APPENDIX 8.2

Air Dispersion Modelling Report

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1.0 INTRODUCTION

1.1 Background

This Air Dispersion Modelling Report has been prepared for the proposed Carmanhall Road Strategic Housing Development (SHD; hereafter the 'Proposed Development'). The Proposed Development is located at the former Avid Technology International site on Carmanhall Road, Sandyford Industrial Estate, Dublin 18, (the 'Site' / 'Application Site').

In accordance with EPUK/IAQM guidance "Land-Use Planning and Development Control: Planning for Air Quality" (IAQM 2017 Guidance), a quantitative assessment of effects from road traffic emissions for the operational phase of the Proposed Development has been undertaken.

The number of construction vehicles will be dependent on the appointed Main Contractor's methodology and sequencing of works, however due to the size of the development it is not anticipated that the maximum number of Heavy Duty Vehicle (HDV) (>3.5 tonnes) Annual Average Daily traffic (AADT) movements during the construction period, will be above the threshold (100 AADT) for a quantitative assessment of construction traffic referred to in the IAQM 2017 planning guidance (Table 6.2) or the 200 HDV AADT screening criteria defined in the Design Manual for Roads and Bridges (DMRB) (LA105 Air Quality, 2019). Therefore, a quantitative assessment of construction vehicle emissions has not been undertaken and the emissions are considered not significant.

The assessment has been undertaken to predict concentrations of the road transport derived pollutants, principally nitrogen dioxide (NO_2), particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$) and to determine whether likely road traffic emissions occurring during the operation of the Proposed Development are predicted to generate significant effects on local air quality.

1.2 Study Area

The Study Area for this assessment extends to 200 m either side of all roads. Two road links were identified as 'affected roads' – i.e. those meeting the criteria set out in the IAQM 2017 Guidance but due to the extent of the traffic model, all roads have been included in the assessment. The assessed roads for the operational phase are detailed below.

- Link 001 – Carmanhall Road, adjacent to Arkle Road
- Link 002 – Carmanhall Road, towards Blackthorn Road
- Link 003 – Blackthorn Road, towards Blackthorn Ave
- Link 004 – Blackthorn Road, north of Burton Hall Road
- Link 005 – Burton Hall Road, towards Blackthorn Road
- Link 006 – Blackthorn Road, south of Burton Hall Road
- Link 007 – Carmanhall Road, towards Blackthorn Drive

For ecological receptors, DMRB states that a quantitative impact assessment of road source emissions may be required if Natura 2000 Sites (e.g. Special protection Areas and Special Areas of Conservation) are within 200 m of 'affected roads'. No such protected sites are located within 200 m of the roads and therefore impacts of operational traffic on ecological receptors are deemed not significant.

1.3 Legislation and Guidance

European Air Quality Directives

The European Union (EU) Directive on Ambient Air Quality Assessment and Management came into force in September 1996 (96/62/EC) and defines the policy framework for 12 air pollutants known to have harmful effects on human health and the environment. Air quality limit values (ambient pollutant concentrations not to be exceeded after a given date) for the pollutants are set through a series of Daughter Directives. The first Daughter Directive (1999/30/EC) sets limit values for NO_2 and PM_{10} (amongst other pollutants) in ambient air.

Following the Daughter Directives, EU Council Directive 2008/50/EC came into force in June 2008, consolidating the existing air quality legislation, making provision for Member States to postpone attainment deadlines and allowing exemption from the obligation to limit values for certain pollutants, subject to strict conditions and assessment by the European Commission. Directive 2008/50/EC was transposed into Irish legislation in 2011 through The Air Quality Standards Regulations 2011. The directive merged the four daughter directives and EU Council decision into a single directive on air quality. The new Directive also introduced a new limit value for $PM_{2.5}$ but does not change the existing air quality standards.

National Air Quality Legislation

The Air Pollution Act (1987) is the primary legislation relating to air quality in Ireland and provides the means for local authorities to take the measures that they deem necessary to control air pollution.

The Air Quality Standards Regulations (2011) transpose the Directive on ambient air quality (2008/50/EC) into Irish law. These regulations establish limit values and thresholds for various pollutants in ambient air.

The Environmental Protection Agency (EPA) monitor the levels of various pollutants against the standards set out in EU and Irish legislation. The EPA are the competent authority for annual reporting to the Minister for the Environment, Heritage and Local Government and the European Commission.

The Air Quality Standards (AQSs) – the background pollutant levels considered acceptable for human health and the environment – for nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$) when measured as annual mean concentrations, are as follows:

- NO_2 - 40 µg/m^3;
- PM_{10} - 40 µg/m^3; and
- $PM_{2.5}$ - 25 µg/m^3.

There are four air quality Zones in Ireland, defined for air quality management and assessment purposes. Highly populated areas are classified as Zone A, with sparsely populated areas as Zone D. Sandyford is designated as a Zone A for air quality, as it is located in the Dublin Conurbation.

1.4 Assessment Method

A detailed air quality assessment, including air dispersion modelling using ADMS-Roads (v.5.0.0.1), has been undertaken. In the absence of any relevant Irish guidance, the assessment follows the methodology set out in Defra's Local Air Quality Management Guidance Technical Guidance (TG16) (LAQM 2018).

ADMS-Roads has been used to predict NO_2, PM_{10} and $PM_{2.5}$ concentrations. The outputs of the modelled scenarios have been used to calculate a percentage change in concentrations. This value has then been compared to appropriate long-term and short-term standards set to protect human health, to assess compliance.

The findings of the modelling study and conclusions reached are presented in terms of predicted impact on local air quality sensitive receptors (i.e. residential receptors, locations where the general public may be present for sufficient periods of time and ecological designated sites) located within the area surrounding the Site (further discussed in Section 4.3).

1.5 Evaluation Criteria

The Institute of Air Quality Management (IAQM) provides advice on descriptors of the impact of the change in air quality as a consequence of development in the IAQM 2017 Guidance document. These impact assessment criteria have been adopted for the purposes of the assessment undertaken and are presented in Table 1.

Table 1: IAQM Impact Significance Descriptors

Long term average conc. at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	<1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
>110% of AQAL	Moderate	Substantial	Substantial	Substantial

2.0 EXISTING AIR QUALITY

2.1 Baseline Sources

A review of publicly available information identifies that the Irish EPA do not operate background air quality monitoring within Sandyford or the immediate surrounds. However, the EPA do operate several continuous monitoring stations within Dublin (Zone A) at both urban and suburban locations.

Sandyford is a suburb of Dublin, so in the absence of local background data, the most recent annual mean data (2019) for NO_2, NO_x, PM_{10} and $PM_{2.5}$ from suburban monitoring locations in Dublin (Zone A) is presented in Table 2 below for 2019.

Table 2: Annual mean monitoring data for Zone A stations with averages of all locations shown.

	Monitoring Location	Annual Mean Concentration (μg/m^3)
NO_2	Swords	15
	Davitt Road	24
	Dún Laoghaire	15
	Blanchardstown	31
	Ballyfermot	20
	Average	**21**
NO_X	Swords	21
	Davitt Road	46
	Dún Laoghaire	27
	Blanchardstown	70
	Ballyfermot	28
	Average	**38.4**

	Monitoring Location	Annual Mean Concentration (µg/m³)
PM_{10}	Dún Laoghaire	12
	Blanchardstown	19
	Ballyfermot	14
	Tallaght	12
	Phoenix Park	11
	Average	**13.6**
$PM_{2.5}$	Ballyfermot	10
	Phoenix Park	8
	St Anne's Park	8
	Davitt Road	11
	Finglas	9
	Average	**9.2**

2.2 Project Specific Monitoring

A baseline NO_2 diffusion tube monitoring study would usually be undertaken at a number of roadside locations surrounding the site, to use for the validation of the air quality traffic modelling (should it be required). Due to the current Coronavirus (COVID-19) crisis, it is likely that traffic flows are currently reduced compared to the pre-COVID levels. The traffic count data collection has been undertaken in February 2020 prior to the implementation of COVID travel restrictions and therefore more recent monitoring data will not be suitable for the validation of the traffic model. As a result, no Site visits were undertaken for Air Quality and Climate.

The assessment undertaken therefore considers an un-validated change to the base-case (modelled using the pre-COVID baseline traffic data) and considers the average Zone A background data when making a comparison with the AQS.

2.3 Background Data Used in this Assessment

Due to the absence of monitoring data for the Site or specific roadside location monitoring, the Zone A annual monitoring data have been used to represent the background air quality. The data used in the assessment is an average of the monitoring data, as presented in Table 2 and below:

- NO_2 average background – 21 µg/m³
- NO_x average background – 38.4 µg/m³
- PM_{10} average background – 13.6 µg/m³
- $PM_{2.5}$ average background – 9.2 µg/m³

The Zone A background concentrations, pollutant concentrations at the Site are below the relevant AQSs.

3.0 EMISSIONS SOURCES AND SCENARIOS

3.1 Background

The emissions sources considered in the assessment comprise the network of roads in the vicinity of the Site and background concentrations of pollutants, as calculated from the Zone A monitoring data.

Traffic data for the purposes of the air quality assessment was generated by the transport consultants, AECOM, in the form of 24-hour Annual Average Daily Traffic (AADT) and Heavy Goods Vehicle (HGV) flows for the links shown in Figure 1.

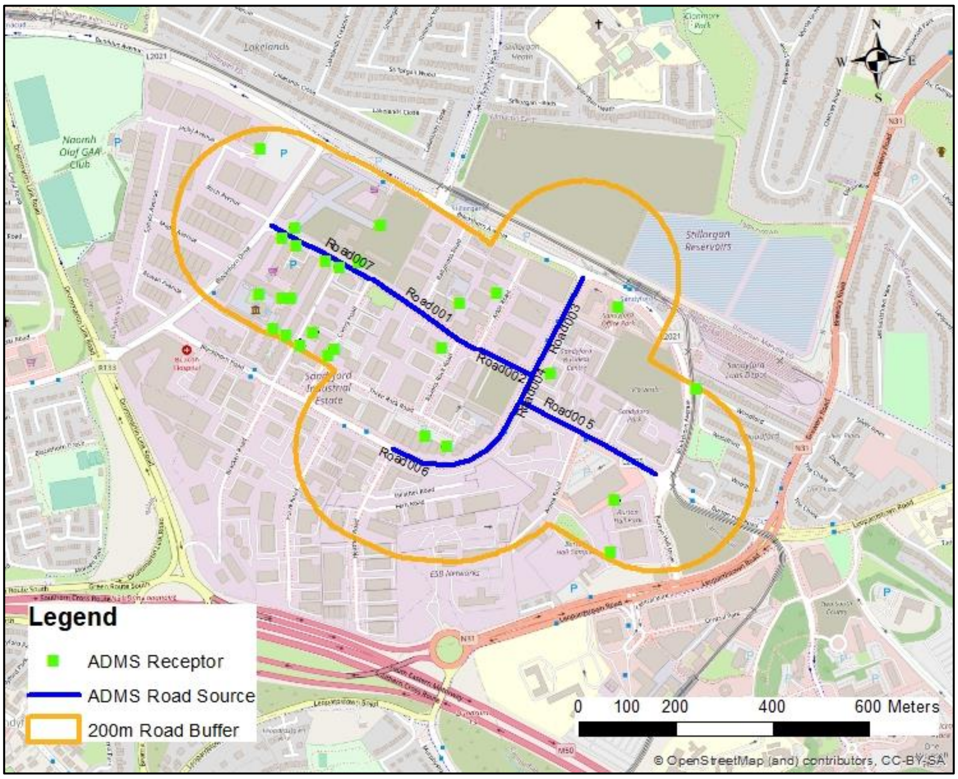

Figure 1: Modelled Traffic Links

3.2 Operational Sources

Data was provided for 2020 Baseline (Operational Scenario 001), 2038 Future Baseline (i.e., without the Proposed Development) (Operational Scenario 002) and 2038 Future with Development (Future Baseline with the Proposed Development fully operational) (Operational Scenario 003).

Due to the extent of the road network, and for conservativeness, all roads have been included in the model.

The flows for Operational Scenario 001, Operational Scenario 002 and Operational Scenario 003 for each road link are provided in Table 3.

Table 3: Sources included in the modelled operational scenarios.

Affected Road Link ID	LDV 24-hour AADT			HDV 24-hour AADT		
	Operational Scenario 001	Operational Scenario 002	Operational Scenario 003	Operational Scenario 001	Operational Scenario 002	Operational Scenario 003
Link 001	7,549	9,138	9,646	185	224	236
Link 002	7,549	9,138	9,606	185	224	235
Link 003	13,360	16,174	16,454	133	161	164

Affected Road Link ID	LDV 24-hour AADT			HDV 24-hour AADT		
	Operational Scenario 001	Operational Scenario 002	Operational Scenario 003	Operational Scenario 001	Operational Scenario 002	Operational Scenario 003
Link 004	13,392	16,212	16,408	110	133	134
Link 005	13,957	16,896	17,030	121	147	148
Link 006	8,694	10,526	10,587	92	112	113
Link 007	9,237	11,182	11,697	87	105	110

3.3 Model Scenarios

A quantitative local air quality assessment has been undertaken using the latest version of CERC ADMS-Roads dispersion modelling software, to predict concentrations of NO_2, PM_{10} and $PM_{2.5}$ at identified sensitive receptors. The assessment follows the methodology set out in Defra's Local Air Quality Management Guidance (LAQM 2018) and quantifies total pollutant concentrations for the following scenarios:

- Baseline - Operational Scenario 001: 2020 Baseline (assuming 2020 vehicle emissions data, 2019 background pollutant concentrations and modelled using 2020 meteorological data as the most recent full calendar year available);
- Future Baseline 2038 Concentrations Without Proposed Development, Do Nothing Scenario - Operational Scenario 002: 2038 Future Baseline: 2038 fully operational year, with no Proposed Development traffic (assuming 2020 vehicle emissions data for conservatism, 2019 background pollutant concentrations and 2020 meteorological data); and
- Future 2038 With Proposed Development, Do Something Scenario - Operational Scenario 003: 2038 Future with Development: 2038 fully operational year, with Proposed Development traffic (assuming 2020 vehicle emissions data for conservatism, 2019 background pollutant concentrations and 2020 meteorological data).

4.0 ATMOSPHERIC DISPERSION MODELLING

4.1 Justification of Atmospheric Dispersion Model

Pollutant emissions were modelled using the advanced atmospheric dispersion modelling software ADMS-Roads 5.0.0.1 (utilising emissions factor toolkit UK EFTv9.0). ADMS-Roads is an advanced dispersion model that allows multiple road and industrial sources (including point, line, area and volume sources) to be modelled simultaneously. The model uses a number of input parameters to simulate the dispersion of pollutant emissions, predicting ambient pollutant concentrations. The input parameters include information on pollutant emissions, local meteorological conditions and background pollutant concentrations. ADMS-Roads is regularly used in detailed assessment dispersion modelling studies for the purposes of Local Air Quality Management and environmental impact assessment.

4.2 General Model Assumptions

Details of the applied general model assumptions are provided in Table 4:

Table 4: General ADMS-Roads Model Assumptions

Variables	ADMS-Roads Model Input
Surface roughness at source	1 (cities, woodlands)
Minimum Monin-Obukhov length (urban)	10
Terrain types	Flat

Variables	ADMS-Roads Model Input
Receptor locations	See Table 9 and Figure 5
Emissions	NO_x (converted to NO_2 for reporting), PM_{10} and $PM_{2.5}$
Emissions factors	Emission Factor Toolkit v9.0
Meteorological data	Dublin Airport, 2020
Model Outputs	Long-term annual mean NO_x concentrations (converted to NO_2 for reporting),
	Long-term annual mean PM_{10} concentrations
	Long-term annual mean $PM_{2.5}$ concentrations

Modelled NO_x values were converted to NO_2 using the Defra 'NOx to NO_2' calculator version 7.1, released in April 2019 (Last accessed 17 February 2021, Available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html). This version has been used as it corresponds with using EFTv9.0 in the model.

4.3 Receptors

Modelled Domain

The extent of the modelled domain is provided in Table 5.

Table 5: Extent of the Modelled Domain

Point	X (ITM)	Y (ITM)
Southwest corner	318549	225987
Northeast corner	320050	227352

Discrete Receptors

The assessment required the modelling of pollutant concentrations at identified sensitive human receptors within 200 m of the roads. These were identified as discrete receptors in the model and represented areas of population and other locations where there is likely to be relevant public exposure to the emissions (e.g., schools, health facilities and leisure facilities). All receptors were modelled at a height of 1.5 m, which is equivalent to breathing height. The discrete receptors included in the models for the Operational Scenarios 001 to 003 are listed in Table 6 and shown in Figure 2..

Table 6: Discrete Receptors in Operational Scenario Models

Receptor ID	Description	X Coordinate (m)	Y Coordinate (m)
ADM01	Leisure	318941	227047
ADM02	Residential	319013	226884
ADM03	Residential	318987	226861
ADM04	Residential	319016	226847
ADM05	Residential	319077	226815
ADM06	Residential	319105	226801
ADM07	Health	318940	226746

Receptor ID	Description	X Coordinate (m)	Y Coordinate (m)
ADM08	Health	318986	226737
ADM09	Residential	319005	226737
ADM10	Residential	318968	226673
ADM11	Residential	318995	226660
ADM12	Residential	319024	226641
ADM13	Health	319051	226666
ADM14	Residential	319147	226812
ADM15	Residential	319190	226887
ADM16	Residential	319082	226618
ADM17	Residential	319095	226632
ADM18	Residential	319356	226728
ADM19	Health	319317	226636
ADM20	Leisure	319431	226747
ADM21	Leisure	319283	226452
ADM22	Leisure	319327	226430
ADM23	Health	319542	226581
ADM24	Health	319683	226718
ADM25	Leisure	319676	226318
ADM26	Health	319668	226212
ADM27	Residential	319844	226549

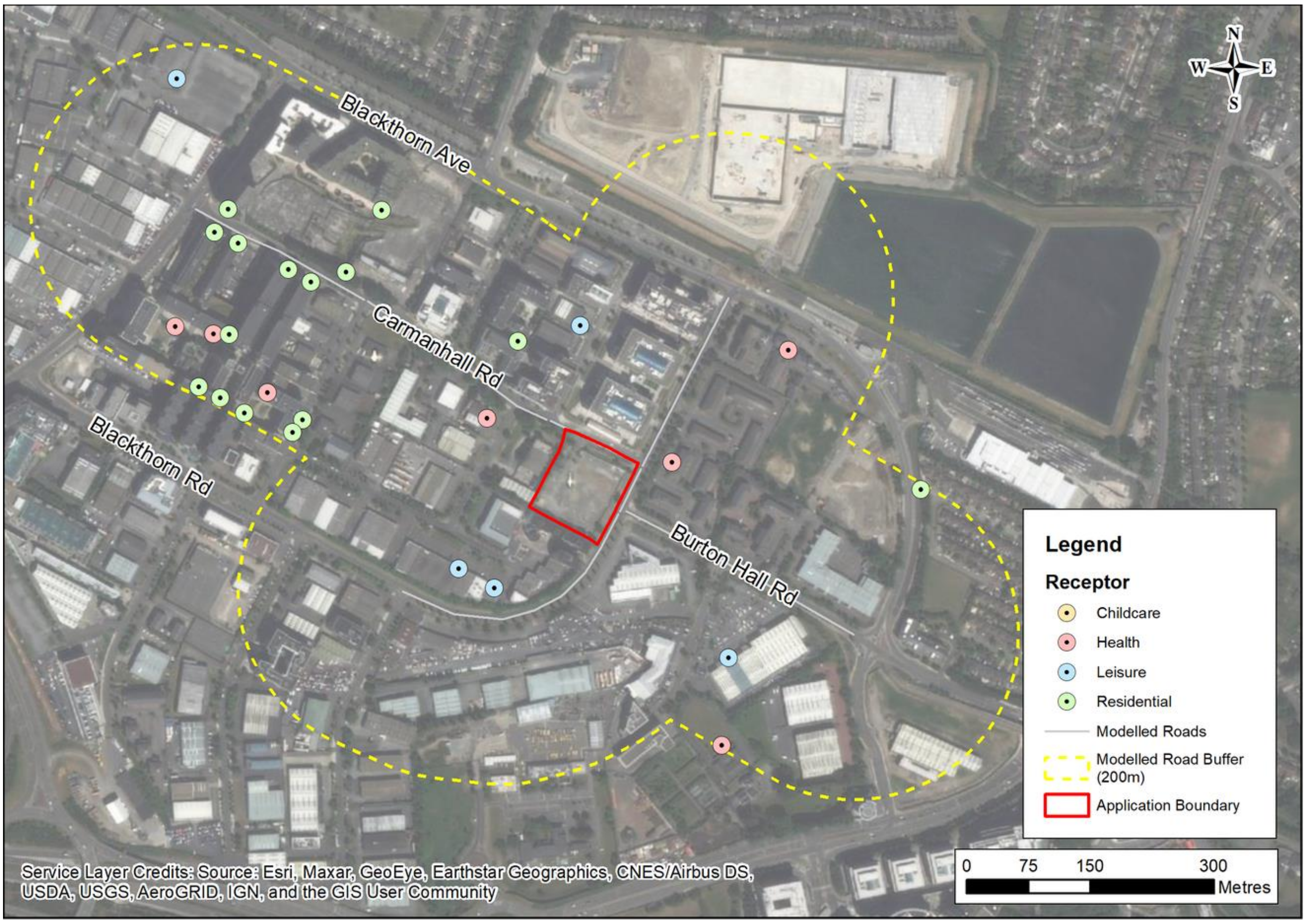

Figure 2: Discrete receptors in Operational Scenario Models

4.4 Meteorology

Meteorological Characteristics

Meteorological data from Dublin Airport was used in this assessment. The Dublin Airport meteorological station lies approximately 17 km to the north of the Site and is the closest representative operational meteorological station with a full year of recent data. The dataset used was for 2020 and included the following hourly sequential data (Table 7).

The wind rose for the meteorological data used is presented in Figure 3.

Table 7: Hourly sequential readings used in the 2020 meteorological dataset.

Parameter	Units
Wind speed	m/s
Wind direction	Degrees measured clockwise from North
Cloud cover	oktas
Surface temperature	˚C
Relative humidity	%

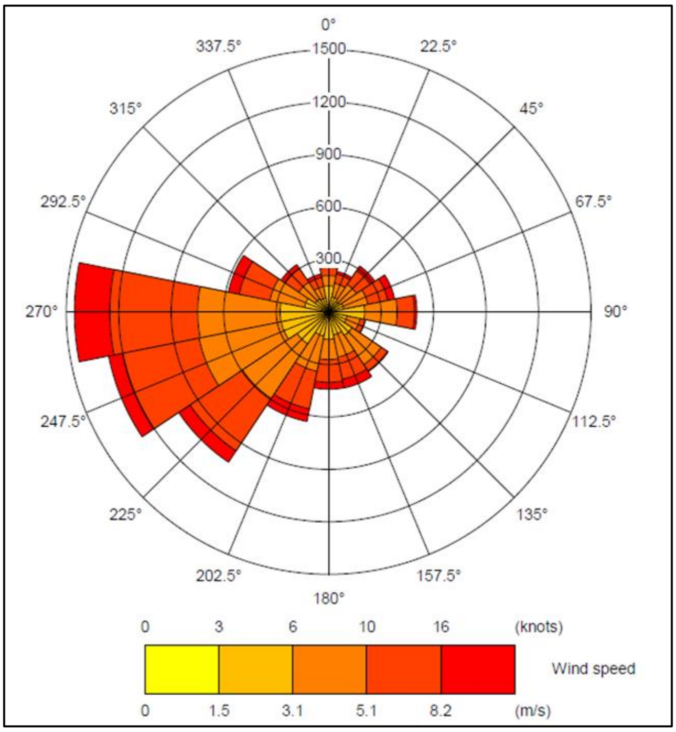

Figure 3: Dublin Airport Windrose for 2020

Surface Characteristics

The characteristics of the land use are based on default values for surface roughness contained within ADMS-Roads. A surface roughness value of 1 m (cities, woodland) is used at the dispersion site (the Site) and a value of 0.02 m (open grassland) is used at the meteorological measurement site (Dublin Airport) to account for the nature of the site as an airfield.

4.5 Road Traffic Emissions

Atmospheric emissions from road traffic were calculated by the model based on information of traffic flows and the latest in-built database of vehicle emission factors, UK Emission factor toolkit (EFT) v.9.0. the EFT does not have specific data for Ireland; therefore, the Northern Ireland data has been used in the assessment. Information on traffic flows on roads was obtained from AECOM, as described in Section 3.1 of this report. Traffic speeds were estimated from national speed limits as no speed data were available.

Traffic count data were converted into ADMS-Roads format, which requires the data to be input as vehicle counts per hour, vehicle speed, and road type. The data was further classified into the ADMS-Roads two-category vehicle classes, light vehicles and heavy vehicles. As data were supplied as 24-hour AADT, the data was converted to hourly vehicle data. It is known that the traffic profiles change depending on the hour of the day and the day of the week, therefore this is represented in the model. The Department for Transport (DfT) have published UK traffic distributions considering the time of day and the day of the week (Table TRA 0308-https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra accessed on: 11 February 2021) for both cars and heavy goods vehicles. Although the data is applicable to the UK, it has been applied in this assessment in the absence of an alternative dataset. In the absence of separate cars and light Dusty Vehicle (LDV) traffic data, all LDVs were assumed to be cars. This data was used to generate variable emissions files, as described below.

ADMS-Roads uses the variable emissions files and the information from the in-built emissions factors database (EFTv.9.0) to calculate an overall pollutant emission for each road in grams/km/second. The emission factors depend in part on assumptions made of vehicle types of different types of road.

The Emissions data in ADMS Roads, EFTv.9.0, has annual emissions factors up to 2030. Scenario Operation 002 and 003 have assessment years of 2038, but emissions data for 2020 have been used for these scenarios for conservatism as EFTv.9.0 assumes that emissions will reduce in the future based on technology advances. This provides a conservative assessment as the higher emissions data values are applied.

Variable Emissions Data

Time varying emission files were generated for each road source based on the DfT traffic distribution data for both cars and HGVs. In the absence of separate cars and LDV traffic data, all LDVs were assumed to be cars.

ADMS Roads is limited to one emissions profile which has to be applied to both cars and HGVs on a road source. The DfT traffic distribution is different for both vehicle types, therefore an emissions profile was generated which combines the emissions of both vehicle types. The generation of the combined emissions profiles is detailed below:

1) The EFTv.9.0 was used to identify the emissions from a single car and a single HGV travelling at each relevant vehicle speed;

2) A factor was generated using the emissions data in step 1 to calculate the equivalent number of cars of each HGV, considering the speeds of both the car and HGV on each road source; and

3) For each day and hour, the average hours LDV data was multiplied by the DfT factor for cars. The average hours HDV was multiplied by the DfT factor for HDVs and then multiplied by the HDV to LDV factor calculated in step 2. These values were then added together and divided by the total cars equivalent (cars plus HDV multiplied by the HDV to LDV factor) to give the factor per hour per road source.

NO_X to NO_2 Conversion

DEFRA publish a NO_x to NO_2 converter v7.1 (DEFRA, 2019) which is made available as a tool to calculate the road source NO_2 contribution from modelled road source NO_x contributions. The tool comes in the form of a Microsoft Excel spreadsheet and uses local authority area specific data to calculate annual mean concentrations of NO_2 from dispersion model output values of annual mean concentrations of NO_x. This tool was used to calculate the total NO_2 concentrations at receptors from the modelled road NO_x contribution and associated background concentration. Due to the location of the Site, the setting for all non-urban traffic was selected. The tool does not contain information for local authorities in Ireland and therefore data for Belfast was applied in the model. Although the population data for Belfast is lower than that of Dublin, the Proposed Development is located on the outskirts of Dublin.

4.6 Terrain

No terrain data was input into the model due to there being only small changes in elevation across the study area.

4.7 Special Treatments

No special treatments in excess of those previously outlined in the preceding sections were incorporated into the study.

4.8 Predicting the Number of Times per Year the NO_2 Hourly Mean Objective is Exceeded

Research projects completed on behalf of DEFRA and the Devolved Administrations (Laxen and Marner (2003) and AEAT (2008)) have concluded that the hourly mean NO_2 objective is unlikely to be exceeded if annual mean concentrations are predicted to be less than 60 µg/m^3.

In 2003, Laxen and Marner concluded: "…local authorities could reliably base decisions on likely exceedances of the 1-hour objective for nitrogen dioxide alongside busy streets using an annual mean of 60 µg/m^3 and above."

The findings presented by Laxen and Marner (2003) are further supported by AEAT (2008), who revisited the investigation to complete an updated analysis including new monitoring results and additional monitoring sites. The recommendations of this report are: "Local authorities should continue to use the threshold of 60 µg/m^3 NO2 as the trigger for considering a likely exceedance of the hourly mean nitrogen dioxide objective."

The assessment considers the likelihood of exceeding the hourly mean NO_2 objective by comparing predicted annual mean NO_2 concentrations at all receptors to an annual mean equivalent threshold of 60 µg/m^3 NO_2. Where predicted concentrations are below this value, it can be concluded with confidence that the hourly mean NO_2 objective (200 µg/m^3 NO_2, not to be exceeded more than 18 times per year) will be achieved at all relevant commercial properties. Although the assessment includes and refers to commercial property receptors, the findings would be applicable to all receptor types.

5.0 MODEL VERIFICATION

When using air dispersion modelling to predict pollutant concentration, it is necessary to make a comparison between the modelled predictions and measured concentrations at the same location, to ensure that the model is reproducing concentrations as actually observed. The accuracy of the future year of modelling results are relative to the accuracy of the base year results, therefore greater confidence can be placed in future year predicted concentrations if good agreement is found with the base year.

In this instance, it was not possible to verify the data with model outputs with the monitoring data available as no comparable diffusion tube monitoring was undertaken due to COVID-19, as outlined in Section 2.2. Therefore, the focus of the assessment is on the percentage change between the modelled scenarios and the Zone A average background data.

6.0 MODEL RESULTS

6.1 Model Coverage

The modelled results at each of the sensitive receptors, detailed in Section 4.3, identified for each of the scenarios considered for NO_2, PM_{10} and $PM_{2.5}$ are presented in this section.

6.2 Operational Scenarios

Future Baseline

The change in predicted concentrations of NO_2, PM_{10} and $PM_{2.5}$ between Operational Scenario 001 and Operational Scenario 002 are presented in Table 8**,** Table 10 and Table 12, respectively.

As discussed in Section 5.0 the difference between the scenarios, including the average 2019 baseline concentration, has been calculated for each future scenario, as monitored diffusion tube data could not be collected and used to calibrate the model.

Table 8: Predicted change in operational baseline conditions, 2020 - 2038, calculated from annual average NO_2 concentrations µg/m^3, 2019 emission factors

Receptor	Difference between Operational Scenarios 001 and 002 (%)
ADM01	0.05
ADM02	1.08
ADM03	0.95
ADM04	1.12

Receptor	Difference between Operational Scenarios 001 and 002 (%)
ADM05	1.04
ADM06	1.08
ADM07	0.09
ADM08	0.09
ADM09	0.14
ADM10	0.09
ADM11	0.09
ADM12	0.09
ADM13	0.14
ADM14	1.25
ADM15	0.28
ADM16	0.09
ADM17	0.09
ADM18	0.51
ADM19	0.51
ADM20	0.37
ADM21	0.51
ADM22	0.78
ADM23	1.42
ADM24	0.47
ADM25	0.24
ADM26	0.09
ADM27	0.19

The results indicate that the 2038 future baseline (Operational Scenario 002) annual average concentrations will increase by up to 1.4% when compared to the Operational Scenario 001 2020 baseline for all modelled receptors, as shown in Table 9.

As shown in Table 9 the greatest percentage increase for NO_2 (1.42%) has been applied to the average of the Zone A 2019 background data (21 µg/m^3), shown in Table 2. This gives a 2038 baseline predicted maximum concentration of 22.9 µg/m^3.

Table 9: Scenario 002 Predicted NO_2 concentration based on maximum background and maximum modelled percentage change.

Pollutant	Background (µg/m^3)	Background data source	Modelled Maximum % change	Predicted Maximum Concentration (µg/m^3)	% of AQS
NO_2	21	Zone A average	1.42	21.3	53.3

For the 2038 future baseline, annual average NO_2 concentrations are predicted to remain at less than 54% of the NO_2 AQS for all receptors.

This value is below the 60 µg/m^3 threshold mentioned in Section 4.8 regarding the trigger for considering a likely exceedance of the hourly mean NO_2 objective.

Table 10: Predicted change in operational baseline conditions, 2020 - 2038, calculated from annual average PM_{10} concentrations µg/m^3, 2019 emission factors.

Receptor	Difference between Operational Scenarios 001 and 002 (%)
ADM01	0.02
ADM02	0.38
ADM03	0.33
ADM04	0.40
ADM05	0.36
ADM06	0.38
ADM07	0.03
ADM08	0.04
ADM09	0.04
ADM10	0.02
ADM11	0.03
ADM12	0.03
ADM13	0.04
ADM14	0.45
ADM15	0.10
ADM16	0.03
ADM17	0.04
ADM18	0.17
ADM19	0.17
ADM20	0.12
ADM21	0.18
ADM22	0.27
ADM23	0.52
ADM24	0.15
ADM25	0.07
ADM26	0.03
ADM27	0.08

The model results indicate an overall negligible increase in PM_{10} concentrations between Operational Scenario 001 and Operational Scenario 002, as shown by Table 10.

As shown in Table 11 the greatest percentage increase for PM_{10} (0.52%) has been applied to the average of the Zone A 2019 background data (13.6 µg/m^3), shown in Table 2. This gives a 2038 baseline predicted maximum concentration of 14.0 µg/m^3.

Table 11: Scenario 002 Predicted PM_{10} concentration based on average background and maximum modelled percentage change.

Pollutant	Background ($\mu g/m^3$)	Background data source	Modelled Maximum % change	Predicted Maximum Concentration ($\mu g/m^3$)	% of AQS
PM_{10}	13.6	Zone A average	0.52	13.7	34.3

Predicted concentrations at all receptor locations in both scenarios are less than 36% of the PM_{10} AQS.

Table 12: Predicted change in operational baseline conditions, 2020 - 2038, calculated from annual average $PM_{2.5}$ concentrations $\mu g/m^3$, 2019 emission factors.

Receptor	Difference between Operational Scenarios 001 and 002 (%)
ADM01	0.02
ADM02	0.32
ADM03	0.28
ADM04	0.34
ADM05	0.31
ADM06	0.33
ADM07	0.03
ADM08	0.03
ADM09	0.03
ADM10	0.02
ADM11	0.02
ADM12	0.02
ADM13	0.03
ADM14	0.38
ADM15	0.08
ADM16	0.03
ADM17	0.03
ADM18	0.15
ADM19	0.15
ADM20	0.11
ADM21	0.15
ADM22	0.23
ADM23	0.45
ADM24	0.13
ADM25	0.06
ADM26	0.02
ADM27	0.06

The model results indicate an overall negligible increase in $PM_{2.5}$ concentrations between Operational Scenario 001 and Operational Scenario 002, as shown in Table 12.

As shown in Table 13, the greatest percentage increase for $PM_{2.5}$ (0.45%) has been applied to Zone A 2019 background data (9.2 µg/m^3), shown in Table 2. This gives a 2038 baseline predicted maximum concentration of 9.2 µg/m^3.

Table 13: Scenario 002 Predicted $PM_{2.5}$ concentration based on average background and maximum modelled percentage change.

Pollutant	Maximum background (µg/m^3)	Background data source	Modelled Maximum % change	Predicted Maximum Concentration (µg/m^3)	% of AQS
$PM_{2.5}$	9.2	Zone A Average	0.45	9.2	37.0

Predicted Change Attributable to the Operation of the Proposed Development

The change in ambient concentrations attributable to the existence of the Proposed Development is determined by comparing the change in concentrations between Operational Scenario 002 (2038 Future Baseline) and Operational Scenario 003 (2038 Future with Proposed Development).

NO_2

The model results indicate that operation of the Proposed Development (Operational Scenario 003) produces up to 0.35% change in NO_2 concentrations at all receptors when compared with Operational Scenario 002, as shown in Table 14

Table 14: Predicted change between Scenario 002 and Scenario 003, calculated from annual average NO_2 concentrations µg/m^3, 2019 emission factors.

Receptor	Difference between Operational Scenarios 002 and 003 (%)
ADM01	<0.01
ADM02	0.31
ADM03	0.27
ADM04	0.31
ADM05	0.31
ADM06	0.31
ADM07	<0.01
ADM08	0.05
ADM09	<0.01
ADM10	<0.01
ADM11	<0.01
ADM12	0.05
ADM13	<0.01
ADM14	0.35
ADM15	0.09
ADM16	<0.01

Receptor	Difference between Operational Scenarios 002 and 003 (%)
ADM17	0.05
ADM18	0.14
ADM19	0.14
ADM20	0.09
ADM21	0.05
ADM22	0.05
ADM23	0.17
ADM24	0.05
ADM25	<0.01
ADM26	<0.01
ADM27	0.05

As shown in Table 15 to predict the worst case NO_2 concentration, this percentage increase has been applied to the calculated predicted NO_2 concentration of 22.9 µg/m^3 for Scenario 002 (As shown in Table 9). This gives a worst case 2038 concentration of 23.0 µg/m^3 for Scenario 003.

Table 15: Scenario 003 Predicted NO_2 concentration based on maximum background and maximum modelled percentage change.

Pollutant	Scenario 002 Predicted Concentration (µg/m^3)[1]	Modelled Maximum % change[2]	Scenario 003 Maximum Predicted Concentration (µg/m^3)	% of AQS
NO_2	22.9	0.35	23.0	57.5

Notes:

1. Calculated in Table 9
2. Change between Scenario 002 and Scenario 003

For the 2038 Future scenario with the Proposed Development, annual average NO_2 concentrations are predicted to remain at less than 58% of the NO_2 AQS for all receptors.

PM_{10}

The model results indicate that operation of the Proposed Development (Operational Scenario 003) produces a negligible change (no more than 0.14%) in PM_{10} concentrations at all receptors when compared with Operational Scenario 002, as shown in Table 16.

Table 16: Predicted change between Scenario 002 and Scenario 003, calculated from annual average PM_{10} concentrations µg/m^3, 2019 emission factors.

Receptor	Difference between Operational Scenarios 002 and 003 (%)
ADM01	<0.01
ADM02	0.11
ADM03	0.10

Receptor	Difference between Operational Scenarios 002 and 003 (%)
ADM04	0.12
ADM05	0.11
ADM06	0.12
ADM07	0.01
ADM08	0.01
ADM09	0.01
ADM10	0.01
ADM11	0.01
ADM12	0.01
ADM13	0.01
ADM14	0.14
ADM15	0.03
ADM16	0.01
ADM17	0.01
ADM18	0.05
ADM19	0.05
ADM20	0.03
ADM21	0.01
ADM22	0.01
ADM23	0.06
ADM24	0.02
ADM25	<0.01
ADM26	<0.01
ADM27	0.01

Table 17: Scenario 003 Predicted PM_{10} concentration based on maximum background and maximum modelled percentage change.

Pollutant	Scenario 002 Predicted Concentration ($\mu g/m^3$)[1]	Modelled Maximum % change[1]	Scenario 003 Maximum Predicted Concentration ($\mu g/m^3$)	% of AQS
PM_{10}	14.02	0.14	14.04	35.1

Notes:
1. Calculated in Table 11
2. Change between Operational Scenario 002 and Operational Scenario 003

As shown in Table 17, to predict the worst case PM_{10} concentration, this percentage increase has been applied to the calculated predicted PM_{10} concentration of 14.02 for Scenario 002 (as shown in Table 11). This gives a worst case 2038 concentration of 14.04 $\mu g/m^3$ for Scenario 003.

For the 2038 Future scenario with the Proposed Development, annual average PM10 concentrations are predicted to remain at less than 36% of the PM10 AQS for all receptors.

$PM_{2.5}$

The model results indicate that operation of the Proposed Development (Operational Scenario 003) produces a negligible change (no more than 0.12%) in $PM_{2.5}$ concentrations at all receptors when compared with Operational Scenario 002, as shown in Table 18.

As shown in Table 19 to predict the worst case $PM_{2.5}$ concentration, this percentage increase has been applied to the calculated predicted $PM_{2.5}$ concentration of 9.2 µg/m^3 for Scenario 002 (As shown in Table 13). This gives a worst case 2038 concentration of 9.3 µg/m^3 for Scenario 003.

For the 2038 Future scenario with the Proposed Development, annual average PM2.5 concentrations are predicted to remain at less than 38% of the $PM_{2.5}$ AQS for all receptors.

Table 18: Predicted change between Scenario 002 and Scenario 003, calculated from annual average $PM_{2.5}$ concentrations µg/m^3, 2019 emission factors.

Receptor	Difference between Operational Scenarios 002 and 003 (%)
ADM01	0.00
ADM02	0.10
ADM03	0.09
ADM04	0.10
ADM05	0.09
ADM06	0.10
ADM07	0.01
ADM08	0.01
ADM09	0.01
ADM10	<0.01
ADM11	0.01
ADM12	0.01
ADM13	0.01
ADM14	0.12
ADM15	0.02
ADM16	0.01
ADM17	0.01
ADM18	0.04
ADM19	0.04
ADM20	0.02
ADM21	0.01
ADM22	0.01
ADM23	0.05
ADM24	0.01
ADM25	<0.01
ADM26	<0.01
ADM27	0.01

Table 19: Scenario 003 Predicted $PM_{2.5}$ concentration based on maximum background and maximum modelled percentage change.

Pollutant	Scenario 002 Predicted Concentration ($\mu g/m^3$)[1]	Modelled Maximum % change2	Scenario 003 Maximum Predicted Concentration ($\mu g/m^3$)	% of AQS
$PM_{2.5}$	9.2	0.12	9.2	36.8

Notes:
1. Calculated in Table 13
2. Change between Operational Scenario 002 and Operational Scenario 003

7.0 ASSESSMENT OF IMPACTS

7.1 Operational Phase

The modelling results presented show that for the 2038 future operational baseline year (Operational Scenario 002) there is a predicted increase of no more than 1.42% in annual average NO_2 concentrations across the Study Area when compared to the 2020 baseline (Operational Scenario 001). When the Proposed Development is included (Operational Scenario 003), the model predicts a further small increase in NO_2 concentrations when compared with Operational Scenario 002; however, the increase is no more than 0.35%. The change is therefore considered negligible.

For PM_{10}, the model results indicate an overall negligible increase of less than 0.52% in PM_{10} concentrations between Operational Scenario 001 and Operational Scenario 002. When the Proposed Development is included, the model predicts a further small increase of PM_{10} concentrations when compared with the future baseline; however, the increase is by no more than 0.14%. The change is therefore considered negligible.

For $PM_{2.5}$, the model results indicate an overall negligible increase of less than 0.45% in $PM_{2.5}$ concentrations between Operational Scenario 001 and Operational Scenario 002. When the Proposed Development is included (Operational Scenario 003), the model predicts an increase in $PM_{2.5}$ concentrations when compared with the future baseline (Operational Scenario 002); however, the increase is no more 0.12%. The change is therefore considered negligible.

An assessment of the impact of the change in air quality is assessed in accordance with the criteria set out in Section 1.5. In all cases the predicted change in air quality concentrations is considered negligible. The change in traffic linked to the Proposed Development will thus have an impact on air quality but will not significantly change the pollutant concentrations in the area:

- For NO_2, the model indicates that ambient concentrations will be below the annual mean objective of 40 $\mu g/m^3$ for all receptors, with worst case concentrations below 58% of the AQS. Therefore, the predicted impact is classified as negligible.
- For PM_{10}, the model indicates that ambient concentrations will be below the annual mean objective of 40 $\mu g/m^3$ for all receptors, with concentrations below 36% of the AQS. Accordingly, the predicted impact is classified as negligible.
- For $PM_{2.5}$, the model indicates that ambient concentrations will be below the annual mean objective of 25 $\mu g/m^3$ for all receptors, with concentrations below 38% of the AQS. Accordingly, the predicted impact is classified as negligible.

8.0 REFERENCES

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