indicates that there is a third party risk impact associated with the operations at Dublin Airport associated with each of the operational scenarios that cannot be regarded to be negligible. Neither should this risk be regarded to be in any way exceptional when assessed against quantitative criteria developed by reference to risks associated with a wide range of activities that are undertaken in modern society. Whilst it is to be expected that there will be some additional risk associated with the proposed Relevant Action, the increase can be seen to be modest when set in the context of the increased level of activity that would be supported and the risk remains well within the level that is considered acceptable.

Accidents cannot be eliminated entirely and risks are typically accepted in return for the benefits that the activities giving rise to those risks provide. Such risks must be managed so as to be as low as reasonably practicable and are subject to regulatory scrutiny. As noted earlier in Section 8.2, a very considerable amount of effort is directed towards ensuring the safety of air transport operations, primarily from the perspective of the safety of passengers. These efforts similarly limit the risk to third parties on the ground. In that respect, risks are mitigated effectively by ensuring that aircraft accident rates are minimised such that they can be considered to be as low as reasonably practicable.

Further effective mitigation is provided by the location of flight paths relative to areas of development which means that risks to third parties on the ground are low in the unlikely event of an aircraft accident on take-off or landing. The majority of crashes can be expected to involve impact in unpopulated areas, given the runway and flight path layout with respect to areas of development. A comparison with other airports indicates that the residual risks associated with operations at Dublin Airport are relatively small when compared with those at some major airport locations. As discussed in Section 9.6, the parallel runway configuration will be operated in a manner that can be expected to further minimise the extent to which third parties are exposed to risks, by concentrating operations at those runway ends that leads to the least exposure.

The residual individual risk impacts for the 2022 baseline and for 2025 permitted operations have been assessed as being within the "slight" to moderate " effects" category, according to the impact significance classification summarised in Table 8-1. **For the proposed operations, the residual impacts are predicted to increase slightly, in accordance with the anticipated increase in movement numbers but the impact significance is predicted to remain within the same category.**

In summary, the assessment indicates that there will be a relatively small increase in the residual risk impacts as a result of the proposed Relevant Action. The risk mitigation provided by the high safety standards of modern civil aircraft operations, the inherent safety associated with the runway and flightpath layout and the mode of operation that will be employed ensure that the residual risks are at a level generally considered tolerable.

The scale of the risk associated with proposed operations can be put in perspective by a comparison between the risk contours for those operations and the contours identified for the parallel runway configuration in the DoEHLG study, shown in Figure 8-1 that informed the initial planning decision for the Northern Runway. In the context of PSZ policy, the DoEHLG study contours are considered to be acceptable. The predicted contours for the proposed operations are considerably smaller overall than those identified in the DoEHLG study and may therefore be considered acceptable also.

8.9 Bird Strike Hazard

Bird strike is a well-recognised hazard to aviation. Most bird strikes take place in the vicinity of airports during take-off and landing operations when aircraft are flying at lower altitudes at which birds fly. Following a number of catastrophic bird strike incidents in the earlier years of civil aviation, effective mitigation measures against bird strike have been established and the losses of civil airliners due to bird strike are now very rare events. Bird strike-related losses account for a small proportion of the total of accidental aircraft losses. The control measures fall into two categories as follows:

- Airfield bird hazard management by the adoption of various measures including habitat management to make areas around airports unattractive to birds and active dispersion;
- Technological measures to make aircraft more resilient to bird strike.

Modern aircraft standards are such that aircraft can usually withstand a bird strike without a catastrophic loss. Aircraft engines are built to withstand the ingestion of individuals of larger species and several individuals of smaller species without failure. Aircraft can fly safely following the loss of one engine. Catastrophic losses in the event of bird strike are therefore limited essentially to events involving multiple strikes of larger species that affect more than one engine. Effective bird hazard management that is based on an understanding of bird movements and the local environment around airports can ensure that such events are very rare.

The bird hazard management measures in place at Dublin Airport have been developed to address the requirements of the proposal to change permitted operations. In accordance with international good practice, the measures in place under the wildlife and habitat management section of the Aerodrome Manual (Dublin Airport, 2016) include the following:

- Bird detection and dispersal activities;
- Habitat management to make the airfield less attractive to birds;
- Land use planning controls in the areas surrounding the airport to avoid bird attraction;
- Bird activity and bird strike recording and monitoring;
- Action to disrupt bird flight lines and bird concentrations both on the airfield and in the surrounding countryside.

The Airport is currently being operated safely and daa have implemented an effective bird hazard management programme.

The proposed Relevant Action will therefore have no significant implications for future bird strike management requirements and the bird strike risk. An extended bird hazard management programme formed part of the planning permission for North Runway and this programme will be implemented when construction is completed and North Runway becomes operational. This programme will be able to effectively address bird hazard management for operations under the proposal to change permitted operations. The measures adopted to ensure that the permitted operations are safe should ensure that any operations from the runway system will be safe in this respect, regardless of the level of activity. It can therefore be concluded that the proposal to change permitted operations raises no additional issues in respect of bird strike-related risk than those already addressed by the risk assessment set out earlier.

8.10 Wake Vortex

Aircraft in flight creates vortices, circulating currents of air that are shed from the aircraft wings. For the most part, these vortices are dissipated by the effects of the wind and atmospheric turbulence before they reach the ground and, whilst they may more often be heard after an aircraft has passed, they seldom have any physical impact at ground level. Occasionally, however, vortices may persist long enough to make contact with buildings underneath the flight path. In extreme cases, the variation in pressure within these vortices can cause some damage to roofs if tiles or slates are not sufficiently firmly secured. In practice, such events may be encountered due to the passage of larger wide-bodied jets which create the largest vortices and during landing when aircraft are relatively close to the ground.

Wake vortex effects have been extensively studied in the context of operations at other major international airports. It has been established that building damage arising from wake vortices of the magnitudes encountered in practice can typically be eliminated by recovering of roofs in locations that are at risk to strengthen their resistance. Effective preventative measures can therefore be taken to mitigate wake vortex impacts. Once such mitigation measures have been implemented, they will be effective in respect of all future wake vortex events, regardless of frequency.

The issue of wake vortex damage was considered in some detail prior to the planning permission being granted for North Runway. The planning permission assumption was 348,358 movements per annum, significantly higher than the number now envisaged in 2025 for the proposed / unconstrained scenario which is 241,000 movements per annum. In granting permission for North Runway under those assumptions, the wake vortex impacts of that number of operations was evidently considered acceptable by the planning authorities. On that basis, the wake vortex impacts associated with the proposed change in permitted operations can be expected similarly to be considered acceptable.

8.11 Emergency Fuel Dumping

It was recognised that emergency fuel dumping could theoretically impact on people and properties on the ground. However, the available statistics from the UK indicated that there were very few suspected in-flight fuel loss incidents and, given the common operating standards, the same can be expected to apply in the Republic of Ireland. Those incidents that were identified appear to have been related to relatively minor leakages and resulted in no more than minor impacts in terms of oil deposits.

If emergency fuel dumping takes place, it is expected that this will typically be undertaken in a controlled manner in an appropriately selected area. The jettisoning of fuel is a rare occurrence and will not arise in normal operations. Aircraft have two primary weight limits: the maximum take-off weight and the maximum landing weight, with the maximum landing weight generally being the lower of the two. Aircraft under normal operations will depart at not more than the maximum take-off weight which may, according to operational requirements, be more than the maximum landing weight. Normally, aircraft consume fuel en-route and arrive at their intended destinations below the maximum landing weight. The fuel load on departure will have been chosen to provide for an appropriate landing weight, taking account of the anticipated en-route fuel consumption.

In abnormal, non-routine flight when an aircraft must return to the departure airport or divert en-route, for example due to aircraft technical faults or a passenger medical problem, the aircraft weight may exceed the maximum landing weight at the time a landing is required. It is only under these types of non-routine circumstances that there will be an operational benefit from jettisoning fuel. If a decision were to be made to jettison fuel, this would normally be undertaken in a controlled manner in consultation with air traffic control such that the impacts on the ground were minimised. In any event, it is expected that fuel would normally be jettisoned under these circumstances at a sufficient altitude to allow for vaporisation and dispersion before reaching ground level.

It should also be noted that a significant proportion of aircraft are not fitted with fuel jettison systems. Modern aircraft design and manufacturing allows aircraft to land at maximum take-off weight. In the event of an emergency,

requiring a return to the departure airport, these aircraft will circle nearby in order to consume sufficient fuel to get down to the required landing weight limit.

The possibility of a pilot of an aircraft that is fitted with a fuel jettison system deciding to jettison fuel over land at a low altitude in an emergency situation cannot be discounted entirely. However, the jettisoning of fuel under circumstances that would result in any material impact on land in the vicinity of Dublin Airport can be seen to be very unlikely. Overall, it can therefore be concluded that impacts associated with emergency fuel dumping and possible in-flight accidental losses of fuel or oil can be considered to be not significant.

8.12 Figures

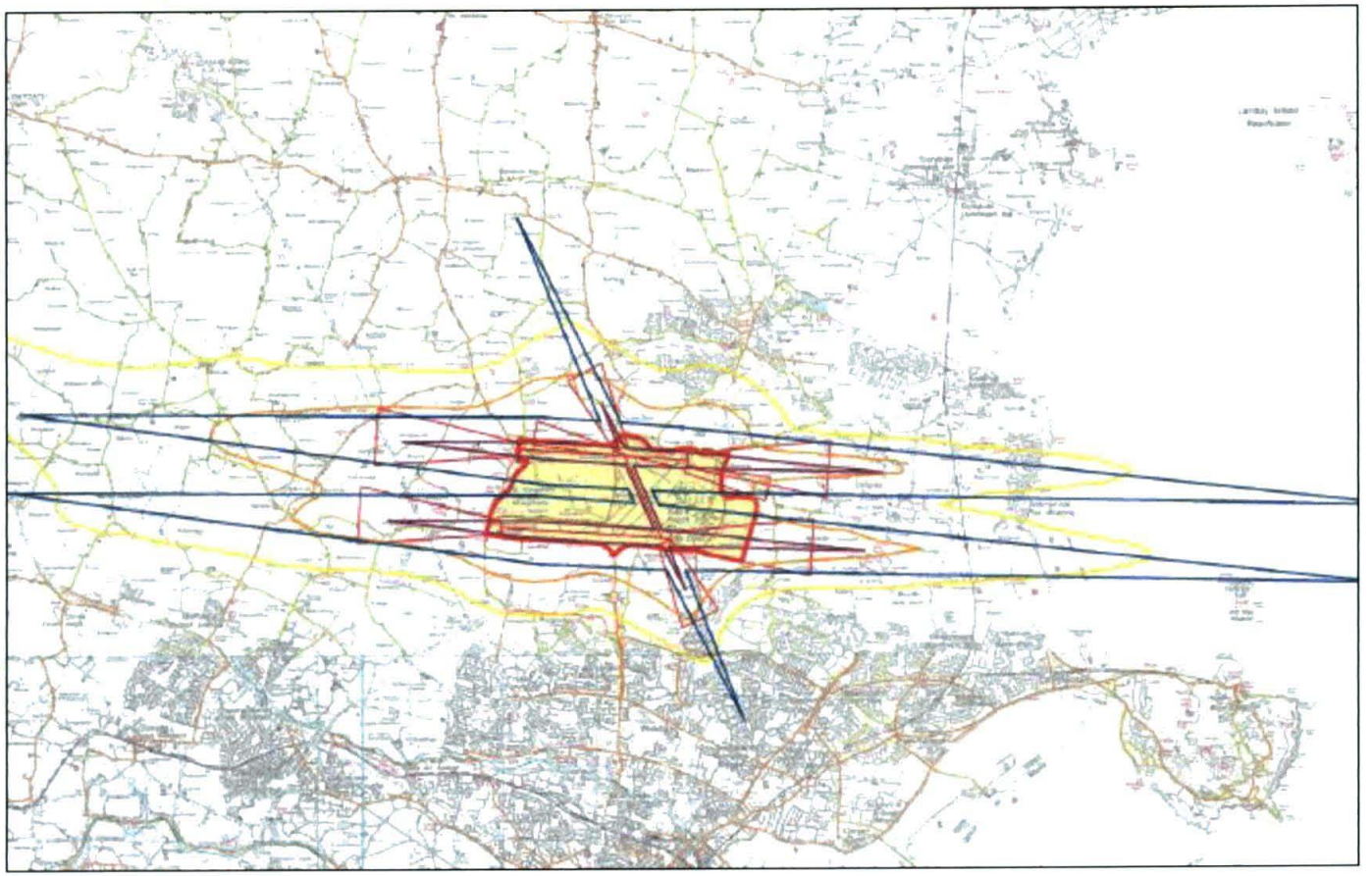


Figure 8-1 Provisional PSZs from the Dublin Airport Local Area Plan

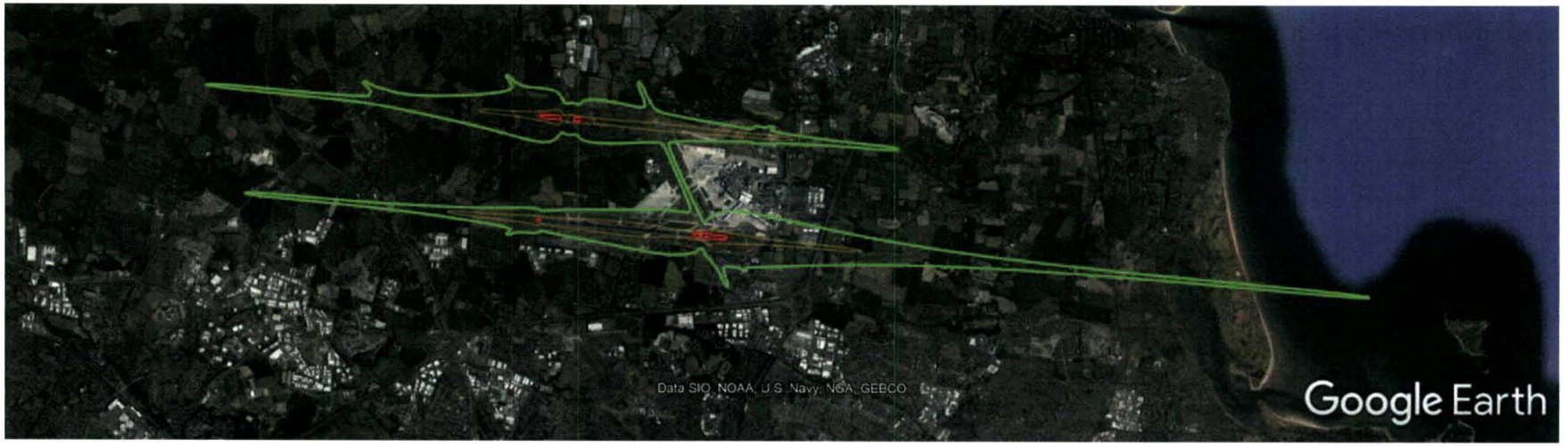


Figure 8-2 2022 Permitted Operations Risk Contours

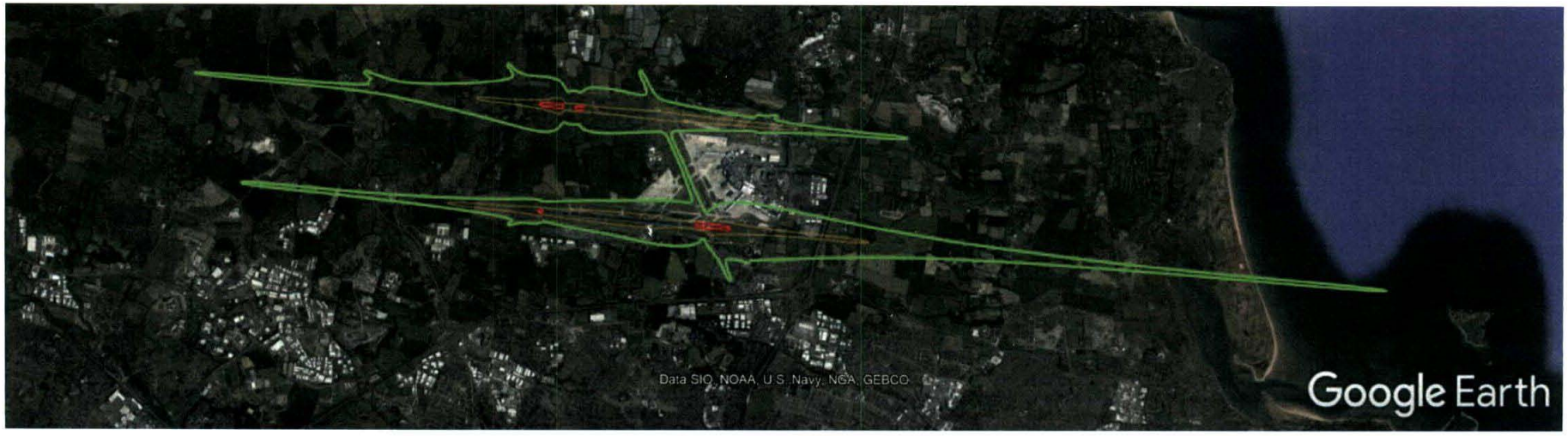


Figure 8-3 2025 Permitted Operations Risk Contours

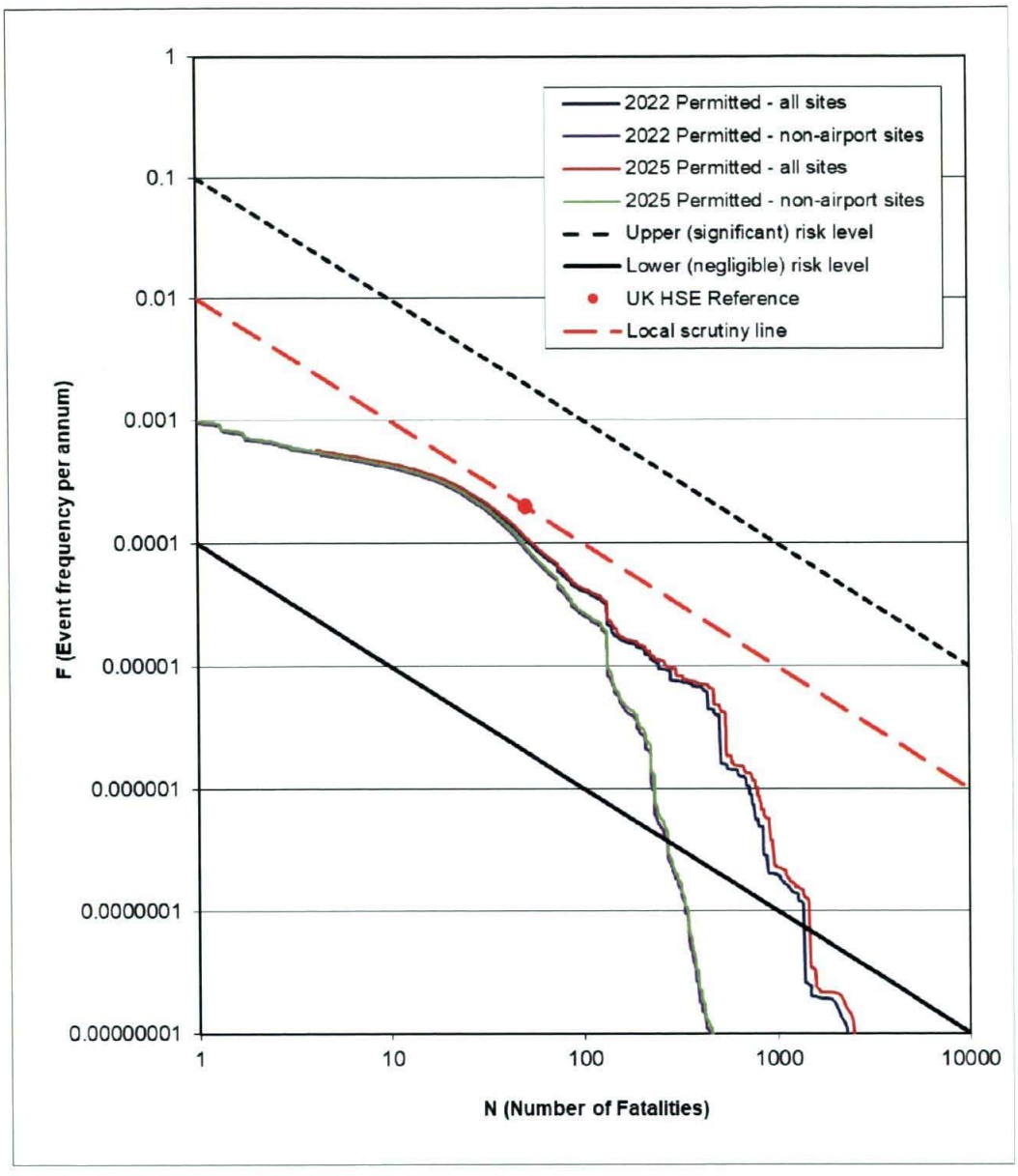


Figure 8-4 Societal Risk FN Curve for 2022 Baseline and 2025 Permitted Operations

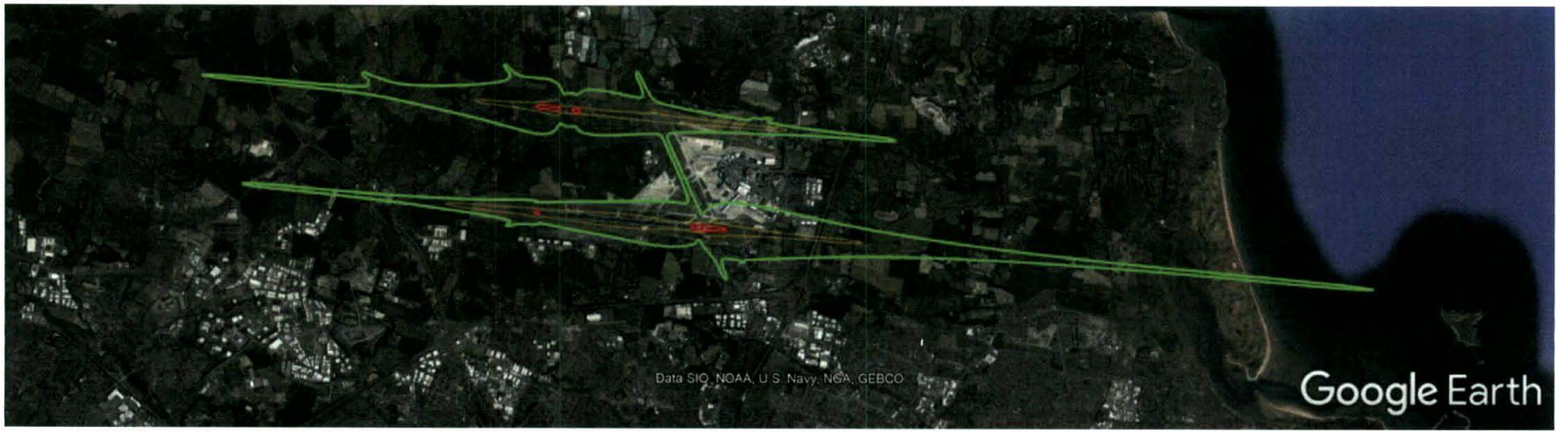


Figure 8-5 2022 Proposed Operations Risk Contours

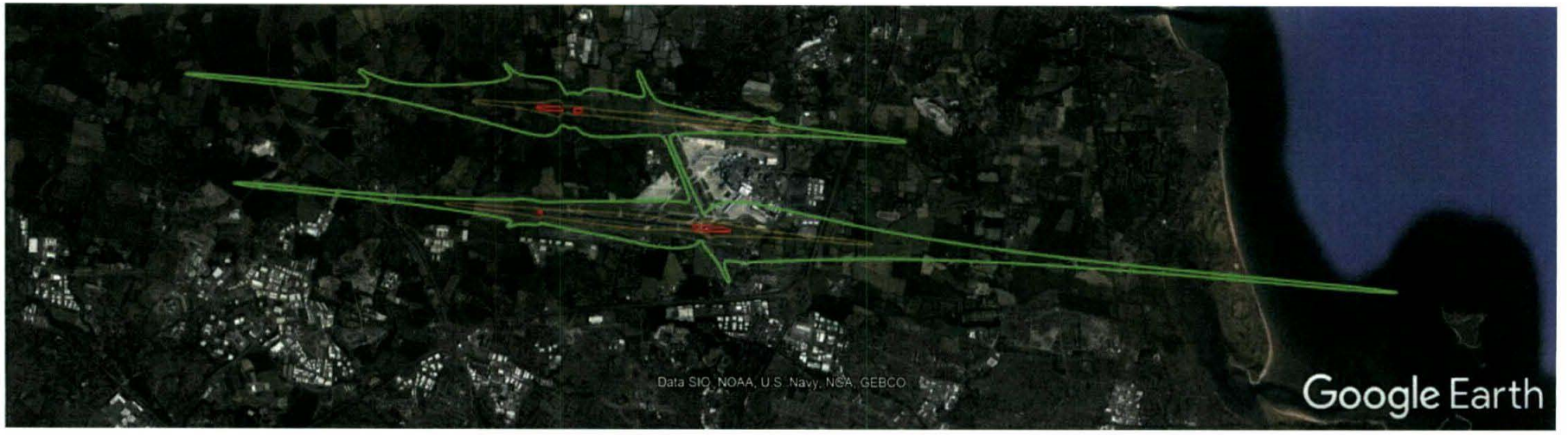


Figure 8-6 2025 Proposed Operations Risk Contours

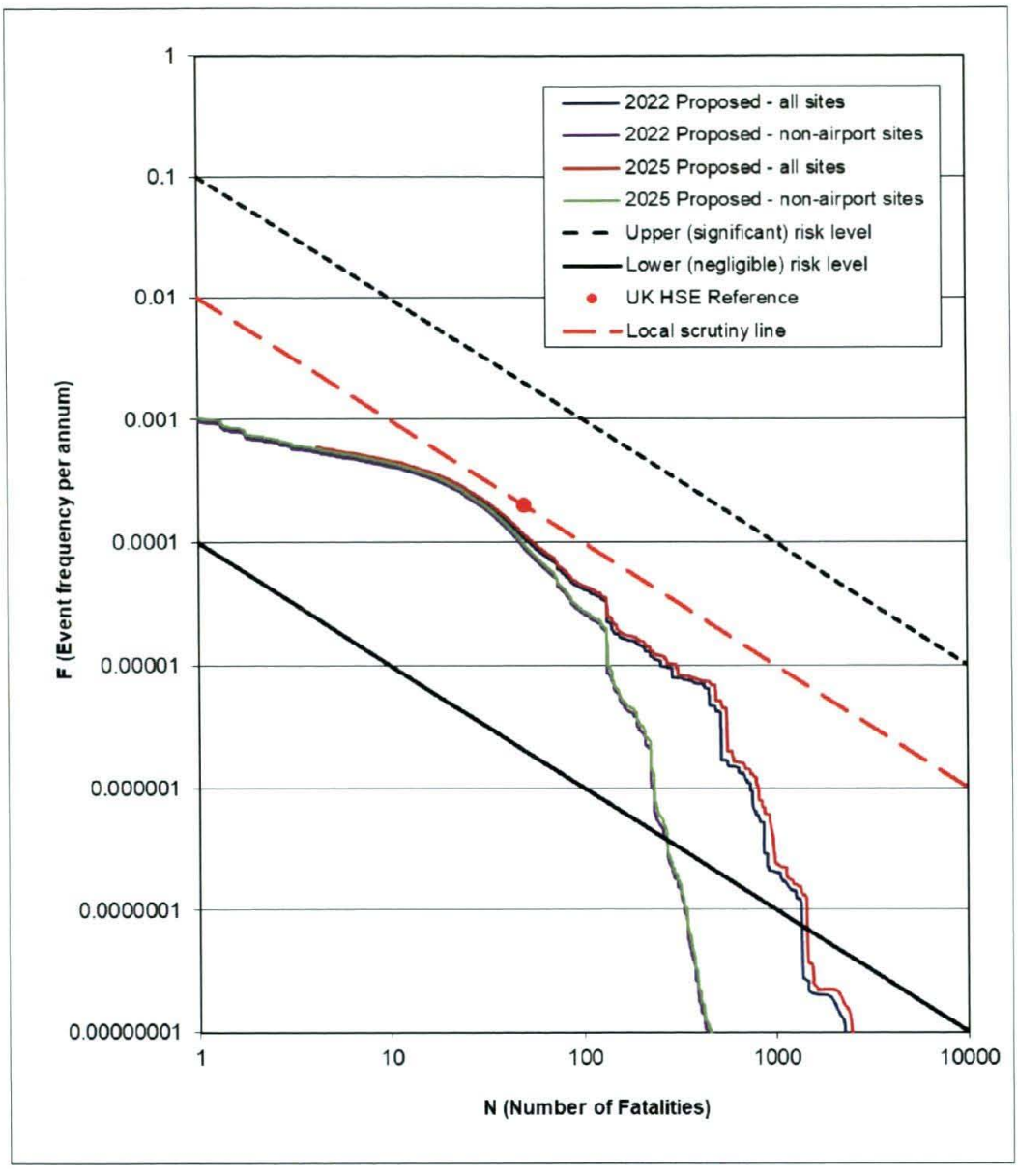


Figure 8-7 Societal Risk FN Curve for 2022 Baseline and 2025 Proposed Operations

Chapter 09:

Traffic and Transportation

09

9. Traffic and Transport

9.1 Introduction

This chapter presents an assessment of the likely potential impact to the road network from the proposed Relevant Action, in accordance with the requirements of the relevant legislation and guidance on preparation and content of EIARs.

9.2 Planning Policy Context

The following lists the relevant policy guidance and used to inform the traffic and transport assessment:

- 'Traffic and Transport Assessment Guidelines' (TII, 2014); and
- Draft 'Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2017)

9.3 Assessment Methodology

The following methodology was used to assess the potential impact of the proposed Relevant Action with regard to the permitted / constrained scenarios (ie the current planning permission) and the proposed / unconstrained scenario (the proposed Relevant Action) for 2022 and 2025:

- The Permitted/Constrained and Proposed/Unconstrained flight schedules for 2022 and 2025 were compared, to determine the potential changes in the number of passengers arriving and departing (airside) on an hourly basis
- Based on known passenger arrival / departures lag times the change in the number of passengers entering and exiting the Airport (landside) on an hourly basis, was determined.
- Based on existing passenger mode shares and existing vehicle occupancies, the change in the number of vehicle trips generated by the different schedules was determined.
- Using recorded Origin-Destination (O-D) survey data for existing Airport traffic, the changes in vehicle trips were distributed on to the surrounding road network, on an hourly basis.
- Any increases in vehicle trips resulting from the proposed Relevant Action were quantified and compared against background traffic flows (defined in Section 9.4.1, below) to assess whether or not they will have a significant adverse effects on network operations.

9.4 Baseline Conditions

9.4.1 Existing Traffic Flows

Traffic count data from surveys undertaken in May 2019 (when the Airport operated at 32 MPPA) was used to determine the existing traffic flows on the surrounding road network. The surveys recorded traffic flows during the periods 05:00 – 10:00 and 16:00 – 19:00, to cover the background peak periods, as well as the Airport-related pre-morning peak. The recorded 2019 background traffic flows are summarised in Table 9-1.

Table 9-1 Recorded Existing Two-Way Background Traffic Flows on Surrounding Road Network (May 2019)

Hour Commencing	*M1 Airport Link Road*	*M1 North of Airport*	*M1 South of Airport*	*M50 South of Junction 3*	*M50 West of Junction 3*	*M50 West of Junction 4*	*R132 North of Airport*	*R132 South of Airport*	*Old Airport Road*	*R108 North of M50*	*Naul Road*	*Kilshane Road*
05:00	3,077	1,966	3,900	2,318	2,577	3,004	761	843	614	663	311	159
06:00	2,843	6,575	8,017	5,215	7,506	8,006	1,073	967	733	880	603	378
07:00	3,464	8,781	10,579	6,553	11,182	11,758	1,633	1,556	1,080	1,130	999	736
08:00	4,032	8,598	10,415	5,908	10,509	11,051	1,969	1,792	1,129	1,212	1,236	930
09:00	3,745	6,860	9,078	5,784	9,056	9,782	1,680	1,630	1,009	1,143	908	706
16:00	3,928	9,114	11,071	6,591	11,330	12,107	2,194	1,815	1,358	1,482	1,271	829
17:00	3,827	9,397	10,918	6,790	10,740	11,436	2,154	1,868	1,380	1,544	1,580	812
18:00	3,383	7,855	9,695	6,154	9,233	10,000	1,687	1,319	1,051	1,153	1,130	450

9.4.2 Mode Share and Vehicle Occupancy

Mode share data from daa's Mobility Management Update (2019), outlined in Table 9-2, was used to determine the number of landside passengers that would use each mode to travel to the Airport for each scenario.

Table 9-2 2019 Passenger Mode Share at Dublin Airport

Mode	Percentage of Passengers
Car Private	35%
Car Rental	6%
Bus	35%
Taxi	22%
Other	2%

As well as the mode shares outlined above, recorded vehicle occupancies from surveys undertaken in May 2019, outlined in Table 9-3, were used to determine the number of vehicle movements generated by each profile.

Table 9-3 Recorded Average 2019 Vehicle Occupancies at Dublin Airport

Mode	Location	Average Occupancy (Passengers)
Car	Combined T1&T2 kerbside set-down	1.33
	Short-Stay car park	1.19
	Long-Stay car park	1.46
Taxi	Combined T1&T2 kerbside set-down	1.42

9.5 Assessment of Effects and Significance

9.5.1 Trip Generation and Distribution

9.5.1.1 Vehicle Trip Generation

Using the data outlined in the previous sections, the number of vehicle trips generated by the permitted / constrained and proposed / unconstrained scenarios for 2022 was calculated, as illustrated in Figure 9-1, below. The hourly difference in vehicle-trip generation resulting from the Relevant Action in 2022 is illustrated in Figure 9-2, below. The figures indicate that the Relevant Action is estimated to result in significant increases in vehicle trips during the periods 00:00 – 02:00, 04:00 – 05:00, and 07:00 – 08:00 with significant decreases during the periods 23:00 – 00:00, 02:00 – 04:00 and 05:00 – 06:00. Over a 24-hour period, there is no net increase in vehicle trips caused by the Relevant Action.

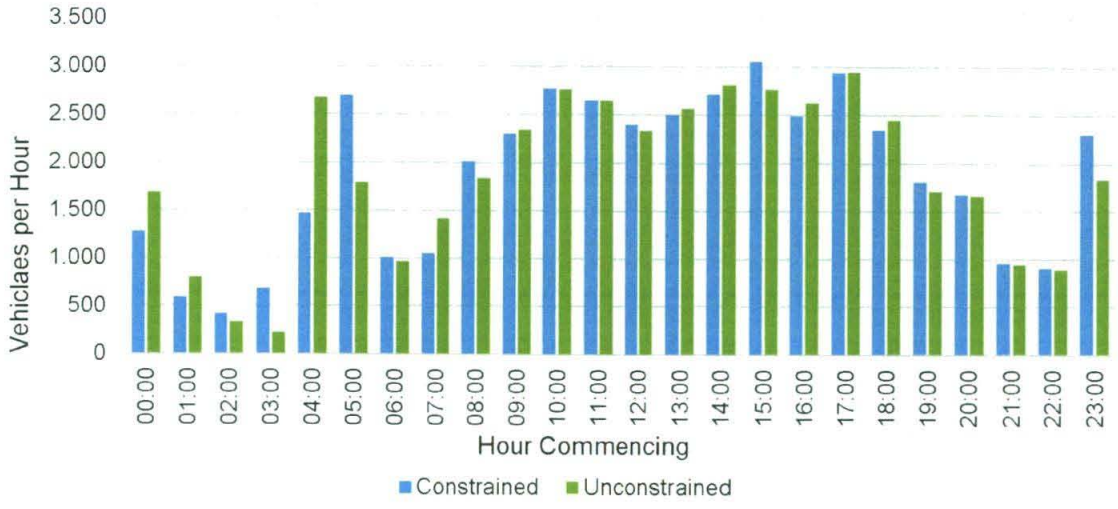


Figure 9-1 2022 Profiles of Vehicle Trips Generated – Permitted / Constrained vs Proposed / Unconstrained

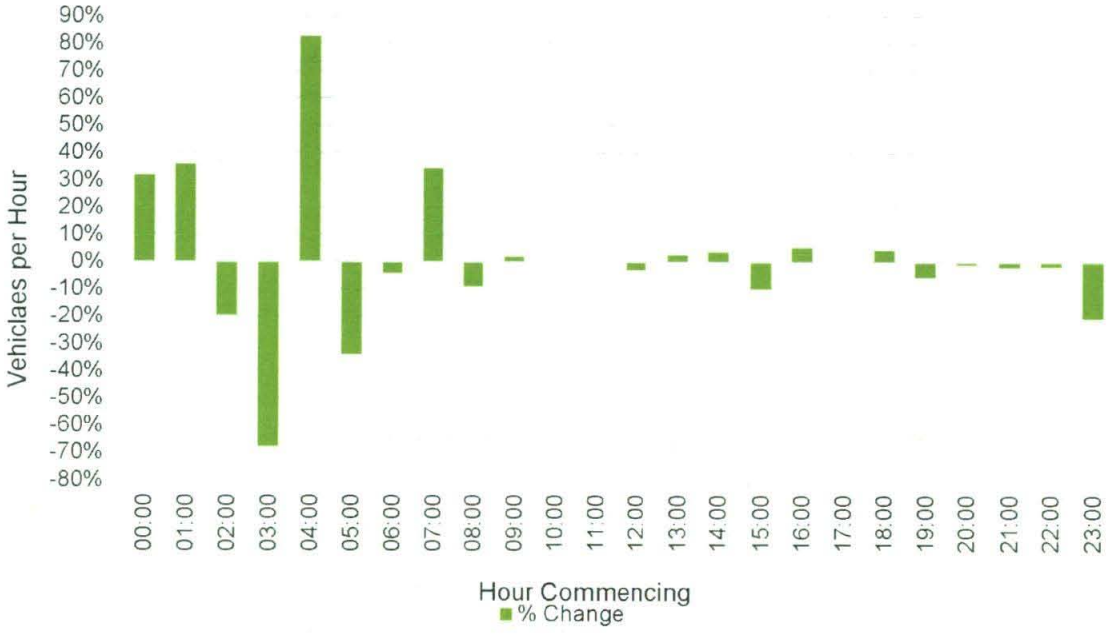


Figure 9-2 2022 Difference in Vehicle Trips Generated – Proposed / Unconstrained vs Permitted / Constrained

The number of vehicle trips generated by the constrained and unconstrained scenarios for 2025 is illustrated in Figure 9-3, while the hourly difference in vehicle-trip generation resulting from the Relevant Action is illustrated in Figure 9-4. The figures indicate that the proposed Relevant Action is estimated to result in similar changes in vehicle trips in 2025 as in 2022.

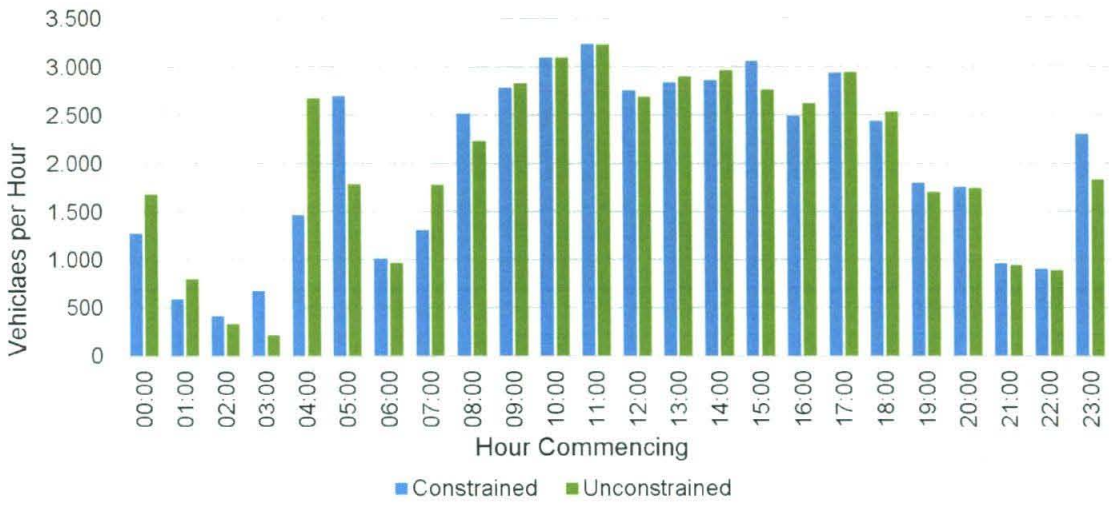


Figure 9-3 2025 Profiles of Vehicle Trips Generated – Permitted / Constrained vs Proposed / 0Unconstrained

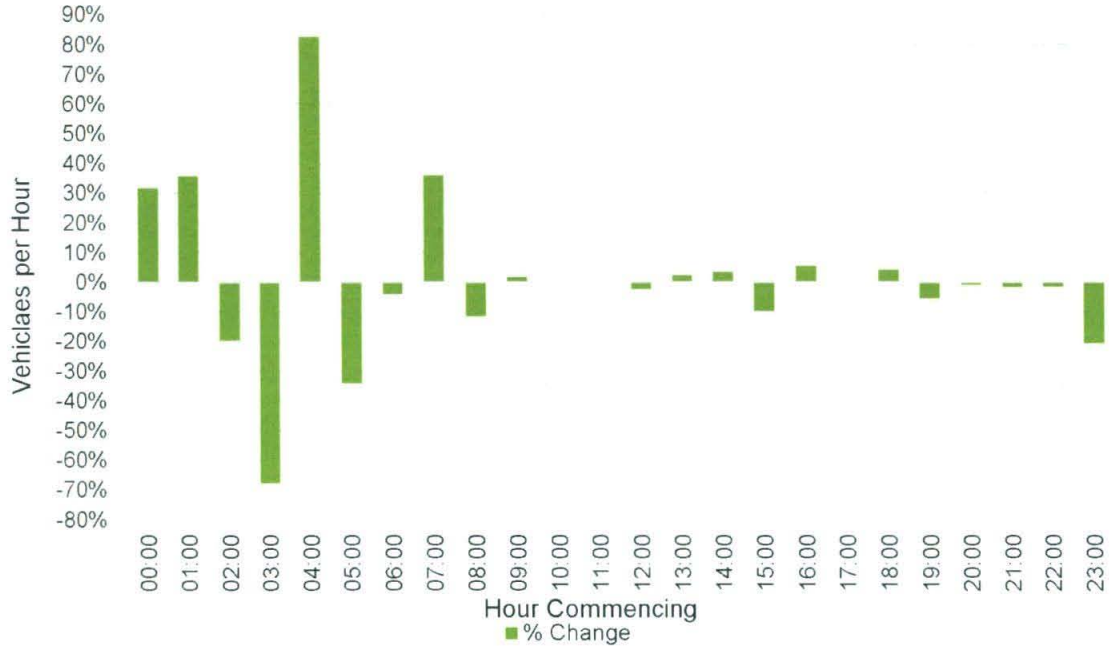


Figure 9-4 2025 Difference in Vehicle Trips Generated – Unconstrained vs Constrained

9.5.1.2 Vehicle Trip Distribution

The two-way hourly difference in vehicle-trip generation resulting from the Relevant Action was distributed on to the road network in the vicinity of the Airport, using passenger origin-destination data from Automatic Number Plate Registration (ANPR) surveys undertaken in May 2019, as summarised in Table 9-4 and Table 9-5. As can be seen, the proposed Relevant Action will not result in any additional trip generation over a 24-hour period.

Table 9-4 Estimated Change in Airport-Generated Traffic on Surrounding Road Network caused by Relevant Action 2022

Hour Commencing	M1 Airport Link Road	M1 North of Airport	M1 South of Airport	M50 South of Junction 3	M50 West of Junction 3	M50 West of Junction 4	R132 North of Airport	R132 South of Airport	Old Airport Road	R108 North of M50	Naul Road	Kilshane Road
00:00	273	47	227	53	170	222	40	92	77	63	8	1
01:00	142	24	118	27	88	115	21	48	40	33	4	1
02:00	-54	-9	-45	-10	-34	-44	-8	-18	-15	-13	-2	0
03:00	-307	-52	-255	-59	-191	-250	-45	-104	-87	-71	-9	-2
04:00	813	139	674	157	506	661	120	275	230	189	24	4
05:00	-615	-105	-510	-119	-382	-500	-91	-208	-174	-143	-18	-3
06:00	-27	-5	-22	-5	-17	-22	-4	-9	-8	-6	-1	0
07:00	243	41	202	47	151	198	36	82	69	56	7	1
08:00	-119	-20	-98	-23	-74	-96	-18	-40	-33	-28	-3	-1
09:00	30	5	25	6	19	25	4	10	9	7	1	0
10:00	-2	0	-1	0	-1	-1	0	-1	0	0	0	0
11:00	-3	0	-2	-1	-2	-2	0	-1	-1	-1	0	0
12:00	-43	-7	-36	-8	-27	-35	-6	-15	-12	-10	-1	0
13:00	43	7	36	8	27	35	6	15	12	10	1	0
14:00	67	11	56	13	42	55	10	23	19	16	2	0
15:00	-197	-34	-163	-38	-122	-160	-29	-67	-56	-46	-6	-1
16:00	91	15	75	18	57	74	13	31	26	21	3	0
17:00	2	0	1	0	1	1	0	1	0	0	0	0
18:00	69	12	58	13	43	57	10	24	20	16	2	0
19:00	-64	-11	-53	-12	-40	-52	-10	-22	-18	-15	-2	0
20:00	-9	-2	-8	-2	-6	-8	-1	-3	-3	-2	0	0
21:00	-10	-2	-8	-2	-6	-8	-2	-3	-3	-2	0	0
22:00	-9	-2	-7	-2	-6	-7	-1	-3	-3	-2	0	0
23:00	-316	-54	-262	-61	-197	-257	-47	-107	-89	-73	-9	-2
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 9-5 Estimated Change in Airport-Generated Traffic on Surrounding Road Network caused by Relevant Action 2025

Hour Commencing	M1 Airport Link Road	M1 North of Airport	M1 South of Airport	M50 South of Junction 3	M50 West of Junction 3	M50 West of Junction 4	R132 North of Airport	R132 South of Airport	Old Airport Road	R108 North of M50	Naul Road	Kilshane Road
00:00	273	47	227	53	170	222	40	92	77	63	8	1
01:00	142	24	118	27	88	115	21	48	40	33	4	1
02:00	-54	-9	-45	-10	-34	-44	-8	-18	-15	-13	-2	0
03:00	-307	-52	-255	-59	-191	-250	-45	-104	-87	-71	-9	-2
04:00	813	139	674	157	506	661	120	275	230	189	24	4
05:00	-615	-105	-510	-119	-382	-500	-91	-208	-174	-143	-18	-3
06:00	-27	-5	-22	-5	-17	-22	-4	-9	-8	-6	-1	0
07:00	317	54	263	61	197	258	47	107	89	74	9	2
08:00	-192	-33	-159	-37	-120	-156	-28	-65	-54	-45	-6	-1
09:00	30	5	25	6	19	25	4	10	9	7	1	0
10:00	-2	0	-1	0	-1	-1	0	-1	0	0	0	0
11:00	-3	0	-2	-1	-2	-2	0	-1	-1	-1	0	0
12:00	-43	-7	-36	-8	-27	-35	-6	-15	-12	-10	-1	0
13:00	43	7	36	8	27	35	6	15	12	10	1	0
14:00	67	11	56	13	42	55	10	23	19	16	2	0
15:00	-197	-34	-163	-38	-122	-160	-29	-67	-56	-46	-6	-1
16:00	91	15	75	18	57	74	13	31	26	21	3	0
17:00	2	0	1	0	1	1	0	1	0	0	0	0
18:00	69	12	58	13	43	57	10	24	20	16	2	0
19:00	-64	-11	-53	-12	-40	-52	-10	-22	-18	-15	-2	0
20:00	-9	-2	-8	-2	-6	-8	-1	-3	-3	-2	0	0
21:00	-10	-2	-8	-2	-6	-8	-2	-3	-3	-2	0	0
22:00	-9	-2	-7	-2	-6	-7	-1	-3	-3	-2	0	0
23:00	-316	-54	-262	-61	-197	-257	-47	-107	-89	-73	-9	-2
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

9.5.2 Vehicle Trip Impact

To determine the impact caused by the Relevant Action, the change in Airport-related traffic on the surrounding road network, as outlined above, was added to / subtracted from the recorded 2019 background traffic flows on the network (outlined previously in Table 9.1) to determine the percentage change in hourly traffic flows, as outlined in Table 9-6 and Table 9-7.

It is possible that 2022 and 2025 traffic flows on the surrounding network may be higher than 2019. If this is the case, any potential hourly increase in traffic caused by the Relevant Action will have a less significant percentage impact. As such, it was considered that using the recorded 2019 background traffic flows for the analysis would provide a more robust assessment of the potential impact.

Road links on which the predicted increase in traffic flows are greater than 5% of the recorded 2019 background traffic flows were considered to have the potential to have a significant impact and are therefore highlighted in Table 9-6 and Table 9-7. These links were then subjected to further analysis.

Table 9-6 Percentage Change in Background Traffic Flows caused by Relevant Action 2022

Hour Commencing	M1 Airport Link Road	M1 North of Airport	M1 South of Airport	M50 South of Junction 3	M50 West of Junction 3	M50 West of Junction 4	R132 North of Airport	R132 South of Airport	Old Airport Road	R108 North of M50	Naul Road	Kilshane Road
05:00	-20.0%	-5.3%	-13.1%	-5.1%	-14.8%	-16.7%	-11.9%	-24.7%	-28.3%	-21.5%	-5.7%	-2.0%
06:00	-0.9%	-0.1%	-0.3%	-0.1%	-0.2%	-0.3%	-0.4%	-0.9%	-1.0%	-0.7%	-0.1%	0.0%
07:00	**7.0%**	0.5%	1.9%	0.7%	1.4%	1.7%	2.2%	**5.3%**	**6.4%**	**5.0%**	0.7%	0.2%
08:00	-2.9%	-0.2%	-0.9%	-0.4%	-0.7%	-0.9%	-0.9%	-2.2%	-3.0%	-2.3%	-0.3%	-0.1%
09:00	0.8%	0.1%	0.3%	0.1%	0.2%	0.3%	0.3%	0.6%	0.8%	0.6%	0.1%	0.0%
16:00	2.3%	0.2%	0.7%	0.3%	0.5%	0.6%	0.6%	1.7%	1.9%	1.4%	0.2%	0.1%
17:00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18:00	2.1%	0.2%	0.6%	0.2%	0.5%	0.6%	0.6%	1.8%	1.9%	1.4%	0.2%	0.1%

Table 9-7 Percentage Change in Background Traffic Flows caused by Relevant Action 2025

Hour Commencing	M1 Airport Link Road	M1 North of Airport	M1 South of Airport	M50 South of Junction 3	M50 West of Junction 3	M50 West of Junction 4	R132 North of Airport	R132 South of Airport	Old Airport Road	R108 North of M50	Naul Road	Kilshane Road
05:00	-20.0%	-5.3%	-13.1%	-5.1%	-14.8%	-16.7%	-11.9%	-24.7%	-28.3%	-21.5%	-5.7%	-2.0%
06:00	-0.9%	-0.1%	-0.3%	-0.1%	-0.2%	-0.3%	-0.4%	-0.9%	-1.0%	-0.7%	-0.1%	0.0%
07:00	**9.1%**	0.6%	2.5%	0.9%	1.8%	2.2%	2.9%	**6.9%**	**8.3%**	**6.5%**	0.9%	0.2%
08:00	-4.8%	-0.4%	-1.5%	-0.6%	-1.1%	-1.4%	-1.4%	-3.6%	-4.8%	-3.7%	-0.5%	-0.1%
09:00	0.8%	0.1%	0.3%	0.1%	0.2%	0.3%	0.3%	0.6%	0.8%	0.6%	0.1%	0.0%
16:00	2.3%	0.2%	0.7%	0.3%	0.5%	0.6%	0.6%	1.7%	1.9%	1.4%	0.2%	0.1%
17:00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18:00	2.1%	0.2%	0.6%	0.2%	0.5%	0.6%	0.6%	1.8%	1.9%	1.4%	0.2%	0.1%

Tables 9-6 and 9-7 highlight the road links on the surrounding network on which the Relevant Action will result in an increase in traffic flows greater than 5% of the recorded 2019 background traffic flows.

To further assess the potential impact on these links, the 'Relevant Action traffic flows' were compared to the maximum recorded 2019 background traffic flows, as summarised in Table 9-8 and Table 9-9.

Table 9-8 Relevant Action Traffic Flows vs Existing Maximum Traffic Flows - 2022

Link	Time Period	Increase in Flow	Background Flow	Relevant Action Flow	Max. Recorded Hourly Flow		Relevant Action Flow Exceeds Existing Max Flow?
					Period	Flow	
M1 Airport Link Road	07:00 – 08:00	243	3,464	3,707	08:00 - 09:00	4,032	No
R132 South of Airport	07:00 – 08:00	82	1,556	1,638	17:00 - 18:00	1,868	No
Old Airport Road	07:00 - 08:00	69	1,080	1,149	17:00 - 18:00	1,380	No
R108 North of M50	07:00 - 08:00	56	1,130	1,186	17:00 - 18:00	1,544	No

Table 9-9 Relevant Action Traffic Flows vs Existing Maximum Traffic Flows - 2025

Link	Time Period	Increase in Flow	Background Flow	Relevant Action Flow	Max. Recorded Hourly Flow		Relevant Action Flow Exceeds Existing Max Flow?
					Period	Flow	
M1 Airport Link Road	07:00 – 08:00	317	3,464	3,781	08:00 - 09:00	4,032	No
R132 South of Airport	07:00 – 08:00	107	1,556	1,663	17:00 - 18:00	1,868	No
Old Airport Road	07:00 - 08:00	89	1,080	1,169	17:00 - 18:00	1,380	No
R108 North of M50	07:00 - 08:00	74	1,130	1,204	17:00 - 18:00	1,544	No

Table 9-8 and Table 9-9 indicate that, although the Relevant Action traffic flows result in a greater than 5% increase on certain links at certain times, in all of these instances, the Relevant Action traffic flows will not exceed the existing maximum recorded 2019 background traffic flows on the affected road links, in 2022 or 2025.

Based on the above assessment, it is considered that the Relevant Action will not result in any significant effect on the surrounding road network.

9.6 Summary

An assessment of the potential traffic and transport impacts of the proposed Relevant Action) was undertaken.

A first principles trips generation exercise was undertaken to determine the change in vehicle trips on the surrounding road network caused by the Relevant Action, using

- Constrained and unconstrained flight schedules for 2022 and 2025;
- Established passenger lag times;
- Recorded passenger landside mode shares and vehicle occupancies; and
- Recorded origin/destination data for passengers travelling to the Airport.

The increase/decrease in traffic flows was compared to recorded existing traffic flows on the surrounding road network to determine the percentage increase/decrease caused by the Relevant Action.

The assessment indicated that:

- Over a 24-hour period, there is no net increase in vehicle trips caused by the Relevant Action. As such, the overall impact is such that it is considered to have a neutral effect.
- Broken down by hour, the Relevant Action will result in an increase in traffic flows on some adjacent roads, and a decrease on others. For the majority of adjacent road links, any increase in traffic flows caused by the Relevant Action, in 2022 and 2025, is estimated to be less than 5% of the recorded 2019 background traffic flows, and is therefore considered to have a slight effect; and
- In all of the instances where the estimated increase was estimated to be greater than 5%, the revised traffic flows resulting from the Relevant Action, in 2022 and 2025, were less than the recorded maximum traffic flows on those links during other time periods. As such, in these instances, the Relevant Action is considered to have a moderate effect.

Taking the above into account, it is considered that the Relevant Action will not result in any significant effect on the surrounding road network.

Chapter 10: Air Quality

10

10. Air Quality

10.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) contains the findings of an assessment of the likely significant effects on air quality as a result of the proposed "Relevant Action'. This Chapter should be read in conjunction with Technical Appendix A10-A.

This assessment and EIAR Chapter have been prepared by AECOM Limited, with support provided by Air Quality Consultants Limited.

The proposed Relevant Action has the potential to impact on local air quality at nearby sensitive receptors during the operational phase, primarily due to the proposed change in aircraft movements. A full description of the proposed Relevant Action is provided in EIAR Chapter 2: *Characteristics of the Relevant Action and* Chapter 3: *Background and Need for the Relevant Action*.

10.1.1Scope of Assessment

The assessment focuses on the impact and effect of changes to long-term and short-term concentrations of nitrogen dioxide (NO_2) and Particulate Matter (PM_{10} and $PM_{2.5}$), considered the pollutants of greatest concern from aircraft emissions, at nearby human health sensitive receptors. Consideration is also given to the potential for odour nuisance associated with aircraft operations.

The air quality assessment is concerned with the impact and effect of emissions associated with a change in aircraft movements only. Whilst the proposed Relevant Action may change traffic flows on the local road network on the approach to and from the Airport, projected changes will not exceed the 10% of future baseline flow criteria set out in TII guidance (NRA, 2011). On average, the change in traffic flow on the local road network averages out at around 1% of future baseline flows (i.e within the permitted / constrained scenario). The implications of such a small change in traffic flow on road traffic emissions would be negligible and therefore screened out of the further assessment. To estimate total pollutant concentrations at air quality sensitive receptors close to the Airport and local road network, the assessment does account for permitted 2022/2025 road traffic flows and emissions on those roads local to the Airport. Therefore, the study area covers a radius of approximately 1km around the Airport boundary and the extent of the road transport network considered within Chapter 9: *Traffic and Transport*. These emission sources combined account for NO_2, PM_{10} and $PM_{2.5}$ concentrations, while hydrocarbon (HC) emissions have been derived based on the anticipated aircraft operations in idle mode. The study area includes likely worst-case impacts from the aircraft emissions, and any impacts beyond 1km are likely to be less than those reported in this assessment.

Following the compilation of a comprehensive emissions inventory of all significant Airport sources of emissions to air, selected representative air quality sensitive receptors within the study area, such as residential properties, schools and hospitals, have been identified on Figure 10-1. This information has been incorporated within an ADMS (Advanced Dispersion Modelling System)-Airport dispersion model, along with road traffic emissions data, to predict future changes to air quality, between the permitted / constrained 2022/2025 and proposed / unconstrained 2022/2025 scenarios. The assessment takes into account all relevant national policies, and statutory guidance. Specific statutory guidance of relevance to this assessment includes

- Advice Notes issued by the Environmental Protection Agency (EPA, 2017);

The assessment also draws on non-statutory guidance:

- Internationally recognised best practice guidance for the assessment of impacts from airports published by the International Civil Aviation Organization (ICAO, 2011).
- Good practice guidance on the assessment of significant effects issued by the Institute of Air Quality Management (EPUK, 2017); and
- elements of technical guidance (Local Air Quality Management Technical Guidance Note (LAQM.TG16)) for calculating air pollutant concentrations issued by the UK Department for Environment, Food and Rural Affairs (DEFRA, 2019).