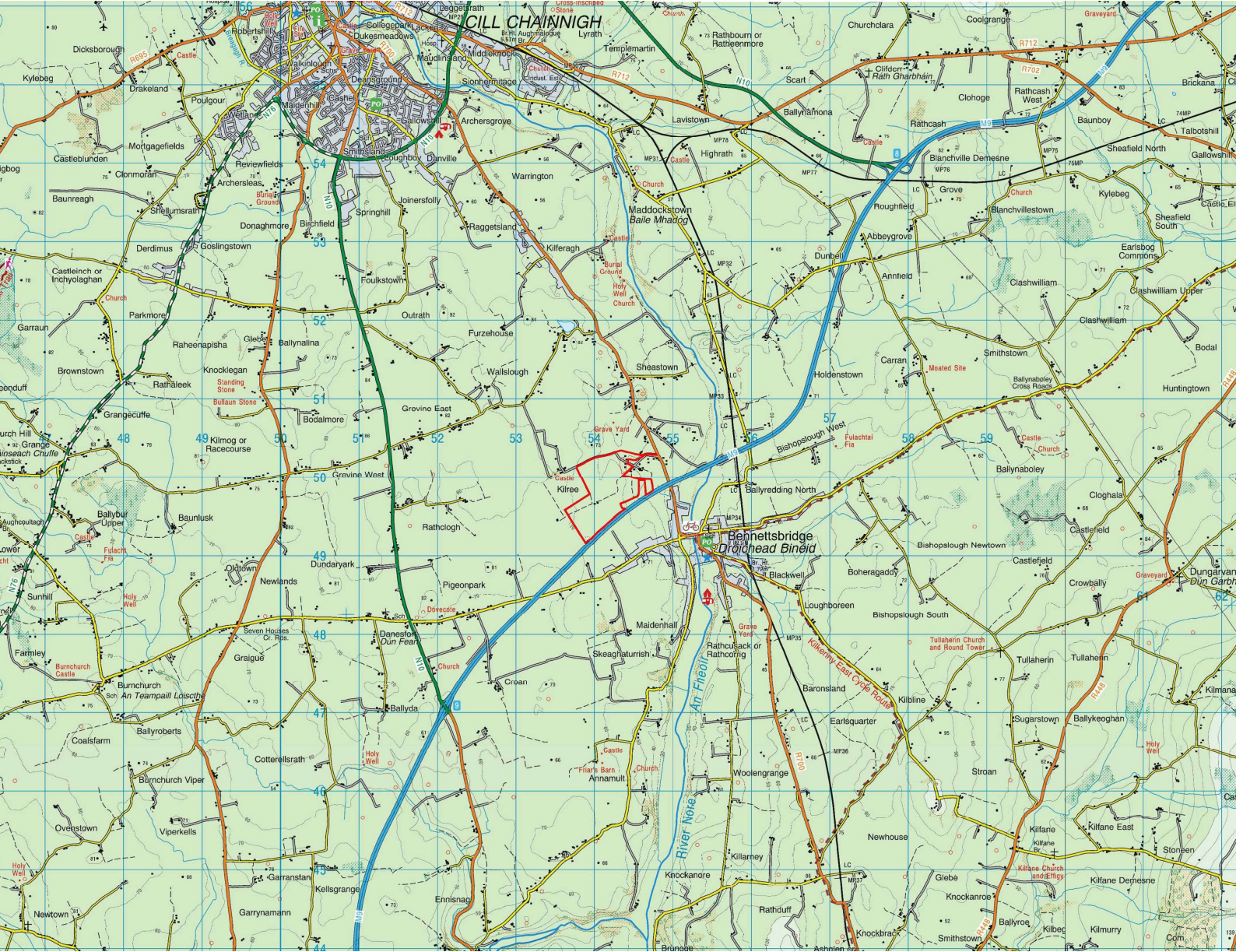


CHAPTER 10

AIR QUALITY

RECEIVED: 18/08/2025



JULY 2025

Table of Contents

CHAPTER 10: AIR QUALITY	4
Introduction	4
Legislative and Policy Context.....	4
Assessment Methodology and Significance Criteria.....	5
Criteria for Rating of Impacts.....	5
Ambient Air Quality Standards	5
Dispersion Modelling Methodology	7
Process Emissions	8
Dust Generation Rates	9
Road Traffic	10
Baseline Conditions.....	10
Meteorological Conditions.....	11
Background Sources of Dust	12
Background Sources of PM ₁₀ and PM _{2.5}	14
Potential Effects.....	16
Construction Phase	16
Operational Phase.....	16
Dust Deposition.....	16
PM ₁₀	17
PM _{2.5}	18
Road Traffic Emissions	20
Human Health	21
Mitigation and Monitoring.....	21
Mitigation.....	21
Monitoring	22
Residual Impacts	22
‘Do-Nothing’ Scenario.....	22
Dust Deposition.....	22
PM ₁₀	23
PM _{2.5}	24
Cumulative Effects	27
Residual Effects	29
Difficulties Encountered.....	29
References	30

Appendices.....	31
Appendix 1: Description of Aermod Model	31
Appendix 2: Aermet	33
Appendix 3: Emission Factors	36
Crushing	36
Screening.....	36
Compacting	36
Topsoil Removal	36
Material Loading	37
Conveyor	37
Blasting.....	37
Stock Pile	37
Road Haulage (Paved)	37
Road Haulage (Unpaved)	38
Wind Erosion of Stockpiles	38

CHAPTER 10: AIR QUALITY

Introduction

- 1.1 This report assesses the likely air quality impacts associated with the operation of proposed continuation of use and lateral extension to a Limestone Quarry at Kilree, Bennettsbridge, Co. Kilkenny.
- 1.2 This report was prepared by Aisling Cashell. Aisling is an Environmental Consultant in the Air Quality & Climate section of AWN Consulting. She holds a BA and MAI in Civil, Structural and Environmental Engineering from Trinity College Dublin. She is a Member of the Institute of Engineers Ireland (MIEI). She has two years of experience in undertaking air quality and climate assessments. She has prepared air quality and climate impact assessments as part of EIARs for residential, commercial and industrial developments, as well as renewable energy developments. She has undertaken air quality and climate impact assessments for transportation schemes, primarily regional and national road schemes, from constraints, through to route selection and EIAR stage.
- 1.3 This report was reviewed by Dr. Jovanna Arndt, a Senior Environmental Consultant in the Air Quality & Climate section of AWN Consulting. She holds a BSc. in Environmental Science and a Ph.D. in Atmospheric Chemistry from University College Cork. She is an Associate Member of both the Institute of Air Quality Management and the Institute of Environmental Sciences. She has been specialising in the area of air quality and climate over 8 years and has prepared air quality and climate assessments for inclusion within EIARs for residential developments such as Twenties Lane (Planning Application Ref: 22713), Cherrywood T13 (Planning Application Ref: DZ23A/0028), Corballis Donabate LRD (Planning Application Ref: LRD0017/S3), commercial and industrial developments by Dublin Airport Authority, Zoetis, Ipsen, Merck Millipore, Greener Ideas Limited and Abbvie, as well as renewable energy developments such as Codling Wind Park and the Cúil Na Móna Anaerobic Digestion Facility. She also specialises in assessing air quality impacts using air dispersion modelling of transportation schemes such as BusConnects Dublin, major Highways England Road schemes and major rail infrastructure in the form of High Speed 2 (HS2 in the UK). She has prepared air dispersion modelling assessments of emissions from data centres, energy centres and the chemical industry as part of EPA Industrial Emissions Licences for Microsoft, Greener Ideas Limited, Merck Millipore, Lilly Limerick, Chemifloc, Takeda, Kingspan and Kilshane Energy. She has also provided Air Quality Action Plan (AQAP) and Air Quality Management Area (AQMA) support to several UK councils and assessed the air quality impacts of potential Clean Air Zones in the UK.

Legislative and Policy Context

- 1.4 The principal guidance and best practice documents used to inform the assessment of potential impacts on air quality are summarised below.
- PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects (Transport Infrastructure Ireland [TII], 2022);
 - Air Dispersion Modelling from Industrial Installations Guidance Note (AG4) (EPA, 2020); and
 - Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (Periodically Updated) (USEPA, 1986).

- 1.5 In addition to specific air quality guidance documents, the following guidelines were considered and consulted in the preparation of this chapter:
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the Environmental Protection Agency (EPA) Guidelines) (EPA, 2022);
 - Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (Department of Housing, Planning & Local Government, 2018); and
 - Environmental Impact Assessment (EIA) Directive Guidance on the Preparation of the Environmental Impact Assessment Report (European Commission, 2017).

Assessment Methodology and Significance Criteria

Criteria for Rating of Impacts

- 1.6 The rating of potential environmental effects of the development on air quality is based on the criteria presented in Table 3.3 of the EPA (2022) document titled *Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports*. These criteria consider the quality, significance, duration and types of effect characteristics identified.

Ambient Air Quality Standards

- 1.7 National and European statutory bodies, the Department of the Environment, Heritage and Local Government in Ireland and the European Parliament and Council of the European Union, have set limit values in ambient air for a range of air pollutants to reduce the risk to health from poor air quality. These limit values or "Air Quality Standards" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set.
- 1.8 Air quality significance criteria are assessed based on compliance with the appropriate standards or limit values. The applicable standards in Ireland are set out in Directive (EU) 2024/2881 of the European Parliament and of the Council of 23 October 2024 on ambient air quality and cleaner air for Europe (recast). This directive supersedes EU Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (CAFE Directive). It sets out new air quality standards for pollutants to be reached by 2030 which are more closely aligned with the World Health Organisation (WHO) air quality guidelines.
- 1.9 The Ambient Air Quality Standards Regulations 2022 (S.I. 739 of 2022) (the Air Quality Standards Regulations 2022) further transposed the CAFE Directive and revoked the Air Quality Standards Regulations 2011, as amended. With the adoption of Directive (EU) 2024/2881, Ireland must transpose this directive into national law, i.e. update the Air Quality Standards Regulations, before December 2026.
- 1.10 The ambient air quality standards applicable for dust deposition and particulate matter (as PM₁₀ and PM_{2.5}) are outlined in Table 0.1. The limit values set out in Directive (EU) 2024/2881 will need to be achieved by 2030, with the limit values set out in the Air Quality Standards Regulations 2022, and future updated regulations, applicable until 2030.

Table 0.1: Air Quality Standards

Pollutant	Limit Type	Directive 2008/50/EC	Directive (EU) 2024/2881	
		Limit Value (applicable until 2030)	Limit Type	Limit Value (attained by 2030)
Dust Deposition	TA Luft (German VDI 2002)	Annual average limit for nuisance dust	350 mg/m ² /day	
Particulate Matter (as PM ₁₀)	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m ³	24-hour limit for protection of human health - not to be exceeded more than 18 times/year	45 µg/m ³
	Annual limit for protection of human health	40 µg/m ³	Annual limit for protection of human health	20 µg/m ³
Particulate Matter (as PM _{2.5})	N/A	N/A	24-hour limit for protection of human health - not to be exceeded more than 18 times/year	25 µg/m ³
	Annual limit for protection of human health	25 µg/m ³	Annual limit for protection of human health	10 µg/m ³

Note 1 EU 2008/50/EC – Clean Air For Europe (CAFE) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

- 1.11 In April 2023, the Government of Ireland published the *Clean Air Strategy for Ireland* (Government of Ireland, 2023), which provides a high-level strategic policy framework needed to reduce air pollution. The strategy commits Ireland to achieving the 2021 World Health Organisation (WHO) Air Quality Guidelines Interim Target 3 (IT3) by 2026, the IT4 targets by 2030 and the final targets by 2040 (Table 0.2). The strategy notes that a significant number of Environmental Protection Agency (EPA) monitoring stations observed air pollution levels in 2021 above the WHO targets; 80% of these stations would fail to meet the final PM_{2.5} target of 5 µg/m³. The strategy also acknowledges that “meeting the WHO targets will be challenging and will require legislative and societal change, especially with regard to both PM_{2.5} and NO₂”. Ireland will revise its air quality legislation in line with the proposed EU revisions to the EU 2008/50/EC – Clean Air For Europe (CAFE) Directive, which will set interim 2030 air quality standards and align the EU more closely with the WHO targets.

Table 0.2 WHO Air Quality Guidelines

Pollutant	Regulation	Limit Type	IT3 (2026)	IT4 (2030)	Final Target (2040)
PM (as PM ₁₀)	WHO Air Quality Guidelines	24-hour limit for protection of human health	75µg/m ³ PM ₁₀	50µg/m ³ PM ₁₀	45µg/m ³ PM ₁₀
		Annual limit for protection of human health	30µg/m ³ PM ₁₀	20µg/m ³ PM ₁₀	15µg/m ³ PM ₁₀
PM (as PM _{2.5})		24-hour limit for protection of human health	37.5µg/m ³ PM _{2.5}	25µg/m ³ PM _{2.5}	15µg/m ³ PM _{2.5}
		Annual limit for protection of human health	15µg/m ³ PM _{2.5}	10µg/m ³ PM _{2.5}	5µg/m ³ PM _{2.5}

Dispersion Modelling Methodology

- 1.12 The methodology used as part of this assessment involved undertaking a desk-based study to examine all relevant information relating to air quality conditions in the vicinity of the application site.
- 1.13 The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA, 2015; 2020; 2022) and using the methodology outlined in the guidance documents published by the USEPA (USEPA, 2017; 2021). The air dispersion modelling input data consisted of information on the physical environment, design details from all emission sources on-site and five full years of meteorological data. Using this input data, the model predicted ambient ground level concentrations and deposition rates beyond the land ownership boundary for each hour of the modelled meteorological years. The model post-processed the data to identify the location and maximum of the worst-case ground level concentration. This worst-case concentration and deposition rate was then added to the background concentration and deposition rate to give the worst-case predicted environmental concentration (PEC) and deposition flux. The PEC was then compared with the relevant ambient air quality standard to assess the significance of the releases from the site.
- 1.14 Air dispersion modelling was undertaken to assess the dust deposition flux at the land ownership boundary, and the PM₁₀ and PM_{2.5} concentrations associated with the activities at sensitive locations beyond the land ownership boundary. Modelling using the United States Environmental Protection Agency (USEPA) new generation dispersion model AERMOD (USEPA, 2021) (Version 22112) was used as recommended by the USEPA (2017) and Irish EPA (2020). The steady-state Gaussian plume model is used to assess pollutant concentrations associated with industrial sources. The model has been designated the regulatory model by the USEPA for modelling emissions from industrial sources in both flat

and rolling terrain (USEPA, 2017). The AERMET meteorological pre-processor (USEPA, 2018) was used to generate hourly boundary layer parameters for use by AERMOD. Dust generation rates were calculated from factors derived from empirical assessment and detailed in the USEPA database entitled *Compilation of Air Pollution Emission Factors*, Volume 2, AP-42 (1986, updated periodically) (USEPA, 1986). The emission factors have been presented in Appendix 2.

Process Emissions

- 1.15 Screening and crushing activities typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns ($1 - 75 \mu\text{m}$). Deposition typically occurs near each site and potential impacts generally occur within 500 metres of the dust generating activity as dust particles fall out of suspension in the air. Larger particles deposit closer to the generating source and deposition rates will decrease with distance from the source. Sensitivity to dust depends on the duration of the dust deposition, the dust generating activity, and the nature of the deposit. Therefore, a higher tolerance of dust deposition is likely to be shown if only short periods of dust deposition are expected and the dust generating activity is either expected to stop or move on.
- 1.16 The potential for dust to be emitted will depend on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speed, wind direction and dust prevention measures in place. This assessment identifies and quantifies the dust sources from the site.
- 1.17 The Kilree facility at Bennettsbridge, Co. Kilkenny is an active limestone quarry that currently operates within an established, consented footprint. Planning consent is now sought to extend the working area westward by ≈ 24.5 ha inside an overall 61 ha application boundary. Approx. 18.2 Ha. of the extension land will be used solely for rock extraction; all crushing, screening, lime batching and ancillary plant will continue to operate on the existing quarry floor, so no change to current processing methods is proposed. Combustion sources in the study area include a licensed fixed asphalt plant within the wider quarry (see Cumulative Effects for more detail).
- 1.18 All processing activities, including crushing, screening, and stockpiling, will remain within the existing quarry void, while extraction will continue with monthly blasting. For the purposes of this assessment an estimate of 10.7 truck movements in and out of the site per hour has been assumed, based on an average of 128 vehicle loads per day total. Loading onto trucks for distribution will occur at the recycled storage area. This equates to c. $3\,200 \text{ t day}^{-1}$ ($\approx 845\,000 \text{ t yr}^{-1}$ assuming 48 active weeks), i.e. a higher output than both the consented 675 kt yr^{-1} and the 750 kt yr^{-1} stress-test requested by the planning authority; the dispersion modelling is therefore inherently conservative.
- 1.19 The annual tonnage of limestone processed will be about 675 000 tonnes, which will be drilled and blasted, then screened, crushed, and exported offsite. Approximately $370\,000 \text{ m}^3$ of overburden will be removed; this material will be used to form screening berms, stored in the designated overburden area, or exported off-site as required. The permitted hours of operation at the site are Monday to Friday 07:00 to 19:00 and Saturdays 07:00 to 14:00. Operations are closed on Sundays and Bank Holidays. These hours have been used for the purpose of the assessment. The following operations are the main dust generating sources or activities at the site:
- Topsoil/subsoil removal of proposed extension area;
 - Compacting of material;
 - Movement of empty trucks along paved public roads;

- Movement of empty trucks along unpaved haul roads;
- Extraction of material;
- Crushing of material;
- Screening of material;
- Transfer of material along conveyors;
- Stockpiling of material;
- Loading of material;
- Blasting of material;
- Movement of full trucks along unpaved haul roads;
- Movement of full trucks along paved public roads;
- Wind erosion at dump areas, stockpiles and exposed surface.

RECEIVED: 18/08/2025

1.20 The formulae and emission rates for the onsite activities are outlined in Appendix 2.

Dust Generation Rates

- 1.21 Dust generation rates depend on the site activity, particle size, the moisture content of the material and weather conditions. Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion created between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where more than 0.2mm of precipitation has occurred.
- 1.22 Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited near the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to the potential dust nuisance at the sensitive receptors. This size range would broadly be described as silt. Emission rates are normally predicted on a site-specific particle size distribution for each dust emission source. In the absence of such information, the particle size distribution outlined in *AP-42 Appendix B.2.2 for Category 3 (mechanically generated aggregate)* (USEPA, 1986) has been used and is outlined in Table 0.3.

Table 0.3 Category 3 Mechanically Generated Aggregates

Cumulative % ≤ Stated Size	Particle Size (µm)	Minimum Value	Maximum Value	Standard Deviation
4	1.0	-	-	-
11	2.0	-	-	-
15	2.5	3	35	7
18	3.0	-	-	-
25	4.0	-	-	-
30	5.0	-	-	-
34	6.0	15	65	13
51	10.0	23	81	14

Source AP-42 (USEPA, 1986)

- 1.23 Dust deposition typically occurs near the dust-generating source. There are a small number of sensitive locations in proximity to the site which can be affected by dust deposition. The site is in an area with a relatively low population density; most residential dwellings are in ribbon development along the local surrounding roads. The nearest dwellings are located within 30m to the northeast of the boundary of the site. Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m.
- 1.24 A receptor grid was created at which concentrations would be modelled. The receptor grid was based on a Cartesian grid with the site at the centre. The inner grid measured 2km x 2km with the site at the centre and concentrations calculated at 50m intervals. The outer grid measured 5km x 5km with the site at the centre and with concentrations calculated at 250m intervals. Boundary receptor locations were also placed along the land ownership and site boundary of the site, at 100m intervals. Nearby sensitive residential properties were also added to the model as discrete receptors giving a total of 2,254 calculation points for the model. The modelling has investigated the deposition and concentrations of dust, PM₁₀ and PM_{2.5} for the activities outlined above.

Road Traffic

- 1.25 There is the potential for emissions from road vehicles accessing the site to impact air quality. Pollutants such as NO₂, PM₁₀, PM_{2.5} and CO₂ are emitted from road vehicles.
- 1.26 The TII guidance *Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106* (TII, 2022), states that road links meeting one or more of the following criteria can be defined as being ‘affected’ by a proposed development and should be included in the local air quality assessment. While the guidance is specific to infrastructure projects, the approach can be applied to any development that causes a change in traffic.
- Annual average daily traffic (AADT) changes by 1,000 or more;
 - Heavy duty vehicle (HDV) AADT changes by 200 or more;
 - Daily average speed change by 10 kph or more;
 - Peak hour speed change by 20 kph or more;
 - A change in road alignment by 5m or greater.
- 1.27 If any of the road links impacts by a proposed development meet any of the above criteria, then a detailed assessment is required.
- 1.28 The above scoping criteria for both air quality have been used in the current assessment to determine whether the impacted road links require modelling. It was found that the traffic changes associated with the proposed development were significantly below the air quality assessment criteria outlined above. A detailed modelling assessment was not required as impacts to air quality because of traffic emissions are predicted to be imperceptible.

Baseline Conditions

- 1.29 The subject site is the Bennettsbridge Limestone quarry at Kilree, Bennettsbridge, Co. Kilkenny. The planning application encompasses approximately 61 hectares in total—about 36.5 ha of the existing operational quarry and infrastructure plus a 24.5 ha lateral extension on adjoining farmland and commercial forestry to the west. Within that extension, roughly 18.2 ha will be quarried (two benches, each c. 19 m high), while c. 6.3 ha will accommodate screening berms, overburden storage, internal haul roads and ancillary works.

Meteorological Conditions

- 1.30 Meteorological conditions significantly affect the level of dust emissions and subsequent deposition downwind of the source. The most significant meteorological elements affecting dust deposition are rainfall and wind-speed. High levels of moisture, either retained in soil or due to rainfall, help to suppress the generation of dust due to the cohesive nature of water between dust particles. Rain also assists in removing dust from the atmosphere through washout. Wind can lift particles up into the air and transport the dust downwind as well as drying out the surface. The worst dust deposition conditions typically occur, therefore, during dry conditions with strong winds.
- 1.31 The most representative Met Éireann synoptic station to the site is at Johnstown Castle, which is approximately 50 km southeast of the site.
- 1.32 Dust emissions are dramatically reduced where rainfall has occurred due to the cohesion between dust particles and water and the removal of suspended dust from the air. It is typical to assume no dust is generated under “wet day” conditions where rainfall greater than 0.2 mm has fallen. Long-term average meteorological data (1991-2020) from Casement Aerodrome meteorological station (the closest meteorological station with 30-year data) (Met Éireann, 2024) identified that typically 194 days per annum are “wet”. Thus, approximately 53% of the time no significant dust generation will be likely due to meteorological conditions.
- 1.33 Wind frequency is also important as dust can only be dispersed by winds, and deposition of dust is a simple function of particle size, wind speed and distance. The closer the source of dust is to a receptor; the higher the potential risk of impact of dust blow. The prevailing winds in the area are south-westerly to westerly, thereby predominantly dispersing any potential dust emissions to the north-east and east of the site (Figure 0.1). Wind speeds averaged 5.0 m/s over the period 1991 - 2020.
- 1.34 All meteorological data referenced within this assessment is provided by Met Éireann (Met Éireann, 2024). The air dispersion modelling assessment has been conducted for five meteorological years (2020 – 2024) using meteorological data from Johnstown Castle meteorological station as per the EPA guidance (2020a).



Figure 0.1 Johnstown Castle Windroses 2020 – 2024 (Met Éireann, 2024)

Background Sources of Dust

- 1.35 The sources of dust arising from the site contribute to background levels of dust. Dust is present naturally in the air from several sources including weathering of minerals, pick-up across open land and dust generated from fires. Monitoring of dust deposition has been carried out on site. Therefore, background levels for the immediate vicinity of the site are not available.
- 1.36 Dust deposition monitoring has been conducted at 4 locations on site (D1 – D4) in recent years. Historical dust monitoring data for March 2020 to October 2024 have been reviewed to inform background concentrations of dust deposition in the vicinity of the site. Long-term average results for location D1 – D4 were 97 mg/m²/day, 157 mg/m²/day, 106 mg/m²/day and 86 mg/m²/day respectively. The overall average dust deposition result across the four monitoring locations is 112 mg/m²/day. These figures are based on partial-year monitoring (March to October). There have been seven exceedances of the 350 mg/m²/day limit value at the subject site over the 2023 – 2025 period, most notably in June 2024. This is likely due to warmer, drier summer conditions facilitating higher dust generation. Table 0.1 details the dust monitoring results for the 2020 to 2024 period.

Table 0.1 Historical Dust Monitoring Data March 2020 – October 2024

Monitoring Period	Location D1	Location D2	Location D3	Location D4
	(mg/m ² / day)			
March 2020	30	15	31	74
April 2020	30	15	31	74

Monitoring Period	Location D1	Location D2	Location D3	Location D4
		(mg/m ² / day)		
May 2020	30	15	31	74
June 2020	39	112	73	90
July 2020	36	56	82	41
August 2020	73	78	78	50
September 2020	122	203	220	52
October 2020	87	75	58	93
March 2021	29	35	41	35
April 2021	41	-	107	31
May 2021	54	174	90	102
June 2021	22	-	34	10
July 2021	61	112	255	82
August 2021	35	121	23	35
September 2021	127	31	71	56
October 2021	58	75	29	23
March 2022	48	-	126	12
April 2022	102	-	138	30
May 2022	62	364	157	123
June 2022	117	87	61	71
July 2022	64	81	122	35
August 2022	117	-	122	31
September 2022	12	273	10	10
October 2022	-	115	91	151
March 2023	79	181	28	26
April 2023	23	146	100	10
May 2023	35	200	41	23
June 2023	24	453	176	31
July 2023	94	302	160	122
August 2023	18	287	-	255
September 2023	18	287	-	255
October 2023	62	141	135	113
March 2024	307	55	27	23
April 2024	181	163	82	151
May 2024	372	156	330	214
June 2024	552	621	426	469
July 2024	350	100	73	79
August 2024	135	55	21	22

Monitoring Period	Location D1	Location D2	Location D3	Location D4
	(mg/m ² / day)			
September 2024	90	239	258	210
October 2024	44	63	105	51

- 1.37 The dust deposition monitoring results discussed above are accounted for in dispersion modelling study by the subject site's operational dust emissions, i.e. emission rates (see Appendix 3).
- 1.38 The purpose of the background level is to account for all non-site related dust. A study by the UK ODPM (UK ODPM, 2000) gives estimates of likely dust deposition levels in specific types of environments. In open country, a level of 39 mg/m²/day is typical, rising to 59 mg/m²/day on the outskirts of town and peaking at 127 mg/m²/day for a purely industrial area. A background dust deposition rate of 39 mg/m²/day was applied as the background dust deposition level for the region of the proposed activities at Kilree, Bennettsbridge, Co. Kilkenny to account for non-site related dust.

Plate 0.2 Dust Monitoring Data Locations



Background Sources of PM₁₀ and PM_{2.5}

- 1.39 Monitoring for PM₁₀ and PM_{2.5} is carried out by the EPA and Local Authorities at a range of locations throughout Ireland. The details of the monitoring are published in annual reports. The most recent annual monitoring report is *Air Quality in Ireland 2023* (EPA, 2023). Four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2023). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed

of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring and assessment, the proposed development is within Zone D.

- 1.40 Long-term PM₁₀ monitoring was carried out at the Zone D locations of Claremorris and Kilkit from 2019 to 2023 (EPA, 2023). Annual mean concentrations of PM₁₀ range from 7 – 11 µg/m³ over the five-year period (Table 0.3). Long term average concentrations are below the annual average limit of 40 µg/m³. Based on the above information a conservative annual mean background concentration of 8 µg/m³ has been used in this assessment.
- 1.41 In relation to the maximum 24-hour averaging period (as a 90.4th%ile), a value of 15 µg/m³ was employed using the methodology outlined in Appendix E of AG4 (EPA, 2020) based on the long-term PM₁₀ monitoring was carried out at Zone D locations over the period 2019 – 2023.

Table 0.3 Trends in Zone D Air Quality – PM₁₀ (µg/m³)

Station	Averaging Period	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean PM ₁₀ (µg/m ³)	11	10	8	8	8
	24-hr Mean > 50 µg/m ³	0	0	0	0	0
Kilkit	Annual Mean PM ₁₀ (µg/m ³)	7	-	-	9	7
	24-hr Mean > 50 µg/m ³	1	-	-	0	0

- 1.42 The results of PM_{2.5} monitoring at the Zone D location Claremorris over the period 2019 – 2023 (Table 0.4) (EPA, 2023). Based on this information, the predicted environmental concentration in terms of PM_{2.5} is 6 µg/m³.

Table 0.4 Trends in Zone D Air Quality -PM_{2.5} (µg/m³)

Station	Averaging Period	Year				
		2019	2020	2021	2022	2023
Claremorris	Annual Mean PM _{2.5} (µg/m ³)	4	5	8	6	5

- 1.43 In relation to the annual averages, the ambient background concentration is added directly to the process concentration. However, in relation to the short-term peak concentration, concentrations due to emissions from elevated sources cannot be combined in the same way. Guidance from the UK DEFRA (UK DEFRA, 2022) and the EPA (EPA, 2020) advises that for PM₁₀ an estimate of the maximum combined pollutant concentration can be obtained as shown below:
- 1.44 PM₁₀ – The 90.4th%ile of total 24-hour mean PM₁₀ is equal to the maximum of either A or B below:
- 90.4th%ile of 24-hour mean background PM₁₀ + annual mean process contribution PM₁₀.
 - 90.4th%ile 24-hour mean process contribution PM₁₀ + annual mean background PM₁₀.

Potential Effects

Construction Phase

- 1.45 The proposed development will include minor work associated with the extension. Any dust emissions generated during preparatory works, such as minor internal adjustments or maintenance to existing infrastructure, are expected to be limited and temporary. Construction dust emissions are not predicted to have a significant impact on local air quality.
- 1.46 The removal of approximately 370 000 m³ of overburden will occur progressively alongside limestone extraction. Therefore, its potential effects are assessed within the Operational Phase.

Operational Phase

- 1.47 The main potential sources of emissions to air will be associated with plant and machinery undertaking day to day activities such as extraction, onsite processing and transportation of material and dust blow generated during dry, windy conditions. Potential impacts associated with day-to-day activities have been separated into dust deposition and vehicle and plant emissions. The assessment is based on the proposed increased traffic volume of 128 truckloads per day.

Dust Deposition

- 1.48 Based on a background dust deposition of 39 mg/m²/day in the region of the site, the combined background and process contribution dust deposition level (i.e. predicted environmental concentration (PEC)) peaks at 199.4 mg/m²/day which is 57% of the TA Luft Limit Value of 350 mg/m²/day. Figure 0.1 shows the geographical variation in annual dust deposition levels in the region of development. The primary source of dust deposition is attributed to the stockpile area, making up more than 75% of the total contribution. Following closely, the second most significant contributor is the paved roads, accounting for 53%.
- 1.49 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 94.3 mg/m²/day or 38% of the TA Luft limit value, including background concentrations.
- 1.50 The impact of dust deposition is considered **direct, slight, negative, localised** and **long-term**.

Table 0.1 Proposed Operations – Dispersion Model Results for TSP

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m ³)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
Dust / 2020	Annual Mean	Boundary	622030, 5829208	159.5	39	198.5	350	57%
Dust / 2021	Annual Mean	Boundary	622030, 5829208	150.1	39	189.1	350	54%
Dust / 2022	Annual Mean	Boundary	622030, 5829208	156.8	39	195.8	350	56%
Dust / 2023	Annual Mean	Boundary	622030, 5829208	155.7	39	194.7	350	56%

Dust / 2024	Annual Mean	Boundary	622030, 5829208	160.4	39	199.4	350	57%
-------------	-------------	----------	-----------------	-------	----	-------	-----	-----

PM₁₀

- 1.51 Predicted PM₁₀ concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the proposed development. For emissions from the proposed development the predicted 24-hour and annual mean concentrations (excluding background, i.e. process contribution (PC)) at the worst-case receptor peak at 41.0 µg/m³ (82% of the PM₁₀ annual mean limit value) and 16.6 µg/m³ (42% of the PM₁₀ annual mean limit value) respectively.
- 1.52 Based on an annual mean background PM₁₀ concentration of 8 µg/m³ in the region of the proposed development, the combined annual PM₁₀ concentration including the site, (i.e. predicted environmental concentration (PEC)), peaks at 24.6 µg/m³ (Table 0.2). This predicted level equates to at most 62% of the annual limit value of 40 µg/m³.
- 1.53 Based on a 24hr (90.4thile) mean concentration of 15 µg/m³, the predicted 24-hour PM₁₀ concentration (including background) peaks at 49.0 µg/m³ which is 98% of the 24-hour limit value of 50 µg/m³ (measured as a 90.4thile).
- 1.54 The geographical variation in the 24-hour mean (90.4thile) PM₁₀ ground level concentrations are illustrated as concentration contours in Figure 0.2. The geographical variation in annual PM₁₀ ground level concentrations in the region of the development are illustrated as contours in Figure 0.3. The locations of the maximum concentrations for PM₁₀ are close to the boundary of the site with concentrations decreasing with distance from the facility.
- 1.55 The impact of PM₁₀ is considered direct, slight, negative, localised and long-term.

Table 0.2 Proposed Operations – Dispersion Model Results for PM₁₀

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations (µg/m ³)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM ₁₀ / 2020	Annual Mean	Sensitive	622116, 5829262	16.5	8	24.5	40	61%
	24-hr Mean (as 90.4 th ile)	Sensitive	622116, 5829262	35.1	15	43.1	50	86%
PM ₁₀ / 2021	Annual Mean	Sensitive	677157, 5921215	16.5	8	24.5	40	61%
	24-hr Mean (as 90.4 th ile)	Sensitive	622116, 5829262	41.0	15	49.0	50	98%
PM ₁₀ / 2022	Annual Mean	Boundary	677257, 5921415	16.6	8	24.6	40	61%
	24-hr Mean (as 90.4 th ile)	Sensitive	622116, 5829262	36.8	15	44.8	50	90%

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM ₁₀ / 2023	Annual Mean	Sensitive	622116, 5829262	16.6	8	24.6	40	62%
	24-hr Mean (as 90.4 th ile)	Sensitive	622116, 5829262	36.1	15	44.1	50	88%
PM ₁₀ / 2024	Annual Mean	Sensitive	622116, 5829262	16.2	8	24.2	40	60%
	24-hr Mean (as 90.4 th ile)	Sensitive	622116, 5829262	39.8	15	47.8	50	96%

PM_{2.5}

- 1.56 Predicted PM_{2.5} concentrations at the worst-case receptor are significantly lower than the limit value of 25 $\mu\text{g}/\text{m}^3$ (see Table 0.3) for the proposed development.
- 1.57 The predicted annual concentration (excluding background, i.e. process contribution (PC)) at the worst-case receptor peaks at 6.28 $\mu\text{g}/\text{m}^3$, which is 25% of the PM_{2.5} annual mean limit value.
- 1.58 Based on a background PM_{2.5} concentration of 6 $\mu\text{g}/\text{m}^3$ in the region of the site, the annual PM_{2.5} concentration including the operations peaks at 12.28 $\mu\text{g}/\text{m}^3$ (i.e. predicted environmental concentration (PEC)). This peak level equates to 49% of the annual limit value for PM_{2.5}.
- 1.59 The impact of PM_{2.5} is considered direct, slight, negative, localised and long-term.

Table 0.3 Proposed Operations – Dispersion Model Results for PM_{2.5}

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM _{2.5} / 2020	Annual Mean	Sensitive	622116, 5829262	6.19	6	12.19	25	49%
PM _{2.5} / 2021	Annual Mean	Sensitive	622116, 5829262	6.22	6	12.22	25	49%
PM _{2.5} / 2022	Annual Mean	Sensitive	622116, 5829262	6.21	6	12.21	25	49%
PM _{2.5} / 2023	Annual Mean	Sensitive	622116, 5829262	6.28	6	12.28	25	49%
PM _{2.5} / 2024	Annual Mean	Sensitive	622116, 5829262	6.10	6	12.10	25	48%

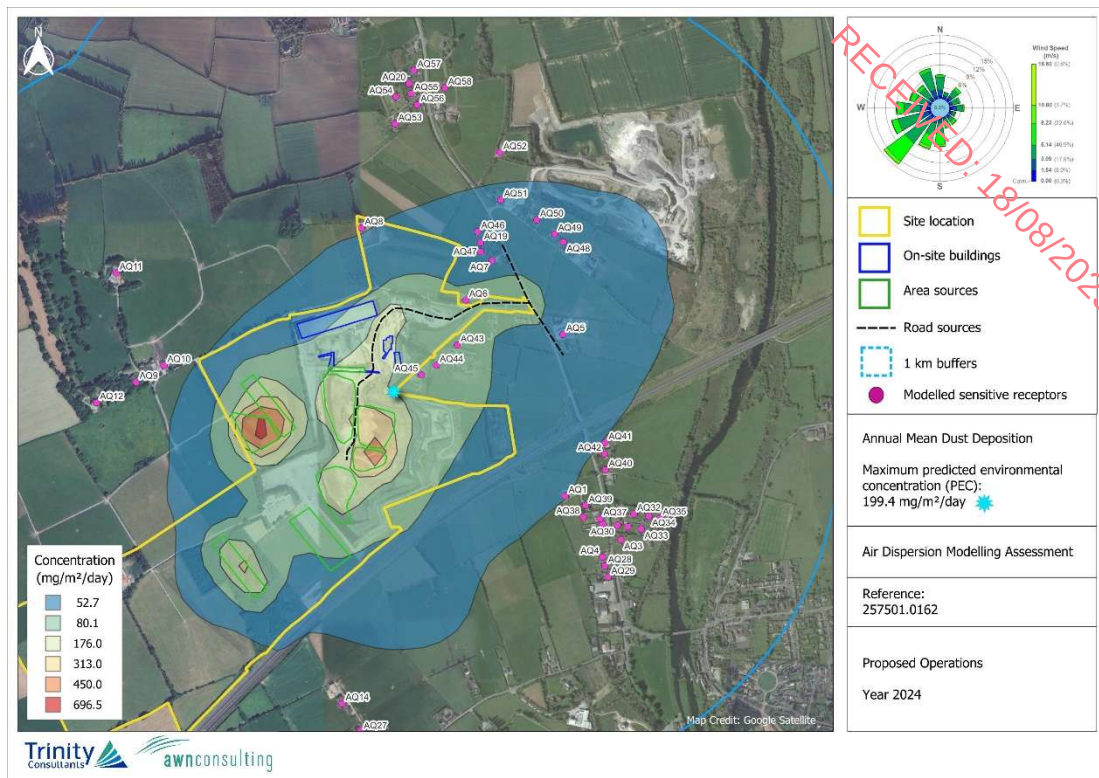


Figure 0.1 Annual Mean Dust Deposition Rate (g/m²/yr) – Proposed Operations

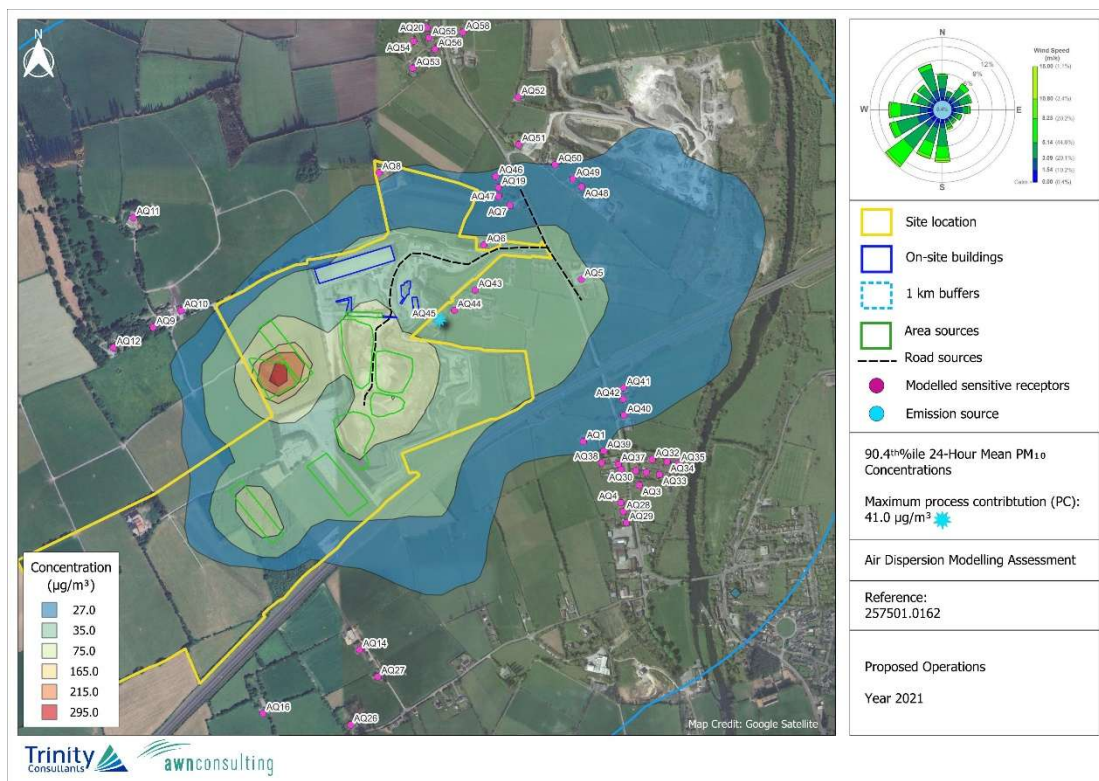


Figure 0.2 Maximum 24-Hr PM₁₀ Concentration (as a 90.4th percentile) (µg/m³) – Proposed Operations

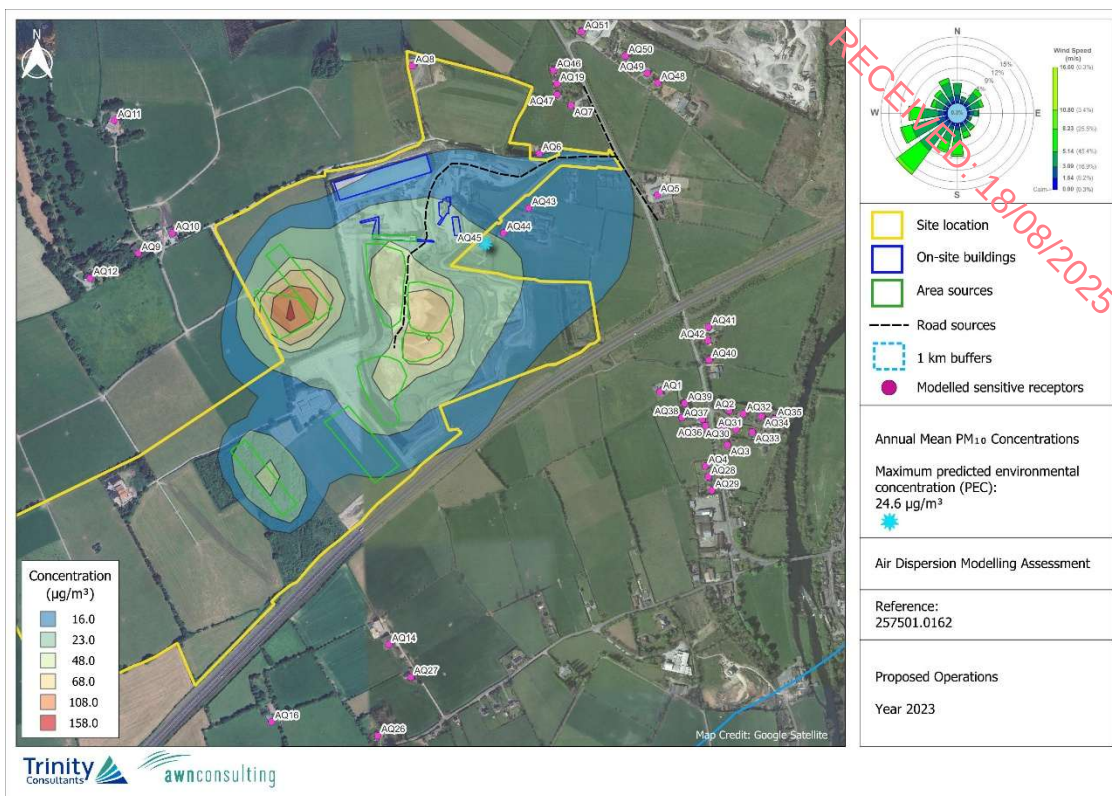
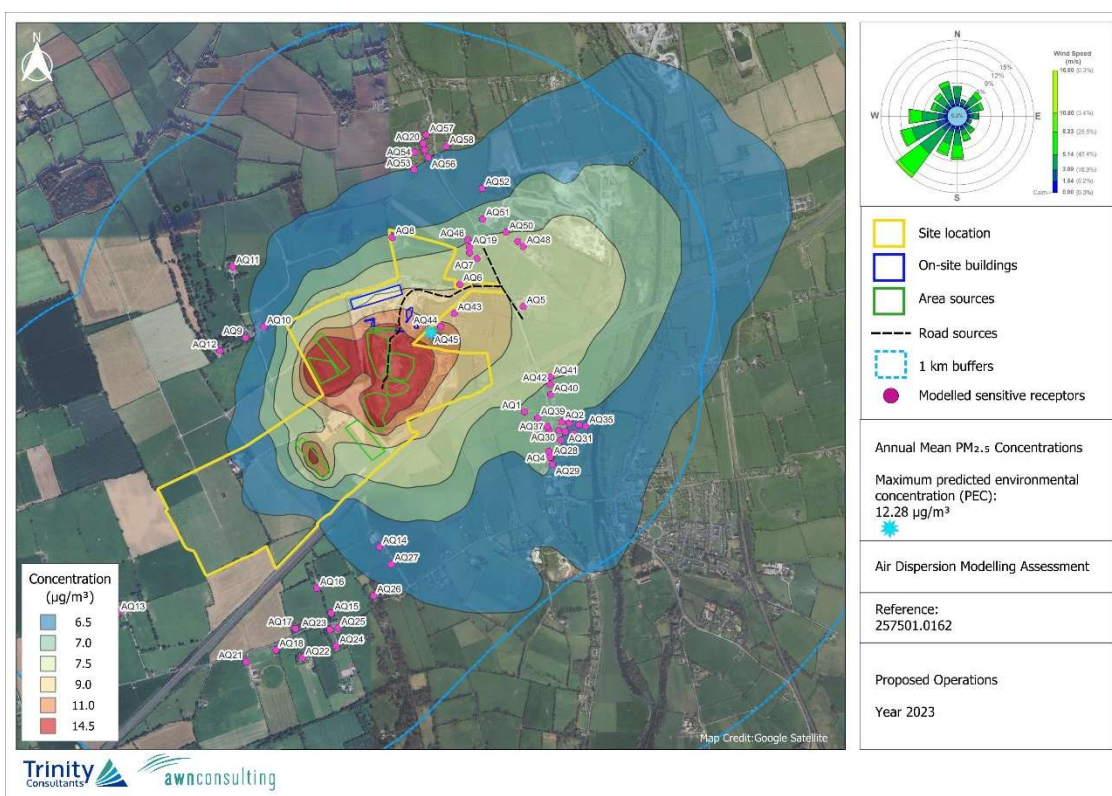


Figure 0.3 Annual Mean PM₁₀ Concentration (µg/m³) – Proposed Operations



1.60 There is the potential for several emissions to the atmosphere during the operational phase of the development. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO₂, PM₁₀, PM_{2.5} and CO₂.

1.61 The traffic generated as part of the proposed development was reviewed against the TII screening criteria as outlined in Section 2.3. It was determined that none of the roads impacted by the development met the screening criteria. Therefore, impacts from road traffic emissions on local air quality are considered **direct, long-term, negative** and **imperceptible**.

Human Health

1.62 Air dispersion modelling of operational activities at the site was undertaken to assess the impact of the development with reference to EU ambient air quality standards which are based on the protection of human health. As demonstrated by the modelling results, emissions of PM₁₀ and PM_{2.5} are compliant with all National and EU ambient air quality limit values (Table 0.1). Therefore, the development will not result in a significant impact on human health.

Mitigation and Monitoring

Mitigation

1.63 There are several mitigation measures in place on site to prevent significant dust emissions from on-site activities. These measures include:

- A wheel wash is in place on site which trucks must pass through prior to exiting onto the public road.
- All fine materials are covered when leaving the site to prevent dust escaping.
- Dust suppression in the form of a sprinkler system is in place.
- Speeds restrictions are in place on site and to be imposed on the proposed private road.
- On-site roads are paved and dampened.

1.64 These measures have been incorporated into the modelling assessment to determine the impact of the site on levels of dust deposition and ambient levels of particulate matter (PM₁₀/PM_{2.5}). The modelling assessment found that there was a slight negative impact on the ambient air quality environment because of the development. These mitigation measures will continue to be enforced to prevent significant dust emissions from the site.

Monitoring

- 1.65 It is recommended that dust deposition monitoring continue to be undertaken at the boundary of the site. Monitoring will ensure that the TA Luft guideline limit value of 350 mg/m²/day is complied with at the site boundary. Monitoring can be carried out using the Bergerhoff method as recommended by the Department of Environment, Heritage and Local Government (DEHLG, 2004). If monitoring indicates a potential issue with dust deposition, additional mitigation measures shall be implemented to remediate. Monitoring should be conducted at the western, eastern and northern site boundaries at a minimum as these areas are closest to sensitive receptors.

Residual Impacts

- 1.66 With the range of mitigation measures to be implemented and design measures to be incorporated into the working scheme, it is considered that the risk of dust impact at receptors from the proposed development reduces further. The proposed screening berms and the location of the stockpiles in the quarry floor act as significant mitigation measures against the dispersal of dust.
- 1.67 After an assessment of potential adverse effects produced by the development it was concluded that there would be no significant adverse air quality effects for both human and ecological receptors.

'Do-Nothing' Scenario

- 1.68 The site is currently operated as a quarry, with ongoing extraction and processing activities. The proposed development involves a lateral extension of the extraction area but does not include any changes to existing processing operations. In the Do-Nothing Scenario, no further extraction would occur beyond the existing permitted area, and operations would continue at current levels. Therefore, dust deposition, PM₁₀ and PM_{2.5} emissions, and traffic emissions are expected to remain consistent with existing baseline conditions.
- 1.69 The main potential sources of emissions to air will be associated with plant and machinery undertaking day to day activities such as extraction, onsite processing and transportation of material and dust blow generated during dry, windy conditions. Potential impacts associated with day-to-day activities have been separated into dust deposition and vehicle and plant emissions. The assessment is based on the proposed increased traffic volume of 128 truckloads per day.

Dust Deposition

- 1.70 Based on a background dust deposition of 39 mg/m²/day in the region of the site, the combined background and process contribution dust deposition level peaks at 128.0 mg/m²/day which is 37% of the TA Luft Limit Value of 350 mg/m²/day. Figure 0.1 shows the geographical variation in annual dust deposition levels in the region of development.
- 1.71 The dust deposition level decreases with increasing distance from the site. The worst-case dust deposition at the closest sensitive receptor to the site peaks at 54.2 mg/m²/day or 27% of the TA Luft limit value, including background concentrations.
- 1.72 The impact of dust deposition is considered **direct, slight, negative, localised** and **long-term**.

Table 0.1 Do-Nothing – Dispersion Model Results for TSP

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
Dust / 2020	Annual Mean	Boundary	622176, 5829517	89.0	39	128.0	350	37%
Dust / 2021	Annual Mean	Boundary	622176, 5829517	85.2	39	124.2	350	35%
Dust / 2022	Annual Mean	Boundary	622176, 5829517	86.6	39	125.6	350	36%
Dust / 2023	Annual Mean	Boundary	622176, 5829517	87.6	39	126.6	350	36%
Dust / 2024	Annual Mean	Boundary	622176, 5829517	88.7	39	127.7	350	36%

PM₁₀

- 1.73 Predicted PM₁₀ concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the proposed development. For emissions from the proposed development the predicted 24-hour and annual mean concentrations (excluding background, i.e. process contribution (PC)) at the worst-case receptor peak at 20.7 $\mu\text{g}/\text{m}^3$ (41% of the PM₁₀ annual mean limit value) and 6.5 $\mu\text{g}/\text{m}^3$ (16% of the PM₁₀ annual mean limit value) respectively.
- 1.74 Based on an annual mean background PM₁₀ concentration of 10.3 $\mu\text{g}/\text{m}^3$ in the region of the proposed development, the combined annual PM₁₀ concentration including the site, i.e. predicted environmental concentration (PEC), peaks at 25.81 $\mu\text{g}/\text{m}^3$ (Table 0.2). This predicted level equates to at most 65% of the annual limit value of 40 $\mu\text{g}/\text{m}^3$.
- 1.75 Based on a 24hr (90.4thile) mean concentration of 15 $\mu\text{g}/\text{m}^3$, the predicted 24-hour PM₁₀ concentration (including background) peaks at 33.71 $\mu\text{g}/\text{m}^3$ which is 67% of the 24-hour limit value of 50 $\mu\text{g}/\text{m}^3$ (measured as a 90.4thile).
- 1.76 The geographical variation in the 24-hour mean (90.4thile) PM₁₀ ground level concentrations are illustrated as concentration contours in Figure 0.2. The geographical variation in annual PM₁₀ ground level concentrations in the region of the development (Figure 0.3). The locations of the maximum concentrations for PM₁₀ are close to the boundary of the site with concentrations decreasing with distance from the development.
- 1.77 The impact of PM₁₀ is considered direct, slight, negative, localised and long-term.

Table 0.2 Do-Nothing – Dispersion Model Results for PM₁₀

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM ₁₀ / 2020	Annual Mean	Sensitive	622254, 5829498	6.2	8	14.2	40	35%
	24-hr Mean (as 90.4 th ile)	Sensitive	622254, 5829498	18.5	15	26.5	50	53%

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM ₁₀ / 2021	Annual Mean	Sensitive	622254, 5829498	6.5	8	14.5	40	36%
	24-hr Mean (as 90.4 th ile)	Sensitive	622254, 5829498	20.7	15	28.7	50	57%
PM ₁₀ / 2022	Annual Mean	Sensitive	622254, 5829498	6.1	8	14.1	40	35%
	24-hr Mean (as 90.4 th ile)	Sensitive	622254, 5829498	18.8	15	26.8	50	54%
PM ₁₀ / 2023	Annual Mean	Sensitive	622254, 5829498	5.9	8	13.9	40	35%
	24-hr Mean (as 90.4 th ile)	Sensitive	622254, 5829498	18.4	15	26.4	50	53%
PM ₁₀ / 2024	Annual Mean	Sensitive	622254, 5829498	6.1	8	14.1	40	35%
	24-hr Mean (as 90.4 th ile)	Sensitive	622254, 5829498	19.8	15	27.8	50	56%

PM_{2.5}

- 1.78 Predicted PM_{2.5} concentrations at the worst-case receptor are significantly lower than the limit value of 25 $\mu\text{g}/\text{m}^3$ (see Table 0.3) for the proposed development.
- 1.79 The predicted annual concentration (excluding background, i.e. process contribution (PC)) at the worst-case receptor peaks at 6.48 $\mu\text{g}/\text{m}^3$, which is 26% of the PM_{2.5} annual mean limit value.
- 1.80 Based on a background PM_{2.5} concentration of 6 $\mu\text{g}/\text{m}^3$ in the region of the site, the annual PM_{2.5} concentration including the operations peaks at 12.48 $\mu\text{g}/\text{m}^3$. This peak level equates to 50% of the annual limit value for PM_{2.5}.
- 1.81 The impact of PM_{2.5} is considered direct, slight, negative, localised and long-term.

Table 0.3 Do-Nothing – Dispersion Model Results for PM_{2.5}

Pollutant / Year	Averaging Period	Worst Case Receptor		Concentrations ($\mu\text{g}/\text{m}^3$)				PEC as % of Limit
		Type	X,Y (UTM Zone 29 N)	PC	Back-ground	PEC	Limit Value	
PM _{2.5} / 2020	Annual Mean	Sensitive	622254, 5829498	6.16	6	12.16	25	49%
PM _{2.5} / 2021	Annual Mean	Sensitive	622254, 5829498	6.48	6	12.48	25	50%
PM _{2.5} / 2022	Annual Mean	Sensitive	622254, 5829498	6.10	6	12.10	25	48%

PM _{2.5} / 2023	Annual Mean	Sensitive	622254, 5829498	5.92	6	11.92	25	48%
PM _{2.5} / 2024	Annual Mean	Sensitive	622254, 5829498	6.10	6	12.10	25	48%

RECEIVED: 18/08/2025

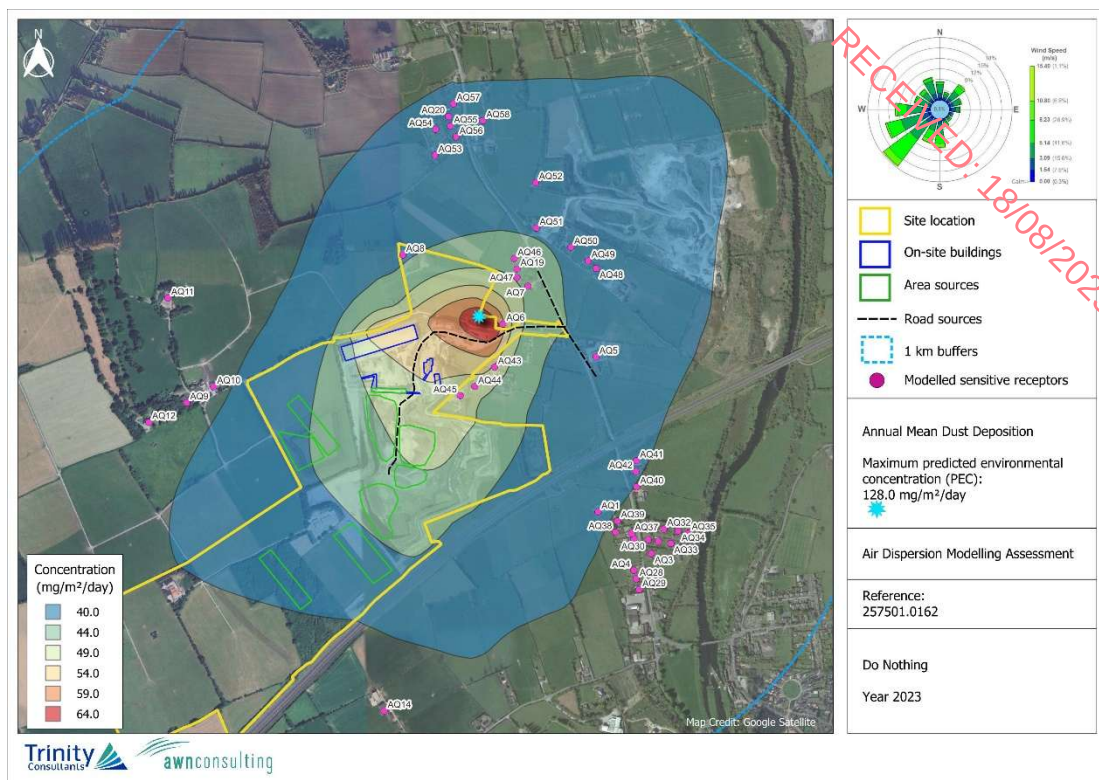


Figure 0.1 Annual Mean Dust Deposition Rate (g/m²/yr) – Do Nothing

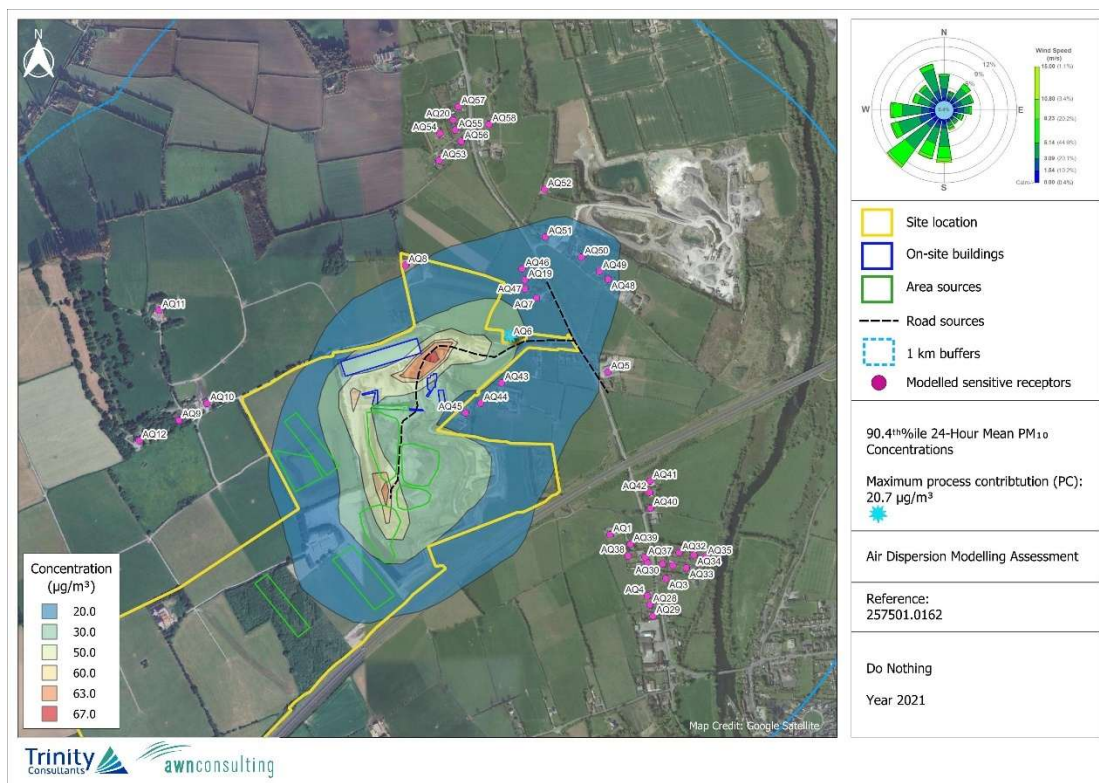


Figure 0.2 Maximum 24-Hr PM₁₀ Concentration (as a 90.4th%ile) (µg/m³) – Do Nothing

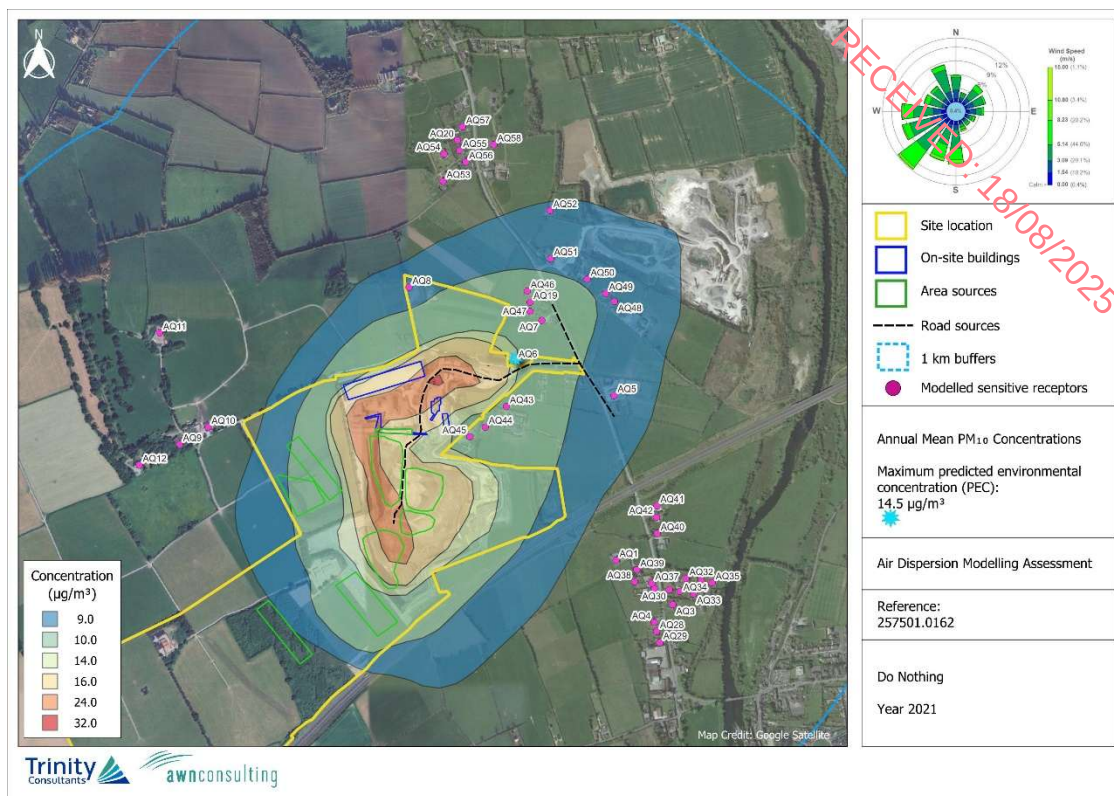


Figure 0.3 Annual Mean PM₁₀ Concentration (µg/m³) – Do Nothing

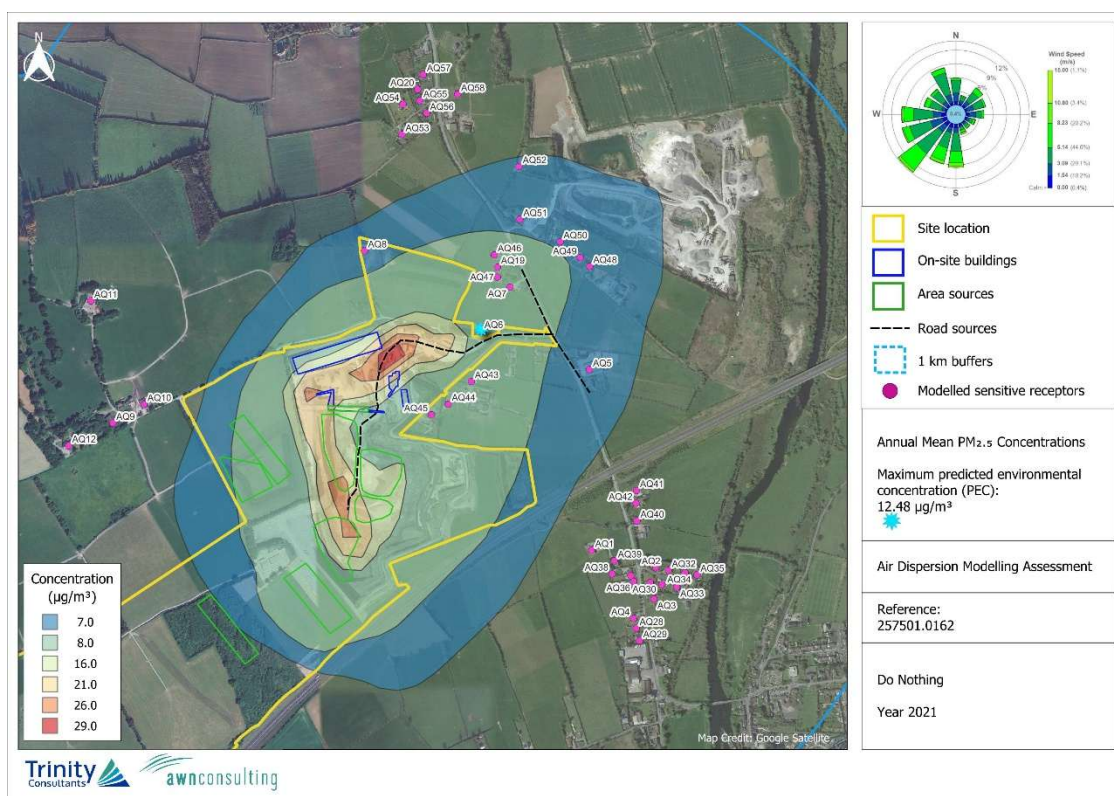


Figure 0.4 Annual Mean PM_{2.5} Concentration (µg/m³) – Do Nothing

Cumulative Effects

- 1.82 Cumulative effects have been assessed for the proposed development. Background concentrations have been included in the modelling study for dust deposition and EPA data for PM₁₀ and PM_{2.5}. These background concentrations account for non-localised sources of the pollutants of concern.
- 1.83 A review of potential cumulative effects has identified Hennessy's Quarry, located approximately 1.5 km from the proposed development, as a potential source of cumulative dust and particulate emissions. However, the results of the dispersion modelling assessment for the proposed development indicate that predicted dust deposition and ambient particulate matter concentrations are well below their respective limit values.
- 1.84 A fixed asphalt-mixing plant run by Breedon Group operates within the overall Bennettsbridge Limestone quarry lands, but outside the boundary of the current planning application. The plant is controlled under a separate planning permission and an Air Pollution Act licence that sets emission-limit values for combustion pollutants (e.g. NO_x, SO₂, total particulates) and requires routine monitoring and reporting to Kilkenny County Council. For the purposes of this EIAR it is therefore treated as part of the baseline air-quality environment.
- 1.85 The dispersion study for the quarry extension focuses on fugitive dust, PM₁₀ and PM_{2.5}, as these are the only pollutants with a credible pathway from the proposed works to sensitive receptors. Combustion gases from the asphalt plant were not re-modelled because the plant's licensed operation, and its associated emissions, will remain unchanged by the proposed lateral extension and are already represented in the measured background concentrations used for the assessment.
- 1.86 Accordingly, the extension will not alter the asphalt plant's emission profile, and cumulative effects from both activities are predicted to remain within statutory air-quality objectives.
- 1.87 Predicted dust deposition levels including background peak at 199.4 mg/m²/day (57% of the TA Luft limit), with a maximum level of 94.3 mg/m²/day (38% of the limit) at the nearest sensitive receptor. PM₁₀ and PM_{2.5} concentrations including background peak at 62% and 49% of their respective annual limit value of 40 µg/m³ and 25 µg/m³, with the highest 24-hour PM₁₀ concentration (49.0 µg/m³) remaining within 98% of the 24-hour limit value of 50 µg/m³ (measured as a 90.4th%ile).
- 1.88 Given that the highest concentrations are located close to the site boundary and decrease with distance, the potential for overlap or interaction with emissions from other sources is limited. Emissions from the proposed development are primarily localised sources such as stockpiling and haul roads, which are not expected to have significant off-site impacts. Additionally, the prevailing wind direction is south-westerly to westerly which would generally blow emissions from the proposed development away from Hennessy's Quarry. This significantly reduces the likelihood of cumulative atmospheric effects occurring between the two operations. There are also a limited number of sensitive receptors located between the two quarries. Additionally, any potential for concurrent peak emissions is further mitigated by operational variability between the two quarries, such as differences in activity intensity, schedules, or phasing of works. Given that both facilities are subject to standard dust management measures, which are expected to further minimise emissions and reduce the likelihood of cumulative impacts, the potential for significant cumulative effects is considered low.

Residual Effects

- 1.89 It is not anticipated that there will be a significant adverse impact on air quality in the vicinity of the proposed development. Modelled emissions from the proposed development lead to ambient concentrations which are well below the relevant ambient air quality standards for dust, PM₁₀ and PM_{2.5}. Thus, the impact on air quality of the proposed development is not significant and no residual impact is anticipated.

Difficulties Encountered

- 1.90 There were no difficulties encountered when compiling this assessment.

References

- California Air Resources Board (CARB) (2021) Miscellaneous Process Methodology 7.9: Entrained Road Travel, Paved Road Dust
- Department of the Environment, Heritage and Local Government (DEHLG) (2004) Quarries and Ancillary Activities, Guidelines for Planning Authorities
- Environmental Protection Agency (2015) *Advice Notes for Preparing Environmental Impact Statements (Draft) on the Information to be Contained in Environmental Impact Assessment Reports (Draft)*
- Environmental Protection Agency (2020) *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)*
- Environmental Protection Agency (2022) *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*
- Environmental Protection Agency (2023) *Air Quality Monitoring Report 2022* (& previous annual reports)
- German VDI (2002) *Technical Guidelines on Air Quality Control – TA Luft*
- Met Éireann (2024) Met Éireann website www.met.ie
- Transport Infrastructure Ireland (TII) (2022) PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects
- UK DEFRA (2022) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. TG(22)
- UK ODPM (2000) *Controlling Environmental Effects: Recycled and Secondary Aggregates Production*
- USEPA (1986) *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition* (periodically updated)
- USEPA (2017) *Guidelines on Air Quality Models*, Appendix W to Part 51, 40 CFR Ch.1
- USEPA (2018) User's Guide to the AERMOD Meteorological Pre-processor (AERMET)
- USEPA (2021) AERMOD Description of Model Formulation and Evaluation

Appendices

Appendix 1: Description of Aermod Model

- 1.91 The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency^{(1),(2)}. The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.
- 1.92 Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.
- 1.93 In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets⁽³⁾.
- 1.94 Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm considers the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.
- 1.95 When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.
- 1.96 In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level

concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

- 1.97 The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.
- 1.98 AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3⁽¹⁾⁽⁴⁾. ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.
- 1.99 Improvements have also been made in relation to mixing height⁽¹⁾⁽⁴⁾. The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.
- 1.100 AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.
- 1.101 AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

- (1) USEPA (1995) User's Guide for the Industrial Source Complex (ISC3) Dispersion Model Vol I & II
- (2) USEPA (1998) Human Health Risk Assessment Protocol, Chapter 3: Air Dispersion and Deposition Modelling, Region 6 Centre for Combustion Science and Engineering
- (3) Paine, R & Lew, F. "Results of the Independent Evaluation of ISCST3 and ISC-PRIME" Prepared for the EPRI, ENSR Document No. 2460-026-3527-02 (1997).
- (4) USEPA (2000) Seventh Conference on Air Quality Modelling (June 2000) Vol I & II

Appendix 2: Aermet

AERMOD incorporates a meteorological pre-processor AERMET (version 24142)⁽²⁾. AERMET allows AERMOD to account for changes in the plume behaviour with height. AERMET calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET meteorological preprocessor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use types was carried out in line with USEPA recommendations⁽⁶⁾ and using the detailed methodology outlined by the Alaska Department of Environmental Conservation⁽⁷⁾. AERMET has also been updated to allow for an adjustment of the surface friction velocity (u^*) for low wind speed stable conditions based on the work of Qian and Venkatram. Previously, the model tended to over-predict concentrations produced by near-ground sources in stable conditions.

Surface Roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. To determine surface roughness length, the USEPA recommends that a representative length be defined for each sector, based on geometric mean of the inverse distance area-weighted land use within the sector, by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Johnstown Castle is shown in Table 1.

Table 1. Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Johnstown Castle

Sector	Inverse Distance Weighted Land Use Classification	Spring	Summer	Autumn	Winter ^a
0-360	100% Grassland	0.050	0.100	0.010	0.010

Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless, and no snow is present (Iqbal (1983)). Thus, for the current location autumn more accurately defines “winter” conditions at the proposed facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Johnstown Castle is shown in Table 2.

Table 2. Albedo based on an area-weighted arithmetic mean of the land use over a 10km x 10km area centred on Johnstown Castle

Simple Average Land Use Classification	Spring	Summer	Autumn	Winter ^a
10% Water	0.012	0.010	0.014	0.014
5% Urban	0.007	0.008	0.009	0.009
75% Grassland	0.135	0.135	0.150	0.150
10% Cultivated Land	0.014	0.020	0.018	0.018

- a. For the current location autumn more accurately defines “winter” conditions at the proposed facility.

Bowen Ratio

The Bowen ratio is a measure of the amount of moisture at the surface of the earth. The presence of moisture affects the heat balance resulting from evaporative cooling which, in turn, affects the Monin-Obukhov length which is used in the formulation of the boundary layer. The area-weighted geometric mean Bowen ratio derived from the land use classification over a 10km x 10km area centered on Johnstown Castle is shown in Table 3.

Table 3. Bowen Ratio based on an area-weighted geometric mean of the land use over a 10km x 10km area centred on Johnstown Castle

Geometric Mean Land Use Classification	Spring	Summer	Autumn	Winter ^a
10% Water	0.1	0.1	0.1	0.1
5% Urban	1.0	2.0	2.0	2.0
75% Grassland	0.4	0.8	1.0	1.0
10% Cultivated Land	0.3	0.5	0.7	0.7

- a. For the current location autumn more accurately defines “winter” conditions at the proposed facility.

(5) USEPA (2004) User’s Guide to the AERMOD Meteorological Preprocessor (AERMET)

- (6) USEPA (2005) Guidelines on Air Quality Models, Appendix W to Part 51, 40 CFR Ch.1
- (7) Alaska Department of Environmental Conservation (2008) ADEC Guidance re AERMET Geometric Means (<http://dec.alaska.gov/air/ap/modeling.htm>)

RECEIVED: 18/08/2025

Appendix 3: Emission Factors

Emission Factors Used In Dust Emission Calculations (USEPA, 1986 & subsequent updates, California Air Resources Board (CARB), 2021)):

Crushing

$$E = ((T \cdot K) / (H \cdot 3600 \cdot A)) \cdot ((365 - P) / 365) \text{ g/s/m}^2$$

Where:

T = Annual Tonnage of Material (675,000 T)

K = 2.7 (Total Dust), 1.2 (PM₁₀), 0.22 (PM_{2.5})

H = Annual Hours of Operation (3350 hours)

A = Area of Activity (1,450m²)

P = 194 Wet Days

Screening

$$E = ((T \cdot K) / (H \cdot 3600 \cdot A)) \cdot ((365 - P) / 365) \text{ g/s/m}^2$$

Where:

T = Annual Tonnage of Material (675,000 T)

K = 12.5 (Total Dust), 4.3 (PM₁₀), 0.28 (PM_{2.5})

H = Annual Hours of Operation (3350 hours)

A = Area of Activity (1,450m²)

P = 194 Wet Days

Compacting

$$E = ((2.6 \cdot (TSC)^{1.2}) / (((TSM)^{1.3} \cdot 3.6 \cdot A)) \cdot ((365 - P) / 365) \text{ g/s/m}^2$$

Where:

TSC = Topsoil Silt Content (6.9%)

TMC = Topsoil Moisture Content (7.9%)

A = Area of Topsoil Removal (10,000m²)

P = 194 Wet Days

TSP results multiplied by 0.1885 for PM₁₀ and by 0.0263 for PM_{2.5}

Topsoil Removal

$$E = ((T \cdot K) / (H \cdot 3600 \cdot A)) \cdot ((365 - P) / 365) \text{ g/s/m}^2$$

Where:

K = 29 (Total Dust), 13.7 (PM₁₀), 2.07 (PM_{2.5})

T = Annual Tonnage of Material (675,000 T)

H = Annual Hours of Operation (3350 hours)

A = Area of Topsoil Removal (10,000m²)

P = 194 Wet Days

Material Loading

$$E = (K * T / ((H * 3.6) * A)) \text{ g/s/m}^2$$

Where:

K = 7.38E-03 (Total Dust), 3.49E-03 (PM₁₀), 5.28E-04 (PM_{2.5})

T = Annual Tonnage of Material (675,000 T)

H = Annual Hours of Operation (3350 hours)

A = Area of Activity (5m²)

Conveyor

$$E = ((T * K) / (H * 3600 * A)) * ((365 - P) / 365) \text{ g/s/m}^2$$

Where:

K = 1.5 (Total Dust), 0.55 (PM₁₀), 0.14 (PM_{2.5})

T = Annual Tonnage of Material (90,750 T)

H = Annual Hours of Operation (3350 hours)

A = Area of Activity (1,450m²)

P = 194 Wet Days

Blasting

$$E = (((A^{1.5}) * K) * N) / ((H * 3600) * A) \text{ g/s/m}^2$$

Where:

T = Annual Tonnage of Material (90,750 T)

K = 0.22 (Total Dust), 0.144 (PM₁₀), 0.0066 (PM_{2.5})

H = Annual Hours of Operation (3350 hours)

A = Area of Blasting (1,500m²)

N = Number of Blasts per Annum (12)

Stock Pile

$$E = ((K) / ((365 - P) / 365)) / (A * F * 24 * 3600) \text{ g/s/m}^2$$

Where:

K = Emission Factor = 3.07E+04 (Total Dust), 1.53E+04 (PM₁₀), 6.13E+03 (PM_{2.5})

P = 194 Wet Days

A = Area (SP1 = 16,286m², SP2 = 12,272m², SP3 = 5,027m², SP4 = 15,394m², SP5 = 11,310m²)

F = Frequency of Disturbance (300 days)

Road Haulage (Paved)

$$E = [k * (sL)^{0.91} * (W)^{1.02}] * (1 - P) / 4N \text{ g/veh km}$$

Where:

sL = surface silt loading (0.6 g/m²)

k = 24 (Total Dust), 4.6 (PM₁₀), 0.66 (PM_{2.5})

W = mean vehicle weight (25 tonnes laden out/14 tonnes unladen in)

P = 194 wet days

N = 365 days

Road Haulage (Unpaved)

$E = [281.9 * k * (s/12)^a * (W/3)^b * ((365-P)/365)]$ g/veh km

Where:

s = surface silt content (10%)

k = 4.9 (Total Dust), 1.8 (PM₁₀), 0.15 (PM_{2.5})

W = mean vehicle weight (25 tonnes laden out/14 tonnes unladen in)

a = 0.9 (PM₁₀/PM_{2.5}), 0.7 (Total Dust)

b = 0.45

P = 194 wet days

Wind Erosion of Stockpiles

The formulae for calculating wind erosion can be found in section 13.2.5 of AP42 titled *Industrial Wind Erosion*. Information on monthly peak wind speeds and the number of gales per month is required to calculate the emission rates.

Table 0.1 Proposed Operations Emission Factors

Operation	Total Dust Emission Rate (g/s/m ²)	PM ₁₀ Emission Rate (g/s/m ²)	PM _{2.5} Emission Rate (g/s/m ²)
Crushing	1.10E-05	4.89E-06	8.96E-07
Screening	1.99E-05	6.85E-06	4.46E-07
Compacting	2.34E-05	4.41E-06	6.16E-07
Topsoil Removal	7.61E-05	3.59E-05	5.43E-06
Material Loading	2.56E-02	1.21E-02	1.83E-03
Conveyor	1.28E-06	4.68E-07	1.19E-07
Blasting	1.01E-05	5.09E-06	3.84E-07
Stock Pile 1	3.98E-05	1.99E-05	7.97E-06
Stock Pile 2	5.29E-05	2.64E-05	1.06E-05
Stock Pile 3	1.29E-04	6.45E-05	2.58E-05
Stock Pile 4	4.21E-05	2.11E-05	8.43E-06
Stock Pile 5	5.74E-05	2.87E-05	1.15E-05
Post WW Laden Out Paved R700	1.24E-03	4.12E-05	5.92E-06

Operation	Total Dust Emission Rate (g/s/m ²)	PM ₁₀ Emission Rate (g/s/m ²)	PM _{2.5} Emission Rate (g/s/m ²)
Post WW Unladen In Paved R700	6.86E-04	2.28E-05	3.27E-06
Post WW Laden Out Paved Public	2.19E-03	7.29E-05	1.05E-05
Post WW Unladen In Paved Public	1.21E-03	4.03E-05	5.79E-06
Post WW Laden Out Paved Private	1.02E-03	3.38E-05	4.85E-06
Post WW Unladen In Paved Private	5.63E-04	1.87E-05	2.69E-06
Pre WW Laden Out Paved Private	1.07E-02	3.56E-04	5.10E-05
Pre WW Unladen In Paved Private	5.92E-03	1.97E-04	2.82E-05
Pre WW Laden Out Unpaved Private	1.47E-04	5.22E-05	4.35E-06
Pre WW Unladen In Unpaved Private	1.13E-04	4.02E-05	3.35E-06

Table 0.2 Do Nothing Emission Factors

Operation	Total Dust Emission Rate (g/s/m ²)	PM ₁₀ Emission Rate (g/s/m ²)	PM _{2.5} Emission Rate (g/s/m ²)
Crushing/Screening	5.47E-08	2.43E-08	4.46E-09
Quarry	2.96E-06	1.46E-06	5.27E-07
Stock Pile	2.5E-06	3.48E-07	1.39E-07
Paved	0.000162	3.120E-005	7.540E-006
Unpaved	0.0409	1.010E-002	1.010E-003
R700	2.16E-04	4.160E-005	1.010E-005