9.0 AIR QUALITY

9.1 Introduction

This chapter assesses the likely impact on air quality associated with the proposed development of a sand and gravel pit at Knocknamoe and Ballymullen townlands, Abbeyleix, Co. Laois.

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to extract the available resource and transport off site to the applicant's manufacturing facility located approximately 1.3km to the south of the application site. The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however this will depend on the demand for material. Therefore, the applicant is seeking a 10-year permission in order to allow for years when the anticipated extraction rate will not be achieved.

This chapter has been updated on foot of Laois County Council's *Request for Further Information* (LCC Reg. Ref. 23/60390).

This chapter was completed by Dr. Avril Challoner who is a Principal Consultant in the Air Quality section of AWN Consulting. She holds a BEng (Hons) in Environmental Engineering from the National University of Ireland Galway, HDip in Statistics from Trinity College Dublin and has completed a PhD in Environmental Engineering (Air Quality) in Trinity College Dublin graduating in 2013. She is a Chartered Environmentalist (CEnv), Chartered Scientist (CSci), Member of the Institute of Environmental Management and Assessment, Member of the Institute of Air Quality Management and specialises in the fields of air quality, EIA and air dispersion modelling.

9.2 Methodology

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.

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 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.

The assessment of the potential impacts of the proposed development (LCC Reg. Ref. 23/60390) on air quality was previously undertaken as part of the EIAR submitted for planning application Reg. Ref. 20/7 which was subsequently withdrawn. This proposal consisted of the extraction of the material and dry screening of the extracted material using over a 4-phase extraction plan with continuous restoration. The processed material would then be transported to existing manufacturing facility or directly to market.

The proposed development (Reg. Ref. 23/60390) broadly consists of the same development as previously proposed as part of Reg. Ref. 20/7 with the following revisions:

- Material will be extracted over an eight-phase extraction plan with a four-phase plan originally proposed. This will reduce the area of the pit which will be subject to quarrying activity at any one time.
- No material will be screened on-site.
- All material will be extracted and loaded directly onto trucks and transported directly to the manufacturing facility.

As the assessment models previously compiled were based on a worst-case scenario with extraction and processing activity being undertaken it is considered that the removal of the processing activity will reduce air emissions from the proposed development. Therefore, the models compiled as part of the EIAR for planning application Reg. Ref. 20/7 were used for this assessment.

9.2.1 Criteria for Rating of Impacts

The rating of potential environmental effects of the proposed project on air quality is based on the criteria presented in Table 9.1 below. These criteria consider the quality, significance, duration and types of effect characteristics identified and are based on Table 3.4 presented in the EPA (2022) document titled *"Guidelines on the Information to Be Contained in Environmental Impact Assessment Reports".*

Table 9.1: Criteria Used in the Assessment of Impacts on Air Quality (EPA, 2022)

Characteristic	Level	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	No effects/effects which are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An effect capable of measurement but without significant consequences.

Characteristic	Level	Description
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends.
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound	An effect which obliterates sensitive characteristics.
Magnitude	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect.
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions.
Probability	Likely	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Duration and Frequency	Momentary	Effects lasting from seconds to minutes.
	Brief	Effects lasting less than a day.
	Temporary	Effects lasting less than a year.
	Short-term	Effects lasting one to seven years.
	Medium-term	Effects lasting seven to fifteen years.
	Long-term	Effects lasting fifteen to sixty years.
	Permanent	Effects lasting over sixty years.
	Reversible	Effects that can be undone, for example through remediation or restoration.
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).
Types of Effects	Indirect (Secondary)	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out.
	'Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail.

Characteristic	Level	Description
	Indeterminable	When the full consequences of a change in the environment cannot be described Irreversible When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents.

9.2.2 Dispersion Modelling Methodology

Air dispersion modelling was undertaken to assess the dust deposition flux at the land ownership boundary, and the PM_{10} 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, 2023) (Version 23132) 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 9.1.

9.2.3 Process Emissions

Quarrying activities typically emit dust. Dust is characterised as encompassing particulate matter with a particle size of between 1 and 75 microns (1-75µm). Deposition typically occurs in close proximity to the 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.

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 report identifies and quantifies the dust sources from the application site.

9.2.4 Dust Generation Rates

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 rainfall greater than 0.2mm has fallen.

Large particle sizes (greater than 75 microns) fall rapidly out of atmospheric suspension and are subsequently deposited in close proximity to the source. Particle sizes of less than 75 microns are of interest as they can remain airborne for greater distances and give rise to 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 9.2. The moisture content of glaciofluvial sands and gravels has been estimated at 1.5%.

Table 9.2: Category 3 Mechanically Generated Aggregate Taken From AP-42 (USEPA 1986)

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

Dust deposition typically occurs in close proximity to the dust-generating source. The immediate vicinity of the application site is a greenfield and forested area. However, Abbeyleix Village is located in proximity to the proposed location. There are a number of sensitive locations present which can be affected by dust deposition. There are two small housing estates and a number of one-off houses within 500m of the site boundary. These residential properties are included as sensitive receptors within the model.

Generally, the potential for severe dust impacts is greatest within 100m of dust generating activities, though residual impacts can occur for distances beyond 100m.

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 extended to 1 km from the site with concentrations calculated at 25 m intervals. The outer grid extended to 5 km from the site with concentrations calculated at 250 m intervals. Boundary receptor locations were also placed along the land ownership boundary of the site, at 10 m intervals. In addition there were receptors for individual residential properties in the area. The modelling has investigated the deposition and concentrations of dust, PM_{10} and $PM_{2.5}$ for the activities outlined in Section 9.5.

9.3 Legislation

9.3.1 Air Quality

A number of international initiatives, protocols and Directives exist to limit and reduce emissions at a national level. The following criteria were considered in the assessment of impact on air quality:

- Air Quality Standards Regulations (S.I. No. 739 of 2022).
- Directive (EU) 2016/2284 on National Emission Ceilings for certain pollutants (NECs) (S.I. 232/2018).
- There are no statutory limits for deposition of dusts and industry guidelines are typically employed to determine any impact. The TA Luft (German Government 'Technical Instructions on Air Quality') states a guideline of 350 mg/(m^2*day) for the deposition of non-hazardous dusts. This value was used to determine the impact of dust deposition as an environmental nuisance.
- Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022) published guidance for assessing dust impacts from infrastructure projects. This has been used to determine the potential impacts from the proposed construction site operations.

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Ambient Air Quality Standards Regulations 2022 (S.I. No. 739 of 2022), which incorporate European Commission Directive 2008/50/EC. European Commission Directive 2008/50/EC has set limit values for a number of pollutants. The limit values for PM_{10} and $PM_{2.5}$ being relevant to this assessment. Council Directive 2008/50/EC combines the previous Air Quality Framework Directive (96/62/EC) and its subsequent daughter directives (including 1999/30/EC and 2000/69/EC) and includes ambient limit values relating to $PM_{2.5}$. The pollutants of concern for the EIAR are PM_{10} and $PM_{2.5}$, the limit values of which are presented in Table 9.3.

Table 9.3: Revised Air Quality Standard Regulations S.I. 739 of 2022 and TA-Luft

Pollutant Criteria Value	Criteria	Value
Particulate Matter (PM_{10})	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m^3 PM_{10}
	Annual limit for protection of human health	40 µg/m^3 PM_{10}
Particulate Matter ($PM_{2.5}$)	Annual target value for the protection of human health	25 µg/m^3 $PM_{2.5}$
Dust deposition (non-hazardous dust)	Average daily dust deposition at the boundary of the site	350 mg/(m^2*day) Total Dust

9.3.2 Dust Deposition

There are no statutory limits on dust deposition and the focus is on the prevention of nuisance and minimising air borne dust emissions where practicable. Although coarse dust is not regarded as a threat to health, it can create a nuisance by depositing on surfaces. No statutory or official air quality criterion for dust annoyance has been set in Ireland, UK, Europe or at World Health Organisation level.

The most commonly applied guideline is the German (TA Luft) (German VDI 2002) guideline of 350mg/m^2/day as measured using Bergerhoff type dust deposit gauges as per the German Standard Method for determination of dust deposition rate (VDI 2119). This is commonly applied to ensure that no nuisance effects will result from specified industrial activities. Below these thresholds dust problems are considered less likely. Dust Deposition is normally measured by gravimetrically determining the mass of particulates and dust deposited over a specified surface area over a period of one month (30 days +/- 2 days).

Recommendations outlined by the Department of the Environment, Heritage & Local Government (DOEHLG 2004), apply the Bergerhoff limit of 350 mg/(m^2*day) to the land ownership boundary of quarries.

9.4 Existing Environment

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to extract the available resource and transport off site to the applicant's manufacturing facility located approximately 1.3km to the south of the application site. The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however this will depend on the demand for material. Therefore the applicant is seeking a 10-year permission in order to allow for years when the anticipated extraction rate will not be achieved.

Abbeyleix Town is located approximately 1km to the north of the application site. There are a number of sensitive locations present which can be affected by dust deposition. There are two small housing estates and a number of one-off houses within 500m of the site boundary. These residential properties are included as sensitive receptors within the model.

9.4.1 Meteorological Conditions

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 as a result of rainfall help 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.

The closest Met Éireann meteorological station to the site is at Oak Park, Carlow, which is approximately 30 km east of the application area.

The mean monthly rainfall from January 2021 to April 2024 recorded at Oak Park Head was 70 mm/month. The monthly total during the September and October accounts for the highest monthly totals over this period.

There is no long-term (1991–2020) dataset for Oak Park available on the Met Eireann website. The closest Met Éireann station with long-term data sets is Casement Aerodrome, located roughly 75 km north east of the proposed development has an average monthly rainfall recorded. Met Éireann records for this station show that the Average Annual Rainfall (AAR) for the period 1991 – 2020 shows 194 days with greater than 0.2 mm of rain.

Wind frequency is 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 westerly to southerly in direction, thereby predominantly dispersing any potential dust emissions to the east and north of the site (see Figure 9.1). The mean wind speed at Oak Park was approximately 3.8 m/s over the period 2003 – 2024 (to the end of April). All meteorological data referenced within this report is provided by Met Éireann (source www.met.ie).

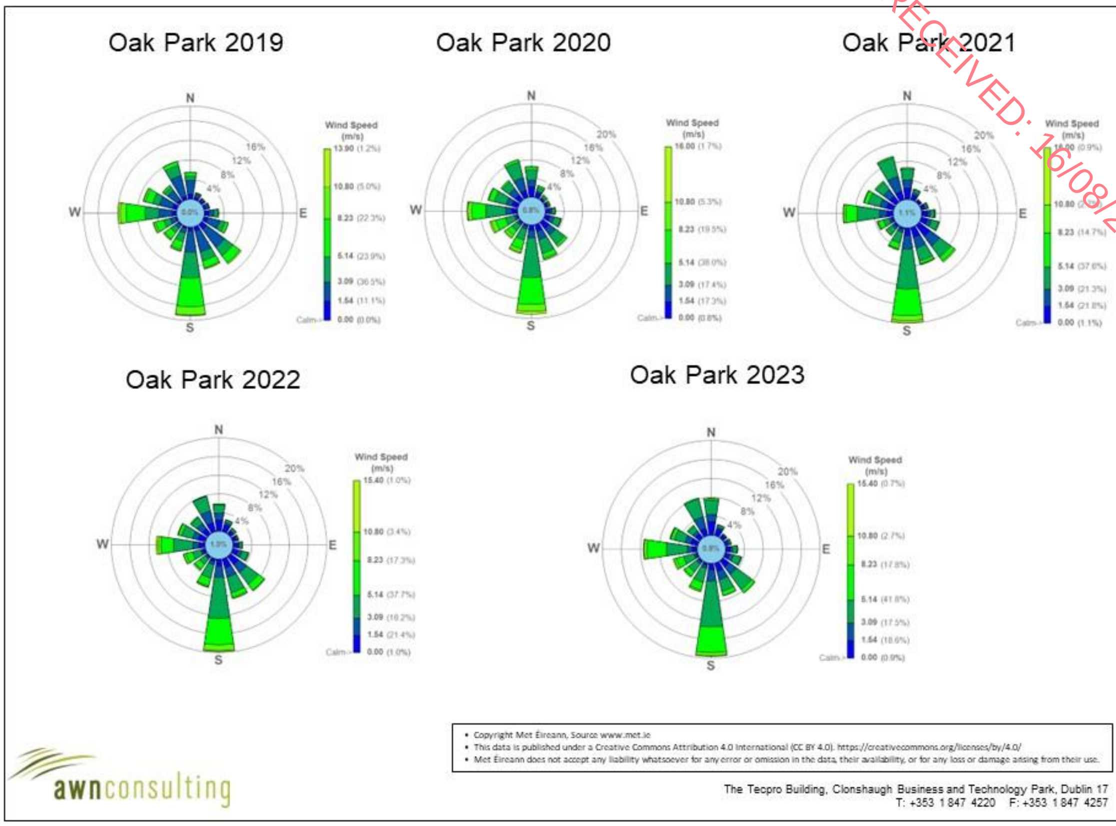


Figure 9.1: Oak Park Windrose 2019 – 2023.

9.4.2 Background Sources of Dust

The sources of dust arising from the site contribute to background levels of dust. Dust is present naturally in the air from a number of sources including weathering of minerals, and pick-up across open land and dust generated from fires. Monitoring of dust deposition is not currently undertaken at the site and therefore background levels for the immediate vicinity of the site are not available.

However, a study by the UK ODPM (UK ODPM 1986) gives estimates of likely dust deposition levels in specific types of environments. In open country a level of 39 mg/(m^2*day) is typical, rising to 59 mg/(m^2*day) on the outskirts of town and peaking at 127 mg/(m^2*day) for a purely industrial area. A level of 39 mg/(m^2*day) can be estimated as the background dust deposition level for the region of the site in Ballymullen, Co. Laois.

9.4.3 Background Sources of PM_{10} and $PM_{2.5}$

Long-term PM_{10} monitoring was carried out at the rural Zone D location of Kilkitt and the urban locations of Claremorris and Castlebar over the period 2018 – 2022 (EPA 2023, EPA 2024). The maximum 24-hour concentration (as a 90^{th}%ile) at each of the Zone D locations is shown in Table 9.4 with the annual average concentrations shown in Table 9.5. The long-term average 90th%ile of 24-hour concentrations at the rural location of Kilkitt and Claremorris ranges from 13 - 20 µg/m^3. The average annual mean concentrations in Kilkitt from 2018 – 2022 ranged from 7 - 9 µg/m^3, including urban locations. In order to be conservative, an upper average concentration of 12 µg/m^3 as an annual mean has been selected as shown in Table 9.5. Based on the above information an estimate of the background PM_{10} concentration in the region of the application site is 12 µg/m^3 whilst a value of 17 µg/m^3 has been selected for the 90th%ile of 24-hr means.

Table 9.4: 90th%ile of 24-Hour PM_{10} Concentrations In Zone D Locations (µg/m^3)

Year	Claremorris	Kilkitt	Castlebar
2018	19.9	15.3	19.9
2019	20.0	13.0	24.0
2020	15.5	-	22.2
2021	13.3	-	21.5
2022	12.5	14.3	19.0
Average	**16.4**	**14.2**	**21.3**

Table 9.5: Annual Mean PM_{10} Concentrations In Zone D Locations (µg/m^3)

Year	Claremorris	Killkitt	Castlebar
2018	12.0	9.0	11.0
2019	11.0	7.0	16.0
2020	10.0	-	14.0
2021	8.1	-	14.2
2022	7.9	8.5	11.2
Average	**9.8**	**8.2**	**13.3**

The results of $PM_{2.5}$ monitoring at Claremorris (Zone D) over the period 2018 – 2022(EPA 2022) indicated an average $PM_{2.5}/PM_{10}$ ratio ranging from 0.4 – 1. Based on this information, a conservative ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration of 7.2 µg/m^3 for the region of the application site.

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 PM_{10} an estimate of the maximum combined pollutant concentration can be obtained as shown below:

PM_{10} - The 90.4th%ile of total 24-hour mean PM_{10} is equal to the maximum of either A or B below:

a) 90.4th%ile of 24-hour mean background PM_{10} + annual mean process contribution PM_{10}

b) 90.4th%ile 24-hour mean process contribution PM_{10} + annual mean background PM_{10}.

9.4.4 Dust Sensitive Receptors

Potentially dust sensitive activities, which can be categorised in relation to their dust sensitivity as potential increases in ambient dust levels, will have varying degrees of effects. This is dependent on the type and sensitivity of the receptor. Although this principle does not always apply, Table 9.6 categorises dust sensitive receptors and highlights their risk in relation to potential sources of dust.

Table 9.6: Levels of Sensitivity per Receptor Type

High Sensitivity	Medium Sensitivity	Low Sensitivity
Hospitals and clinics Retirement homes Hi-tech industries Painting and furnishing Food processing	Schools Residential areas Food retailers Greenhouses and nurseries Horticultural land Biodiversity	Farms Light and heavy industry Outdoor storage

The immediate vicinity of the application site is a greenfield and forested area. However, Abbeyleix town is located approximately 1km to the north of the application site. There are a number of sensitive locations present which can be affected by dust deposition. There are two small housing estates and a number of one-off houses within 500m of the application site boundary. These residential properties are included as sensitive receptors within the model.

Vegetation, berms and the natural topography can act as breaks between the sources and the receptors. However, these are not included in the modelled scenarios as a worst-case. Tree lines can also act as an efficient dust filter and can be a useful dust control safeguard.

9.5 Characteristics of the Development

The development involves the assessment of the likely impact on air quality associated with the proposed development at the Booth Precast Products Ltd located at Ballymullen, Co. Laois.

The application site consists of a greenfield area of 8.5 hectares comprising of several grazing fields with some woodland and scrub in the central area. The applicant proposes to remove the existing woodland, vegetation and overburden and extract the underlying sand and gravel material in line with an eight-phase extraction plan.

All extracted sand and gravel material from the application site will be transported to the applicant’s manufacturing facility located approximately 1.3km to the south of the application site.

The maximum rate of extraction will be in the region of 200,000 tonnes/annum; however, this will depend on the demand for material. Therefore, the applicant is seeking a 10-year permission in order to allow for years when the anticipated extraction rate will not be achieved. The assessment has assumed a single phase of the application site will be disturbed at any time with all other phases left untouched or restored. Full details of the proposed development are included in Chapter 3.0 of the EIAR. The phase modelled was chosen after a sensitivity study modelling the full site area and reviewing the area of worst case impact due to proximity of receptors and wind directions.

During the average year based on the modelled extraction rate of 200,000 tonnes/annum, it is proposed there will be a maximum of 29 external truck movements per day.

The hours of operation at the pit will be Monday to Saturday 08:00 to 18:00 (during daylight hours), With no operations on Sundays or public holidays. These hours have been used for the purpose of the assessment. There will be no blasting on site. The following operations are the main dust generating sources or activities at the pit:

1) Movement of trucks along paved public roads
2) Movement of trucks along unpaved haul roads
3) Extraction of material
4) Loading of material
5) Wind erosion at material storage areas, stockpiles and exposed surfaces.

As stated previously the modelled scenarios were based on screening and stockpiling of material on site. These activities will not be undertaken as part of the revised proposal.

9.6 Predicted Impacts

9.6.1 Operational Phase

The main potential sources of emissions to air are associated with plant and machinery undertaking day to day activities such as extraction 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.

9.6.1.1 Dust

Emissions from the site lead to a dust deposition level averaged over the full year of 6.2 mg/(m^2*day) at the boundary to the pit (see Table 9.7). Based on a worst-case background dust deposition of 39 mg/(m^2*day) in the region of the site, the combined dust deposition level peaks at 48.4 mg/(m^2*day) which is 13.5% of the TA Luft Limit Value of 350 mg/(m^2*day), as shown in Figure 9.3. However, operational activities from the application site contribute a maximum of 2.4% of the TA-Luft Limit Value. The impact of dust deposition is considered localised, long-term and not significant.

Table 9.7: Dispersion Modelling Results for Dust Deposition at Boundary

Pollutant / Year	Worst Case Background Level (mg/(m^2*day))	Process Contribution (mg/(m^2*day))	Predicted Deposition (mg/(m^2*day))	Limit Value (mg/(m^2*day)) Note 1
Dust Deposition / 2019	39	8.40	47.40	350
Dust Deposition / 2020	39	8.00	47.00	350
Dust Deposition / 2021	39	5.78	44.78	350
Dust Deposition / 2022	39	7.24	46.24	350
Dust Deposition / 2023	39	6.62	45.62	350

Note 1 TA-Luft as interpreted by DOEHLG (2004)

PM_{10}

Predicted PM_{10} concentrations are significantly lower than the ambient air quality standards at the worst-case residential receptor due to background concentrations and emissions from the application site (see Table 9.8). For emissions from the application site the predicted 24-hour and annual concentrations (excluding background) at the worst-case off site location peak at 10.9 µg/m^3 and 4.0 µg/m^3 respectively. Based on a background PM_{10} concentration of 12 µg/m^3 in the region of the application site, the combined annual PM_{10} concentration including the site peaks at 16.0 µg/m^3 (see Figure 9.4). This predicted level equates to at most 40% of the annual limit value of 40 µg/m^3. The predicted 24-hour PM_{10} concentration (including background) peaks at 22.8 µg/m^3 which is 46% of the 24-hour limit value of 50 µg/m^3 (measured as a 90.4^{th}%ile). Operational activities from the pit contribute a maximum of 10% of the PM_{10} annual mean limit value. The effect of PM_{10} emissions from the proposed development on air quality is considered as direct, slight, negative and long-term.

Table .:8: Dispersion Modelling Results for PM_{10}

Pollutant / Year	Annual Mean Background (µg/m^3)	Averaging Period	Process Contribution PM_{10} (µg/m^3)	Predicted Emission Concentration PM_{10} (µg/m^3) Note 2	Standard (µg/m^3) Note 1
PM_{10} / 2019	N/A	90.4th%ile of 24-hr means	7.2	19.2	50
	12	Annual Mean	2.9	14.9	40
PM_{10} / 2020	N/A	90.4th%ile of 24-hr means	6.6	18.6	50
	12	Annual Mean	2.6	14.6	40
PM_{10} / 2021	N/A	90.4th%ile of 24-hr means	8.3	20.3	50
	12	Annual Mean	3.2	15.2	40
PM_{10} / 2022	N/A	90.4th%ile of 24-hr means	10.9	22.9	50
	12	Annual Mean	4.0	16.0	40
PM_{10} / 2023	N/A	90.4th%ile of 24-hr means	8.0	20.0	50
	12	Annual Mean	2.9	13.0	40

Note 1 S.I. No. 739 of 2022 and EU Directive 2008/50/EC

Note 2 90.4th%ile of 24-Hr PM_{10} Concentration Calculated According To UK DEFRA Guidance and using background data from the rural Zone D EPA monitoring stations.

$PM_{2.5}$

Predicted $PM_{2.5}$ concentrations at the worst-case receptor are significantly lower than the limit value of 25 µg/m^3 (see Table 9.9).

The predicted annual concentration (excluding background) at the worst-case off-site location at 3.4µg/m^3. Based on a background $PM_{2.5}$ concentration of 7.2 µg/m^3 in the region of the site, the annual $PM_{2.5}$ concentration including the operations peaks at 10.6 µg/m^3. This peak level equates to 43% of the annual limit value for $PM_{2.5}$. The effect of $PM_{2.5}$ emissions from the proposed development on air quality is considered as direct, slight, negative and long-term.

Table 9.9: Dispersion Modelling Results for $PM_{2.5}$

Pollutant / Year	Annual Mean Background (µg/m³)	Averaging Period	Process Contribution $PM_{2.5}$ (µg/m³)	Predicted Emission Concentration $PM_{2.5}$ (µg/m³)	Standard (µg/m³) Note 1
$PM_{2.5}$ / 2019	7.20	Annual Mean	2.4	9.6	25
$PM_{2.5}$ / 2020	7.	Annual Mean	2.2	9.4	25
$PM_{2.5}$ / 2021	7.2	Annual Mean	2.7	9.9	25
$PM_{2.5}$ / 2022	7.2	Annual Mean	3.4	10.6	25
$PM_{2.5}$ / 2023	7.2	Annual Mean	2.5	9.7	25

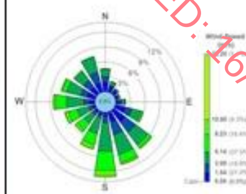
Note 1 S.I. No. 739 of 2022 and EU Directive 2008/50/EC

9.6.1.2 Contour Plots

The geographical variations in pollutant concentrations for the worst-case scenario for each pollutant are illustrated as concentration contours in Figures 9.2 and 9.5. The contents of each figure are described below:

Figure 9.2 Annual Average Dust Deposition (g/m²/year)
Figure 9.3 90.4th Percentile of 24-Hour Average PM_{10} Concentrations (µg/m³)
Figure 9.4 Annual Average PM_{10} Concentrations (µg/m³)
Figure 9.5 Annual Average $PM_{2.5}$ Concentrations (µg/m³)

The concentrations and deposition levels listed in Tables 9.7 – 9.9 are for the maximum concentrations / deposition levels predicted at the worst-case receptors. All other receptors are below these values. The concentration contours show where the maximum concentrations and deposition levels are predicted to occur and the reduction in concentration or deposition with distance away from the maximum.



Background Mapping from Google Earth

Annual Mean Dust Deposition (excluding background) Maximum Deposition Rate = 8.4 g/m²/yr

Boundary Of Land Ownership

N

Project

Booth Precast Products Ltd. EIAR

Reference

247501.0294

Annual Mean Dust Deposition Rate (g/m²/yr) (Excluding background concentrations)

Year 2019

awnconsulting

The Tecpro Building, Clonshaugh Business and Technology Park, Dublin 17
T: +353 1 847 4220 F: +353 1 847 4257

Figure 9.2: Annual Average Dust Deposition (g/m²/yr)

Figure 9.3: 90.4th Percentile of 24-Hour Average PM_{10} Concentrations (µg/m^3)

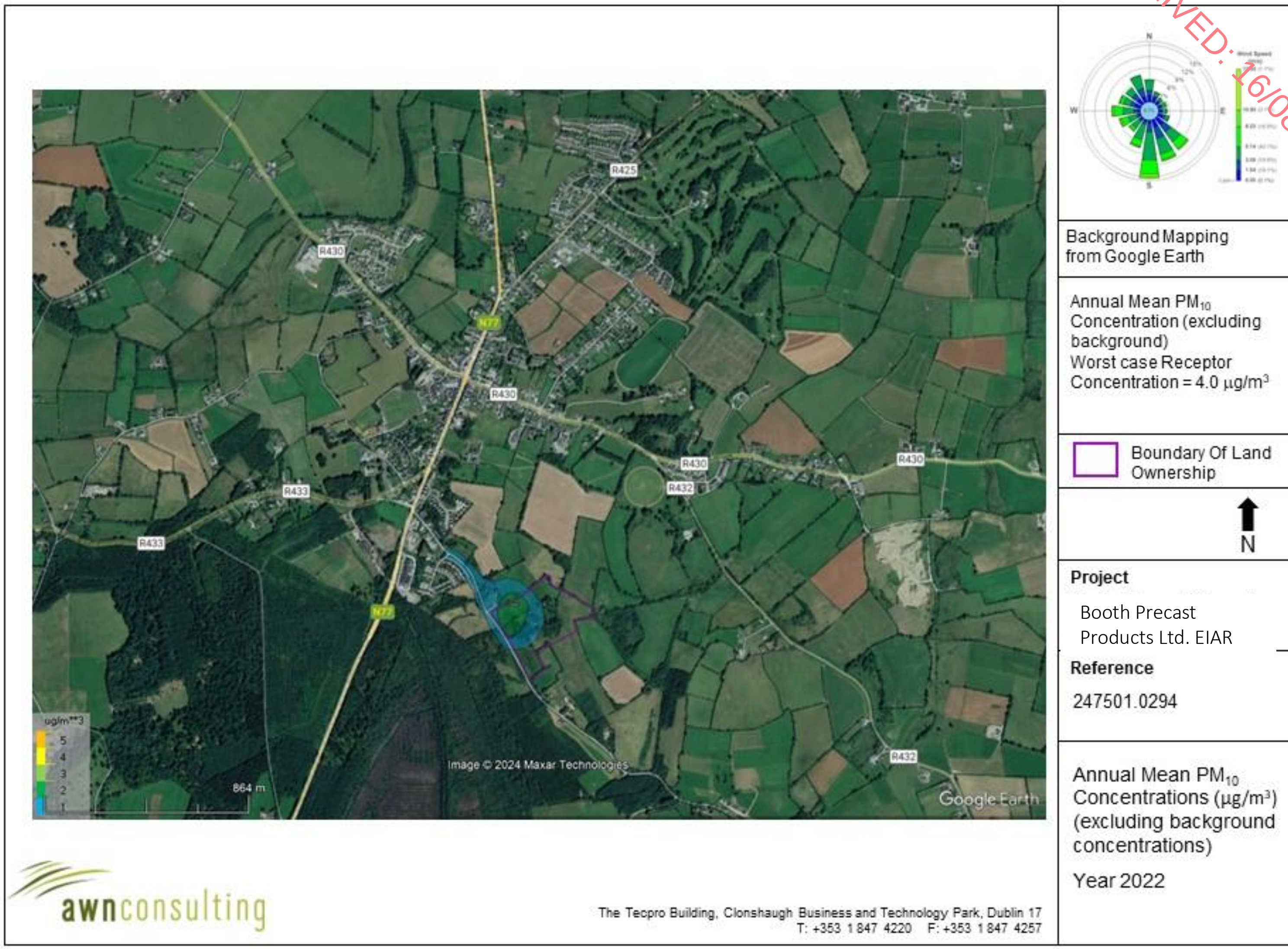


Figure 9.4: Annual Average PM_{10} Concentrations (µg/m^3)

Figure 9.5: Annual Average $PM_{2.5}$ Concentrations (µg/m^3)

9.6.1.3 Road Traffic

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.

If any of the road links impacts by a proposed development meet any of the above criteria, then a detailed assessment is required. Concentrations of key pollutants are calculated at sensitive receptors which have the potential to be affected by the proposed development. For road links which are deemed to be affected by the proposed development and within 200m of the chosen sensitive receptors, inputs to the air dispersion model consist of: road layouts, receptor locations, AADT, percentage heavy goods vehicles, annual average traffic speeds and background concentrations. During the operational phase it is expected that no more than 58 HGV movements per day will occur which is significantly less than the criteria set out by TII for being classified as an 'affected' road. Therefore, the effect on air quality due to the HGVs can be considered direct, imperceptible, localised, negative and long-term.

9.6.1.4 Human Health

The dispersion modelling results show that predicted levels of particulate matter (PM_{10} and $PM_{2.5}$) will be significantly below the EU ambient air quality limit values which are based on the protection of human health. Therefore, the effect on human health is predicted to be direct, imperceptible, localised, negative and long-term.

9.6.2 Do Nothing Scenario

Under the Do-Nothing Scenario the site would remain as per its current use as a greenfield site. Under this scenario levels of dust deposition, PM_{10} and $PM_{2.5}$ would remain at baseline levels. The impact to air quality under this scenario are considered neutral.

9.6.3 Cumulative Impacts

Cumulative effects have been assessed for the application site. Background concentrations have been included in the modelling study for dust deposition and EPA data for PM_{10} and $PM_{2.5}$. These background concentrations account for non-localised sources of the pollutants of concern.

In addition, in order to facilitate the proposed development, some local road improvement works are required. These will be undertaken in advance of construction commencing at the site. The public roadworks have been considered cumulatively with the proposed development. The works primarily involve improving the carriageway, provision of passing bays, signage and pavement strengthening. There is the potential for dust emissions to occur during the works. Applicable dust mitigation measures, as per the air quality assessment and IAQM guidance, will be put in place in order to ensure there is no dust soiling, human health or ecological impacts. With dust mitigation in place air quality impacts are considered not significant.

There are no other significant sources of dust, PM_{10} or $PM_{2.5}$ within the area of impact from the pit and therefore no further prediction of cumulative impact is required.

9.7 Mitigation Measures

The following mitigation measures are implemented within the pit in order to limit the effects on air quality:

- Vehicles using site roads have their speed restricted to 40 kph on unsurfaced roads. Speed restrictions on hard surfaced roads are dictated by site management and are within the legal speed limit.
- A truck wheelwash is available at the site exit to prevent track out of materials onto the public road.
- Un-paved site roads are regularly watered using bowsers, especially during dry and windy periods when watering should be done twice per day.

Further detailed mitigation measures are provided in Appendix 9.2: Dust Minimisation Plan in accordance with the Institute of Air Quality Management (IAQM) (2024) Guidance on the Assessment of Dust from Demolition and Construction Version 2.2.

If monitoring indicates a potential issue with dust deposition, additional mitigation measures shall be implemented to remediate. Remediation measures to be applied are dependent on the type of failure of mitigation that caused exceedances. Therefore, the application of additional measures would be dependent on this review and likely due to a poor adherence to the dust management plan. Should this occur, additional surveys to determine the source of the dust will be conducted and retraining of appliable staff on the dust management plan and how to control dust will be carried out promptly.

9.8 Monitoring

To ensure that the existing development is not impacting on air quality, it is recommended that dust deposition monitoring be undertaken at the boundary of the site. Monitoring will ensure that the TA Luft guideline limit value of 350 mg/(m^2*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 (DOHLEG, 2004).

If monitoring indicates a potential issue with dust deposition, additional mitigation measures shall be implemented to remediate including those detailed in Appendix 9.2.

9.9 Residual Impacts

Modelled emissions from the site lead to ambient concentrations which are within the relevant ambient air quality standards for dust, PM_{10} and $PM_{2.5}$. Thus, the impact on air quality as a result of the proposed development is considered as direct, long term, negative and slight, which is overall not significant in EIA terms.

9.10 Technical Difficulties

There were no significant difficulties encountered during the compilation of the chapter.

9.11 References

DOEHLG (2004) *Quarries and Ancillary Activities, Guidelines for Planning Authorities*

EPA (2010) *Air Dispersion Modelling from Industrial Installations Guidance Note (AG4)*

EPA (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)*

EPA (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)*

Environmental Protection Agency (2024) www.epa.ie/whatwedo/monitoring/air/data

German VDI (2002) *Technical Guidelines on Air Quality Control – TA Luft*

Institute of Air Quality Management (IAQM) (2024) *Guidance on the Assessment of Dust from Demolition and Construction Version 2.2*

Met Eireann (2024) www.met.ie

Transport Infrastructure Ireland (TII) (2022) PE-ENV-01106*: Air Quality Assessment of Specified Infrastructure Projects*

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

Appendix 9.1: Emission Factors

Emission Factors Used In Dust Emission Calculations (USEPA, 1986 & subsequent updates):

Road Haulage (Unpaved)

$E = [281.9*k*(s/12)_a(W/3)_b((365-P)/365)$ g/veh km

Where:
s = surface silt content (9.2%)
k = 4.9 (Total Dust), 1.8 (PM_{10}), 0.15 ($PM_{2.5}$)
W = mean vehicle weight (30 tonnes)
a = 0.9 ($PM_{10}/PM_{2.5}$), 0.7 (Total Dust)
b = 0.45
P = 192 wet days

Road Haulage (Paved)

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

Where:
sL = surface silt loading (9.2 g/m_2)
k = 24 (Total Dust), 4.6 (PM_{10}), 0.66 ($PM_{2.5}$)
W = mean vehicle weight (30 tonnes)
P = 192 wet days
N = 365 days

Material Loading

$E = k(0.0016)*(U/2.2)_{1.3}/(M/2)_{1.4}((365-P)/365)$ kg/Mg

Where:
k = 0.74 (Total Dust), 0.35 (PM_{10}), 0.053 ($PM_{2.5}$)
M = moisture content (2.1%)
U = mean wind speed (3.3 m/s)
P = 192 wet days

Operation	Total Dust Emission Rate	PM_{10} Emission Rate	$PM_{2.5}$ Emission Rate
Conveyor Transfer (g/s/m^2)	5.18E-08	1.90E-08	4.84E-09
Screening (g/s/m^2)	8.08E-07	2.78E-07	1.81E-08
Stockpiling(g/s/m^2)	2.82E-06	1.41E-06	5.65E-07
Primary, Secondary & Teritary Crushing (uncontrolled)	4.46E-07	1.98E-07	3.64E-08
Paved Roads (g/s) per source every 10 m	9.11E-04	1.75E-04	4.23E-05
Unpaved Roads (g/s) per source every 10 m	1.50E-02	4.36E-03	4.36E-04
Blasting (g/s/m^2)	N/A	N/A	N/A

Appendix 9.2: Dust Minimisation Plan

A dust minimisation plan will be formulated as activities are likely to generate some dust emissions. The potential for dust to be emitted depends on the type of activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source. The objective of dust control at the site is to ensure that no significant nuisance occurs at nearby sensitive receptors. In order to develop a workable and transparent dust control strategy, the following management plan has been formulated by drawing on best practice guidance from Ireland, the UK (BRE 2003), (The Scottish Office 1996) (UK Office of Deputy Prime Minister 2002) and the USA (USEPA 1997), (USEPA 1986).

Communications

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition and/or visual inspections.

Site Management

- Regular inspections of the site and boundary should be carried out to monitor dust, records and notes on these inspections should be logged.
- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.

Monitoring

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations with the Local Authority.

Preparing and Maintaining the Site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.

- Erect solid screens or barriers around dusty activities or the site boundary that is at least as high as any stockpiles on site.
- Fully enclose specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.
- A truck wash is available at the site exit to prevent trackout of materials onto the public road.
- Un-paved site roads are regularly watered using bowsers, especially during dry and windy periods when watering should be done twice per day.
- Stockpiling of materials is undertaken in sheltered areas of site where possible. Bowers should be used to increase the moisture value of stockpiles during dry or windy periods.

Operating Vehicles / Machinery and Sustainable Travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Vehicles using site roads have their speed restricted to 40 kph on unsurfaced roads. Speed restrictions on hard surfaced roads are dictated by site management and are within the legal speed limit. Operations
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- No burning of waste materials.

Measures Specific to Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Where possible, only remove the cover in small areas during work and not all at once. Only one phase of the pit should be opened at any one time.
- During dry and windy periods, and when there is a likelihood of dust nuisance, a bowser will operate to ensure moisture content is high enough to increase the stability of the soil and thus suppress dust. Measures Specific to Trackout Site roads (particularly unpaved) can be a significant source of fugitive dust if control measures are not in place. The most effective means of suppressing dust emissions from unpaved roads is to apply speed restrictions. Studies show that these measures can have a control efficiency ranging from 25 to 80%.
- A speed restriction will be applied as an effective control measure for dust for on-site vehicles.

- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.

10.0 NOISE & VIBRATION

10.1 Introduction

This chapter of the EIAR was prepared by Brendan O'Reilly of Noise and Vibration Consultants Ltd who were commissioned to assess the potential noise and vibration impacts associated with the development of a proposed sand and gravel pit at Knocknamoe and Ballymullen townlands, Abbeyleix, Co Laois. This chapter has been updated on foot of Laois County Council's *Request for Further Information* (LCC Reg. Ref. 23/60390).

10.2 The Existing Environment

The application site is approximately 8.5ha. in area and is situated in the townlands of Knocknamoe and Ballymullen which is located approximately 1km south of Abbeyleix town. The site is bordered by agricultural grassland to the east, north and south and by a local public road to the west which defines the western site boundary.

Landuse in the surrounding area is largely agricultural with scattered rural pattern of residential dwellings along the local roads to the west. The density of housing increases on approach to Abbeyleix town.

The site has an elevation range of between approximately 94mOD and 130mOD (Ordnance Datum) and is located on a hillside that steadily slopes in a westerly direction.

10.3 Description of Proposed Activity

The proposed development consists of the removal of the existing vegetation and soil material and extraction of sand and gravel from an 8.5 Ha. greenfield area and transporting the material to the applicants manufacturing facility located approximately 1.3km to the south of the application site. There will be no processing of material on the 8.5 Ha site. The material transported to the manufacturing facility will be processed into various grades of aggregate and sold to market or used to manufacture concrete products. The applicant is applying for planning permission to extract the available reserve of material and to restore the pit in phases on extraction of the available resource.

The existing and proposed layouts and sections through the application site are illustrated on figures attached to Section 3.0 of the EIAR.

10.4 Statement of Authority

This section of the EIAR has been prepared by Mr. Brendan O'Reilly of Noise and Vibration Consultants Ltd. Brendan has a master's degree in noise and vibration from Liverpool University and has over 35 years' experience in noise and vibration control (and many years' experience in preparation of noise impact statements) and has been a member of a number of professional organisations including a committee member of IMQS. Brendan was a co-author and project partner (as a senior noise consultant) in 'Environmental Quality Objectives Noise in Quiet Areas' administered by the Environmental Protection Agency (EPA).

Brendan has considerable experience in the assessment of noise impacts and has compiled EIA studies ranging from quarries, mines, tailing ponds, retail development, wastewater treatment plants, housing developments and wind farms.

10.5 Methodology

In order to carry out a baseline noise survey at receptors surrounding the site and to assess the potential noise emissions from the proposed development, the following relevant guidance and legislation were consulted:

- *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* (Jan 2016).
- ISO 1996-1-2016: *Acoustics: Description and Measurement of Environmental Noise-Basic Quantities and Assessment Procedures*.
- *Integrated Pollution Control Licensing – Guidance Note for Noise in Relation to Scheduled Activities, EPA 1995*.
- ISO 9613-2, *First Edition 1996-12-15. Acoustics-Attenuation of sound during propagation outdoors-Part 2: General method of calculations*
- *Draft Guidelines for the Treatment of Noise and Vibration in National Road Schemes*
- BS5228, 2009 *Code of Practice for Noise Control on Construction and Open Sites: Part 1: Noise.*
- EPA, 2006, *Environmental Management Guidelines-Environmental Management in Extractive Industry (Non-Scheduled Minerals)*.
- EPA, 2003, *Environmental Quality Objectives-Noise in Quiet Areas*
- HMSO, Welsh Office, 1988. *Calculation of Road Traffic Noise*

10.5.1 EPA Description of Effects

The significance of effects of the proposed development is described in accordance with the EPA guidance document *Guidelines on the information to be contained in the Environmental Impact Assessment Reports (EIAR), EPA May 2022*. The details of the methodology for describing the significance of effects are provided in Table 3.4: Section 3.7.3 of the aforementioned EPA 2022 document.

10.5.2 Baseline Noise Survey

A baseline noise survey was carried out at some of the nearest receptors to the proposed development. Two noise monitors were set up to run continuously between 11th and 13th November 2019 at locations NSL1 and NSL2 as shown on Plate 10.1.

10.5.3 Noise Monitoring Methodology

The following instruments were used:

- Two Larson Davis LxT Sound Expert Precision Integrating Sound Level Analyser/Data logger.
- Wind Shields Type: Double Skinned Wind Screens.

- Calibration Type: Larson Davis Precision Acoustic Calibrator.

All instruments conform to BS EN 61672-1 and BS EN 60942, Class 1 and ISO Type 1.

10.5.3.1 Weather

The baseline noise survey was in a range of wind speeds between 2-7m/s. There was no precipitation during the day periods (08.00 to 18.00hrs). During the survey there was dry conditions with a west to north-west light wind.

10.5.3.2 Measurement Parameters

L_{Aeq} is the A-weighted equivalent continuous sound level measured during the sample period. It is an average of the fluctuating noise level over the sample period. It can also be described as a notional steady level that has the same sound energy as the real fluctuating noise over a specified time interval- it is a type of average represented by a single number over a specified time interval.

L_{AFMax} is the maximum A-weighted sound level during a stated time period (Fast Time weighting).

L_{A10} is the A-weighted sound level, which is exceeded for 10% of the sample period.

L_{A90} is the A-weighted sound level, which is equalled or exceeded for 90% of the sample period and is defined as the background noise level.

L_{A50} is the A-weighted sound level, which is exceeded for 50% of the sample period.

Sound Power Level (L_{WA} dB) is a measure of the acoustic energy emitted from a source of noise, expressed in decibels. The Sound Pressure Level is the pressure disturbance in the atmosphere measured using predefined conditions such as the location of the equipment, the environmental conditions, and the distance of the measurement from the measurement point. Sound power level refers to the source and sound pressure level is measured by a sound level meter at a distance from a source.

10.5.3.3 Measurement Procedure

Noise monitors were set up to run continuously with instruments set on 30 minute intervals with microphones at 1.2-1.5m above ground level. All the environmental noise analysers had data logging facilities set on real-time, the logged data was later downloaded via a personal computer using software. All noise monitors were calibrated before and after the survey and the maximum drift of calibration was 0.02dB. All monitors were within calibration certification times (photos of monitor in-situ in Appendix 10.1). Noise monitoring was undertaken at locations NSL1 and NSL2 as shown on Plate 10.1. NSL3 and NSL4 are used as additional locations for prediction.

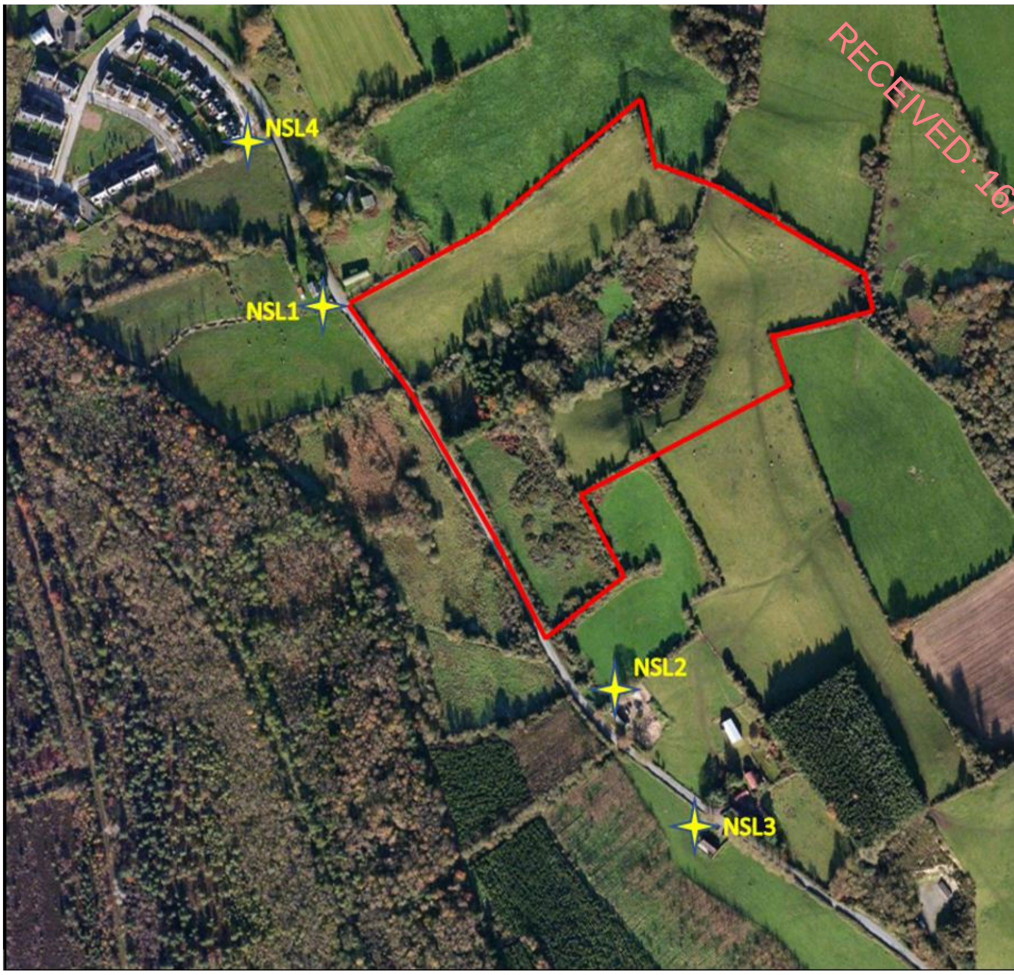


Plate 10.1: Noise monitoring and predictive locations

10.5.4 Results of Baseline Noise Survey

A summary of the baseline mean noise levels is given in Table 10.1 (data in Appendix 10.2).

Table 10.1: Recorded mean noise levels taken at 30-minute intervals

ID	Date	Leq dBA	L10 dBA	L50 dBA	L90 dBA	Comments
NSL1	11th – 13th Nov'19	50.8	52.0	47.0	43.5	Road traffic flow from local road and N77, background from town and N77
NSL2	11th – 13th Nov'19	51.1	50.9	44.0	40.9	Road traffic flow from local road and N77, background from traffic flow on N77

10.6 Relevant Guidance and Legislation

The EPA has produced Environmental Management Guidelines 2006[1]. This document references 'A Guidance Note for Noise in Relation to Scheduled Activities (EPA, 1996[2])'. It deals with the approach to be taken in the measurement and control of noise and provides advice in relation to the setting of emission limits values and compliance monitoring.

In relation to quarry developments and ancillary activities, it recommended that noise from the activities on site shall not exceed the following noise limits at the nearest noise-sensitive receptor:

Daytime	08.00-20.00 hrs	LAeq (1h) = 55dBA
Night-time	20.00-08.00 hrs	LAeq (1h) = 45dBA

95% of all noise levels shall comply with the specified limits values(s). No noise level shall exceed the limit value by more than 2dBA.

Recent night-time hours given by the EPA for licensed activities are 23.00hrs to 07.00hrs. There is no night-time activity proposed for the proposal.

The guidelines also recommend that where existing background noise levels are very low, lower noise level ELV's may be appropriate. It is also appropriate to permit higher ELV's for short term temporary activities such as construction of screening bunds etc. where such activities will result in considerable environmental benefit.

Very low background noise environment is well defined and referenced in the EPA's NG4 (January 2016). Quiet areas are referenced in NG4 and refer to in Environmental Quality Objectives - Noise in Quiet Areas. To qualify the first stage involves screening and a number of criteria needs to be satisfied, one which involves being more than 5km from a National Primary Route. The N77 is a National Primary Route and is within 0.9 km of the nearest receptors. The background noise survey demonstrates that the noise level at nearest receptors around the proposal are above that encountered at a low-level noise environment.

Recent night-time hours given by the EPA for licensed activities are 23.00hrs to 07.00hrs. There is no night-time activity proposed for the proposal and operations will only be conducted during daylight hours, limited to the hours set-out below.

The proposed hours for construction and operation of the development are:

- 08.00 to 18.00hrs Monday to Saturday inclusive.

10.6.1 Construction

<u>Relevant Guidance</u>

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However National Roads

[1] *Environmental Management in the Extractive Industry (Non-Scheduled Minerals), 2006.*
[2] *EPA's Guidance Note For Noise In Relation to Scheduled Activities, 1996*.

Authority ("NRA") give limit values which are deemed acceptable ("the NRA Guidelines")[3]. Guidance to predict and control noise is also given in BS 5228:2009, *Code of Practice for Noise and Vibration Control on Construction and Open Sites* (two parts) where Part 1 deal with Noise. The NRA guidelines for construction noise which are considered typically acceptable are given in Table 10.2.

Table 10.2: Construction noise levels that are typically acceptable based on the NRA guidelines

Day / Times	Guideline Limits
Monday to Friday	
07:00 – 19:00hrs	70dB LAeq, (1h) and LAmax 80dB
19:00 – 22:00hrs	*60dB LAeq, (1h) and LAmax 65dB*
Saturday	
08:00 – 16:30hrs	65dB LAeq,1h and LAmax75dB
Sunday and Bank Holidays	
08:00 – 16:00hrs	*60dB LAeq,1h and LAmax 65dB*

*Construction outside of these times, other than required by an emergency works, will normally require explicit permission from the relevant Local Authority

Part 1 of BS 5228 provides for control of noise effects from construction activities. The control methods include and are not limited to; the management of the site, supervision, maintenance and training, selection of equipment, working methods, hours of operation and screening barriers.

The proposed construction time is similar to operational time at: 08.00 to 18.00hrs Monday to Saturday inclusive.

10.7 Development Proposal

The development includes removal of trees / vegetation, removal of topsoil, construction of acoustic berms followed by the extraction of the underlying sand and gravel. Material will be extracted by an excavator and transported by road trucks to the manufacturing facility located approximately 1.3km to the south of the application site. The development includes:

- Construction activity involves the removal of trees / vegetation, removal topsoil and construction of acoustic berms.
- Extraction of sand and gravel and restoration will be over an 8-phase extraction plan.
- The phased extraction is envisaged to extend over a period of 10 years. Restoration will commence when an extraction phase is completed.

10.7.1 Hours for construction and operation

The proposed times of construction and operation are:

- Monday to Saturday inclusive 08.00 hours and 18.00 hours
- No work Sunday, or Bank holidays

[3] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes.*

All activity onsite will be carried out within the aforementioned hours. The pit will provide employment for approximately 2 people. Plate 10.2 details the proposed phased extraction plan for the application site and the location of the proposed acoustic berms/barrier are detailed on Plate 10.3.

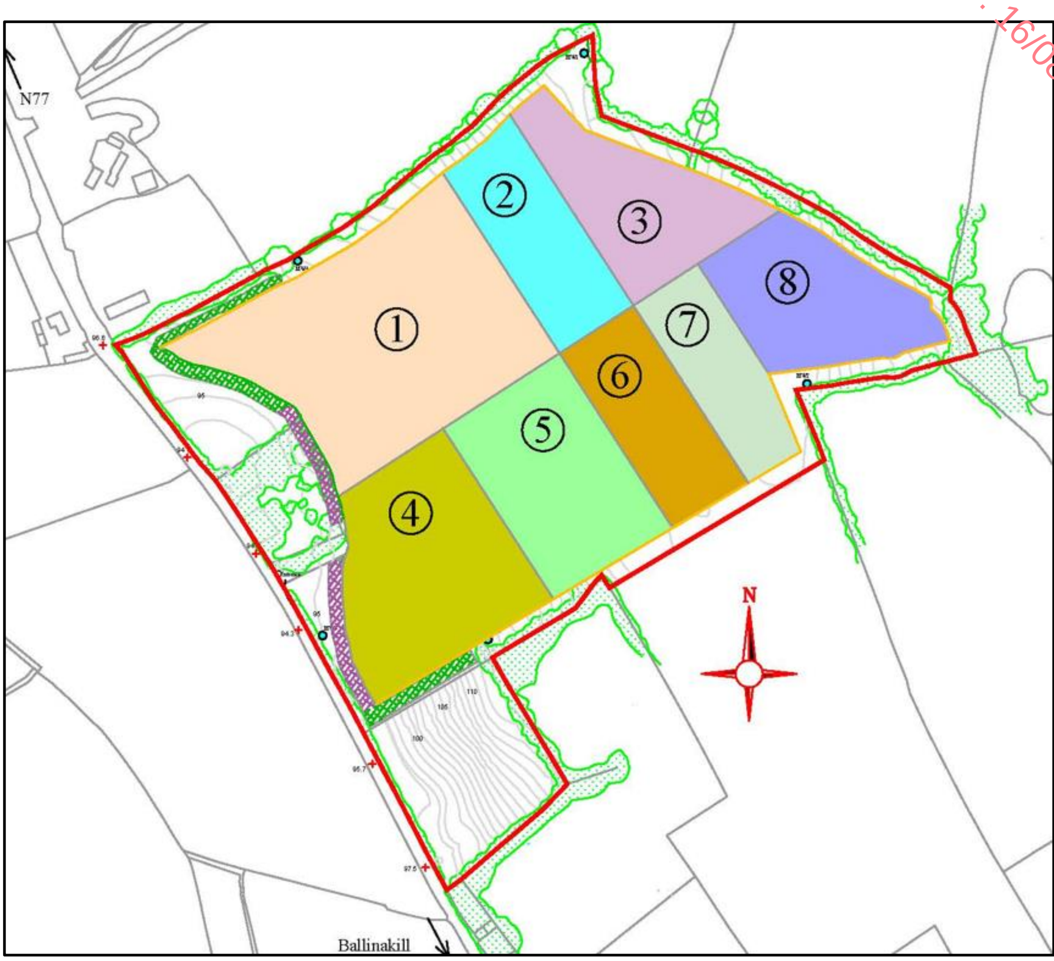


Plate 10.2: Proposed Phases of Extraction

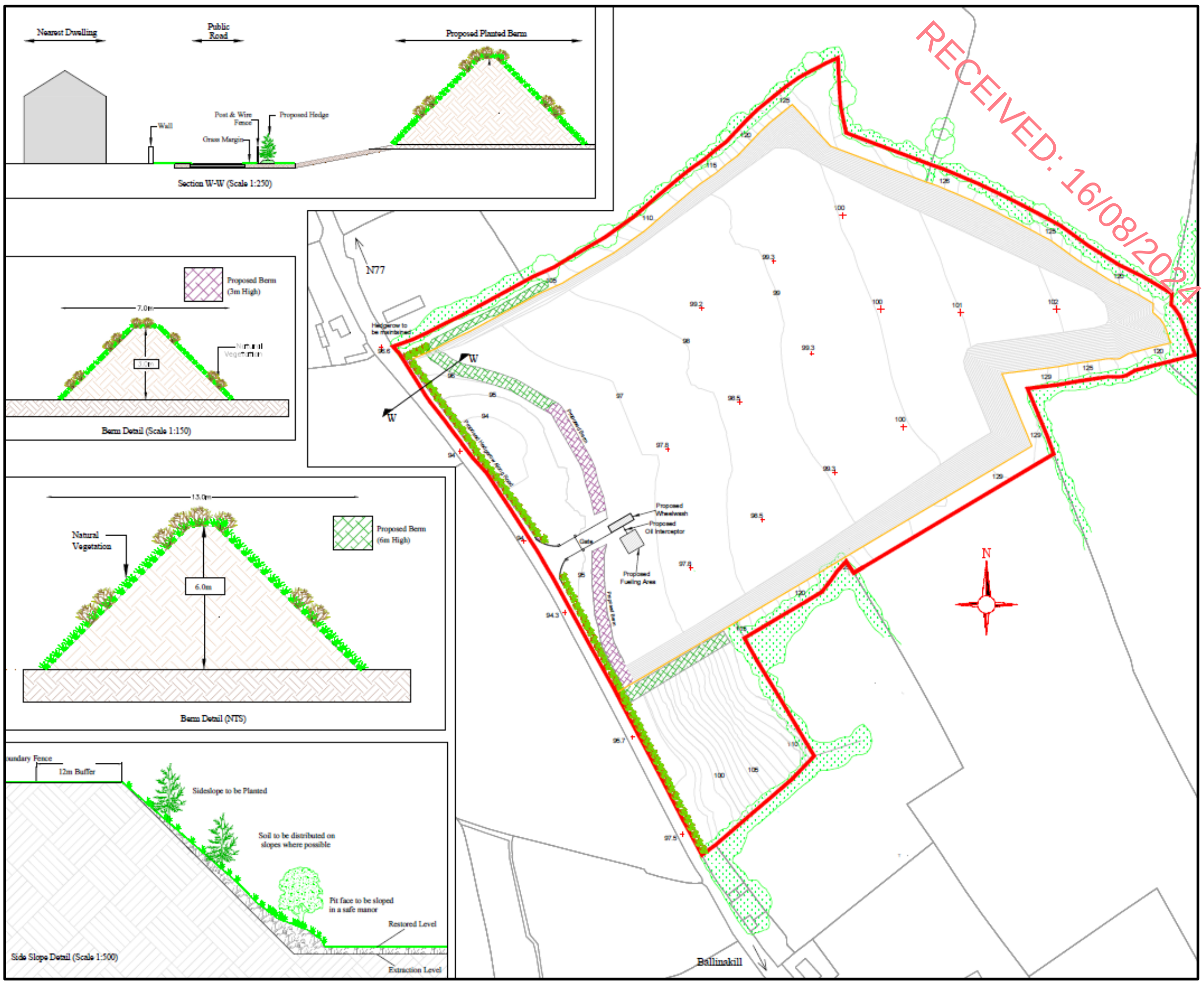


Plate 10.3: Location and Section through Proposed Berms/ Barriers

10.7.2 Predicted Construction Noise Levels

The predicted noise levels are made for construction and operation phases of the development. The maximum levels will be during construction of the acoustic berms. All predictions are made at the boundary of the site when maximum levels are envisaged. This activity involves cutting of trees, removal of topsoil to construct of berms, removal of topsoil in a phased development and construction of wheel wash and concrete refuelling pad located close to the entrance/exit of the development.

10.7.2.1 Tree Cutting

The main noise source generated by this activity will be by a chain saw cutting trees. There will be no tree cutting on the boundary of the site. The nearest trees to the nearest receptor are as listed in Table 10.3. Recent research at the International Academic Research Congress, 2018[4] presented the results and analysis of noise level caused by a chainsaw during tree felling operations. Tree felling involves 4 stages (pre operation, undercut, back cut, post operation) with mean noise levels of 80.2 dBA. Assuming 2 chain-saws in operation the noise emission

[4] Inac TAS, Abdulllah E, AKAY, 2018, Bursa Technical University, Bursa Turkey Analysis of Noise level caused by a chainsaw during tree felling operations, IARC

levels becomes 83.2 dBA. For the purpose of calculation a noise level of 83.2 dBA at 1m from a source which would equal a sound power level (L_{WA} of 94.2dB. The noise levels at a NSL's can be calculated by according to Equation 1.

Equation 1: Predicted Noise level = LW +D – (A_{geo} +A_{atm} +A_{gr} + A_{br} +A_{mis})
Where:
D is assumed as 2 when using hemi-spherical spreading which is taken into account in the equation for geometric spreading (by in effect adding 3dBA to the source).
A_{geo} –Geometric Spreading
Energy density doubles from a point source at ground level which results in hemi-spherical spreading resulting in attenuation over distance according to:
Lp = Lw – (20 log R + 8) which is equivalent to Lp = Lw – 20 log R - 8
Where:
Lp = sound pressure level
Lw = sound power level
R = distance from source to receptor
D = directivity is given as 2 with hemi-spherical spreading / radiation
and where
A_{atm} = Attenuation due to air absorption
A_{gr} = Attenuation due to ground absorption
A_{br} = Attenuation provided by a barrier- building
A_{mis} = Attenuation provided by miscellaneous other effects

Attenuation by Aatm, Agr and Amis is assumed to be 3dBA

The nearest group of trees to the nearest NSL (NSL1) is 112m. NSL2 is 213m from tree cutting. The maximum LAeq, 1hour noise levels generated by tree cutting at NSL1 gives 45.3 dBA. The maximum LAeq, 1hour noise levels generated by tree cutting at NSL2 gives 39.6dBA.

10.7.2.2 Construction of Berm and Removal of Topsoil

The distance to the nearest location of construction and operation activity to the respective NSL's is given for each of the 8 phases of extraction in Table 10.3.

Table 10.3: Distance to receptors from construction noise sources (m)

Phases	Location id			
	NSL1	**NSL2**	**NSL3**	**NSL4**
Phase 1: Overburden removal on site boundary and construction of berm With berm constructed completed	48m 60m	286m	406m	172m
Phase 2: Overburden removal on site boundary	211m	337m	432m	245
Phase 3: Overburden removal on site boundary	256m	364m	449m	275m
Phase 4: Overburden removal on site boundary	164m	171m	302m	289m
Phase 5: Overburden removal on site boundary	200m	209m	309m	303m
Phase 6: Overburden removal on site boundary	255m	253m	332m	334m
Phase 7: Overburden removal on site boundary	293m	287m	354m	360m
Phase 8: Overburden removal on site boundary	328m	344m	410m	385m

Table 10.4 gives a list of plant and sound power levels (LWA dB) of the plant to be used on the site during operation of development. All processing of material will be carried out off site.

Table 10.4: List of plant and LWA levels

Noise Source	Sound Power Level L_{WA}	Comments
Road lorry / truck	108	Operating at normal operation
Komatsu excavator	110	Operating filling truck / topsoil removal
Front end loader	109	Filling truck during operational phases
Tractor and bowser	107	Spraying water

<u>Berm /Barrier Construction</u>

The maximum noise levels will be generated when constructing the berms as there will be no barrier attenuation. The berm construction activity in Phase 1 and Phase 4 (which requires topsoil material from Phase 1) will give the maximum noise levels. The activity will be short term and should be of duration of no more than 1 week equivalent (5 days), however the maximum levels at NSL1 and NSL2 will pertain for less than 1 day. During this activity no allowance is made for barrier attenuation, however attenuation by Aatm, Agr and Amis is assumed to be 3dBA. Construction of the berm will involve a dump truck and excavator operating in tandem which equates to a level equivalent of (108 +110)L_{WA} equal to an L_{WA} = 112.1dB. The predicted noise levels are based on the nearest berm construction activity location in Phase 1 and Phase 4 to the respective NSL's when building the berm with assumption made that that the excavator and truck is working 100% of time. Table 10.5 gives the predicted maximum 1hr noise level from berm construction.

Table 10.5: Predicted maximum noise levels from berm /barrier construction

Receptor ID	Distance to Receptor	Source LWA dB	Ground/Air absorption	Predicted Leq 1hr dBA
Phase 1				
NSL1	48	110.0	3	65.4+
NSL2	172	112.1	3	56.4
NSL3	211	112.1	3	54.6
NSL4	245	112.1	3	53.3
Phase 4				
NSL1	164	112.1	3	56.8
NSL2	171	110.0	3	54.4
NSL3	217	112.1	3	49.4
NSL4	289	112.1	3	51.9

+ Calculations based on an excavator constructing acoustic berm operating at 100% of time

10.7.2.3 Construction of Wheel Wash and Concrete Pad

This activity will be carried out close to the entrance at 170m from NSL1 and 265m from NSL2. These works of short duration with the main noise sources typically be an excavator and readymix truck emptying concrete. Levels expected from such activity given in Table 10.4 (110+108) giving an equivalent combined sound power level of 112.1 dBA. At NSL1 this will give a sound pressure level of 44.1ddBA and 40.5dBA at NSL2 without any berm/barrier effects. This activity is well within the noise limits as given in Table 10.2.

Vibration

Due to distance, there are no ground vibration effects due to the onsite construction of the berms, removal of topsoil, cutting of trees or construction of wheel wash and concrete pad.

10.7.2.4 Decommissioning

Decommissioning of the phases commence when extraction is completed in each phase. Existing site plant will be used so there will be no increase in intensity of works. Decommissioning is expected to be of no more intensity and off shorter duration than construction so effects will be slight.

10.7.3 Assessment

Tree cutting and berm construction noise levels are well within the construction guideline limits of 70dB LAeq, (1hr) as given in Table 10.2. The maximum levels predicted are during the construction of a barrier / berm on the north-east development which will persist for no more than one week equivalent (40 hrs).

10.7.3.1 Description of Construction / Phase Decommissioning Effects

Construction effects include removal of topsoil to construct berms, cutting of trees and removal of topsoil in phases over the 10 year life of extraction. Even though the removal of topsoil will be carried out as part of the phased development the total accumulated time spent on this activity is expected to be no more than 6 months.

Using the EPA criteria for description of effects, the potential worst-case associated with construction and Phase Decommissioning effects at the nearest noise sensitive receptors are described below

Table 10.6: Construction/ Phase Decommissioning Effects

Quality	Significance	Duration
Negative	Slight	Temporary

It is not expected that there will be any cumulative impacts at NSL's during construction or operation.

10.7.4 Operation of Development

With the 6m high berm completed attenuation is assumed as 18 dBA (calculated in excess of 18.4 dBA) and 13 dBA berm attenuation at distance of 150m (calculated at 13.4 dBA). The 6m high berm occupies an area north-west and south of the Development with a berm height of 3m along a section along the road (refer to barrier effect calculations in Appendix 10.3). A berm/barrier is more effective when close to a source, or receptor.

The predicted noise levels are based on the nearest activity location to the respective NSL's during extraction with acoustic berm in place. The maximum predicted noise levels from extraction activity are given in Table 10.7. and is based on Equation 1 with no allowance made except for acoustic berm and mitigation measures hemi-spherical spreading.

The source noise level is taken as an L_{WA} of 112.1dB which means that a truck/lorry and excavator is working together and assumed to be working 100% in all one-hour periods with no down time which is highly unlikely (the plant operating together for 50% in a one hour period would reduce the predicted noise levels by 3dBA).

Table 10.7: Predicted maximum noise levels from sand -pit extraction activity at NSL's

Phases	Location id- 1hour Leq dBA			
	NSL1	NSL2	NSL3	NSL4
Phase 1: Extraction nearest point	65.5-18 = **47.5** at 60m	55-13 = **42.0** at 286m	51.9-13 = **38.9** at 406m	59.4-13 = **46.4** at 172m
Phase 2: Extraction nearest point	57.6-13 = **44.6** at 212m	53.6-13 = **40.6** at 337m	51.4-13 = **38.4** at 432m	56.3-13 = **43.3** at 245m
Phase 3: Extraction nearest point	56.0-13 = **43.0** at 256m	52.9-13 = **39.9** at 364m	51.1-13 = **38.1** at 449m	55.3-13 = **42.3** at 275m
Phase 4: Extraction nearest point	59.8-13 = **46.8** at 164m	59.5-13 = **46.5** at 171m	57.4-13 = **44.4** at 217m	54.9-13 = **41.9** at 289m
Phase 5: Extraction nearest point	58.1-13 = **45.1** at 200m	57.7-13 = **44.7** at 209m	54.3-13 = **41.3** at 309m	54.9-13 = **41.5** at 303m
Phase 6: Extraction nearest point	56.0-13 = **43.0** at 255m	56.1-13 = **43.1** at 253m	53.7-13 = **40.7** at 332m	53.6-13 = **40.6** at 334m
Phase 7: Extraction nearest point	54.8-13 = **41.8** at 293m	55.0-13 = **42.0** at 287m	53.1-13 = **40.1** at 354m	53.0-13 = **40.0** at 360m
Phase 8: Extraction nearest point	53.8-13 = **40.8** at 328m	53.4-13 = **40.4** at 344m	51.9-13 = **38.9** at 410m	52.4-13 = **39.4** at 385m

NB: At the nearest locations NSL1 to the development berm attenuation of 18dBA will be obtained when the noise source is close to the berm. Berm effect is greatest when a noise source is close to a berm (refer to berm / barrier effect in Appendix 10.3).

10.7.5 Assessment

The maximum predicted noise levels are well within the permitted daytime limit of 55dB LAeq (1h) given in the EPA's Environmental Management Guidelines 2006[2]. There is no plan to operate at night-time where a 45dB LAeq (1h) applies.

10.7.5.1 Noise assessment of sand and gravel operation proposal

Noise levels have been predicted at receptor locations at the nearest point in each of the eight phases of development. Mitigating measures have been recommended where deemed necessary. The predicted noise levels are maximum levels and include the cumulative on-site effects. The predicted noise levels are well within the levels recommended by the EPA Environmental Management Guidelines for Quarries.

10.7.5.2 Description of Operational Effects

Using the EPA criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive receptors associated with the operation of the sand and gravel pit is described below. The description includes the ameliorative measures in Section 10.7.6 below.

[2] *Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*, EPA,2006

Table 10.8: Operational Effects

Quality	Significance	Duration
Negative	Not significant	Medium-term

10.7.6 Ameliorative Measures Incorporated in Proposal

- Acoustic berms barrier of minimum 6m height will be constructed as specified in Plate 10.3.
- There will be no processing of material on-site
- During extraction with acoustic berm constructed all plant will operate at local road elevation
- All plant on site will have well maintained silencers.
- Machinery will be throttled down or turned off when not in use.
- A noise buying standard will be put in place where any replacement of mobile plant will have noise characteristics considered.
- Construction activity will not be carried out during extraction activity.
- All mobile plant onsite will have white noise bleepers (broadband) for reversing to Health and Safety Standards

10.8 Cumulative Impacts

The application site was assessed in relation to the sites located within a 5km radius of the application site as tabulated in Tables 3.2 and 3.4 and illustrated on Plate 3.3. None of the sites at distances greater than 1.5km will have a noise impact due to distance on the nearest receptors to this development.

There are three facilities (O'Deas Quarry at 1.2km, Tullyroe Waste Water Treatment Plant at 1.2km and a licenced facility (EPA:po710) not operating all located NW of the proposed site. Due to the significant hill between the aforementioned facilities and the nearest receptors a cumulative noise impact of these facilities would have neutral effects.

Boots Concrete Products is located 1.3km south of the proposal and this facility was inaudible (less than 35dBA) at all both monitoring locations on the visits, accordingly a noise impact which would have neutral effects.

As described in Chapter 3, public road improvements are required on Local Road L5731-25 to facilitate the proposed development. These works will occur in advance of construction commencing on the quarry site and thus cumulative impacts are unlikely to occur. In terms of construction noise, the noise effects of these works are negative, not significant and temporary.

Table 10.9 gives a description of the cumulative effects.

Table 10.9: Cumulative Effects

Quality	Significance	Duration
Neutral	Neutral	Medium-term

10.9 Road Traffic Impacts

The road traffic flow is calculated as an average of 2 lorries per hour (4 movements) based on current demand / calculated based on tonnage. The development of the sand and gravel pit will not increase traffic flow but will lead to a decrease in the traffic flow noise on the north-west section of the local road (flow towards the town and through the town). Material currently being transported to the Booth Manufacturing Plant from Abbeyleix town direction will be significantly reduced which is a positive effect.

10.9.1 Description of Effects

There will be no increase in road traffic by the development and for a section of the local (from entrance of site to the town) road, traffic flow will be reduced. The effects of noise can be summarised as follows:

Table 10.9: Road Traffic Effects

Quality	Significance	Duration
Positive	Imperceptible	Medium-term

10.10 Ground Vibration

Road traffic vibration will not be increased due to the development with traffic flow reduced on the north-west section of the local road. The level of ground vibration at 5m from a loaded lorry will be below the human threshold at less than PPV of 0.2mm/sec[5]. There will be no activity on site that will generate ground vibration at any receptor.

10.11 Do-nothing Scenario

If the proposed development were not to proceed, then a higher level of road traffic would continue along the section of the local road towards the town and through the town.

10.12 Decommissioning Phases

Noise effects during decommissioning and restoration are likely to be of a similar nature to that during construction given in Table 10.6. It is likely that the duration of decommissioning will be shorter than that during construction as decommissioning will be carried on a phased basis as part of the operation. When each phase is fully extracted then the revegetation process will commence with topsoil being placed over the phase area. Any legislation, guidance or best practice relevant at the time of decommissioning would be complied with.

[5] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division"*, ASCE, Vol 100, No. S74, PP. 773-787

10.13 Noise Monitoring

It is proposed to carry out noise monitoring at locations on the perimeter of the site on an annual basis close to the nearest two receptors NSL1 and NSL2.

10.14 Residual Effects

10.14.1 Construction / Decommissioning Phases

During construction the effects are considered not significant at the nearest NSL'S. The activity is temporary with noise levels within recommended limits and defined working hours. There will be no ground vibration sources perceptible or measurable at any receptor. The effects as summarised based on maximum predicted noise levels based on specified ameliorative measures in Section 10.7.6 and are as follows:

Table 10.10: Construction / Decommissioning Phase Residual Effects

Quality	Significance	Duration
Negative	Not significant	Temporary

10.14.2 Operational Phases

At the nearest receptors there will be a slight change in noise levels for the nearest phases, however as the distance of activity increases from receptors the noise levels will decrease. The effects are as follows:

Table 10.11: Operational Residual Effects

Quality	Significance	Duration
Negative	Not Significant	Medium-term

10.15 Technical Difficulties

There were no technical difficulties encountered during the study / assessment.

10.16 Conclusion

Noise levels for the proposal have been predicted and include the cumulative effects of activity. Predictions have been made of maximum hourly noise levels with no allowance made for ground absorption or air attenuation. The predicted noise levels are given as maximum levels (worst -case scenario) and are well within the levels recommended by the EPA Environmental Management Guidelines-Environmental Management in Extractive Industry (Non Scheduled Minerals).

10.17 References

Department of Communities and Local Government (1993) *Minerals Planning Guidance 11 – The Control of Noise at Surface Mineral Workings (MPG-11)*

Department of the Environment, Heritage and Local Government (2004) *Quarries and Ancillary Activities: Guidelines for Planning Authorities*

DEFRA (2005) *Update of Noise Database for Prediction of Noise on Construction and Open Sites*

EPA (2006) *Environmental Management Guidelines Environmental Management in the Extractive Industry (Non-Scheduled Minerals)*

EPA (2012) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*

EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*

BS5228 (2009) *Code of Practice for Noise Control on Construction and Open Sites. Part 1: Noise*

Safety Health and Welfare at Work (Control of Noise at Work) Regulations 2006 (S.I. No. 371 of 2006)

Appendix 10.1: Photos of Monitors in-situ.

NSL1_Noise monitor in-situ

NSL2_Noise monitor in-situ

Appendix 10.2: Baseline Noise Level Data.

Table 1								Locn	NSL1	
Date	Time	Duration	LAeq	LAFmin	LAFmax	LAF5	LAF10	LAF33	LAF50	LAF90
2019-11-11	11:30:00	00:30:00.0	57.2	39.2	83.2	60.7	56.6	50.5	48.7	44.7
2019-11-11	12:00:00	00:30:00.0	52.2	39.2	70.9	56.8	53.5	49.6	48.1	44.1
2019-11-11	12:30:00	00:30:00.0	50.5	40	69	53.8	52.1	49.5	48.2	44.3
2019-11-11	13:00:00	00:30:00.0	51.2	39.3	71.2	54.3	52.6	49.8	48.6	44.2
2019-11-11	13:30:00	00:30:00.0	51.5	40.3	70.2	56.3	53.2	49	47.5	44.2
2019-11-11	14:00:00	00:30:00.0	51.7	39.2	72.5	55.1	52.7	49.5	48.1	44.5
2019-11-11	14:30:00	00:30:00.0	51.2	38.3	68.2	55.5	53.3	50.2	48.8	45.3
2019-11-11	15:00:00	00:30:00.0	53.3	39.8	76	57.7	54.8	51.1	49.7	45.7
2019-11-11	15:30:00	00:30:00.0	52.3	40	70.7	56.5	53.8	50.7	49.3	46.3
2019-11-11	16:00:00	00:30:00.0	52.1	38.8	72.5	55.8	53	49.7	48.5	45.1
2019-11-11	16:30:00	00:30:00.0	51.8	41	67.9	56.5	52.8	49	47.7	45.2
2019-11-11	17:00:00	00:30:00.0	50.2	39.6	64.4	55.2	52.1	48.8	47.8	44.7
2019-11-11	17:30:00	00:30:00.0	49.5	41.1	65.5	53.6	50.8	48.2	47.1	44.2
2019-11-11	18:00:00	00:30:00.0	47.7	39.6	65.5	50.5	48.7	46.6	45.7	43.2
2019-11-11	18:30:00	00:30:00.0	47.2	34.2	63.7	50	48.6	46	45.1	42.2
2019-11-11	19:00:00	00:30:00.0	46.2	36.7	63.3	49.2	47.8	45.7	44.6	41.2
2019-11-11	19:30:00	00:30:00.0	46.8	34.5	65.5	50	47.8	45.3	44.1	39.8
2019-11-11	20:00:00	00:30:00.0	46.8	35.5	62.5	51.2	48.7	45.8	44.7	40.8
2019-11-11	20:30:00	00:30:00.0	46.5	35.3	64.4	49.5	47.7	45.2	44	39.5
2019-11-11	21:00:00	00:30:00.0	45.8	35.2	63.7	49.8	48.2	45.1	43.3	38.6
2019-11-11	21:30:00	00:30:00.0	44.6	32.7	61.8	49	47.3	43.2	41.2	37.2
2019-11-11	22:00:00	00:30:00.0	42.6	31	57.1	47.3	46.2	43	40.6	34
2019-11-11	22:30:00	00:30:00.0	40.6	29.5	53.3	45.2	43.8	40.2	38.5	33.7
2019-11-11	23:00:00	00:30:00.0	43.2	31.8	60.7	47.2	45.5	42.2	40.7	36.7
2019-11-11	23:30:00	00:30:00.0	41.8	29.6	60.5	46.8	44.7	40.3	37.7	32.2
2019-11-12	00:00:00	00:30:00.0	38.7	26.3	59	44.5	42.2	37.1	34.3	28.6
2019-11-12	00:30:00	00:30:00.0	36.1	25.3	51.7	42.2	40.1	34.6	32.2	27.8
2019-11-12	01:00:00	00:30:00.0	38.2	26	61.1	44	42.1	36.6	34	28.8
2019-11-12	01:30:00	00:30:00.0	39.6	27.6	55.1	45.1	43.2	38.3	36.1	31.1
2019-11-12	02:00:00	00:30:00.0	40.6	26.3	58.2	46.8	44.3	37.7	34.8	29.6
2019-11-12	02:30:00	00:30:00.0	41.2	27.6	62.5	46.2	44.1	38.6	36.5	31
2019-11-12	03:00:00	00:30:00.0	40.6	28.1	54.5	46.8	44.1	38.7	36.2	32.2
2019-11-12	03:30:00	00:30:00.0	40.8	27.6	59.5	46.3	44.8	39.8	37.3	30.6
2019-11-12	04:00:00	00:30:00.0	43.1	32.2	59.5	48.7	46.8	41.3	39.2	35
2019-11-12	04:30:00	00:30:00.0	41	29.5	58.5	46.6	44.6	39.5	37.2	32.2
2019-11-12	05:00:00	00:30:00.0	43.7	32	57.6	48.7	47.1	43.2	41	35.7
2019-11-12	05:30:00	00:30:00.0	46.7	34.5	63.7	51.1	48.8	45.2	43.6	39.2
2019-11-12	06:00:00	00:30:00.0	47.3	34.7	66.2	51.3	49.2	46	44.5	39.2
2019-11-12	06:30:00	00:30:00.0	49.7	35.7	71.5	53.2	50.1	46.7	45.2	41.2
2019-11-12	07:00:00	00:30:00.0	51.6	37.2	69.5	55.5	52.6	49.2	47.8	44
2019-11-12	07:30:00	00:30:00.0	52.8	41.6	69.7	57.7	54.5	50.8	49.6	46
2019-11-12	08:00:00	00:30:00.0	52.8	43.1	69.5	56.7	54.2	51.2	50.1	46.6
2019-11-12	08:30:00	00:30:00.0	52.7	42.7	70.5	56.7	53.8	50.8	49.7	46.7
2019-11-12	09:00:00	00:30:00.0	51.7	42	69	56.2	53.2	50	48.8	45.7
2019-11-12	09:30:00	00:30:00.0	51.8	40.7	68	56.2	54.3	50.7	49.2	45.5
2019-11-12	10:00:00	00:30:00.0	51.7	41.3	71.9	55.8	52.7	49.2	48.2	44.7
2019-11-12	10:30:00	00:30:00.0	52	41.2	69.5	56.6	54.2	50.8	49.5	45.5
2019-11-12	11:00:00	00:30:00.0	52.5	43.5	68.2	56.8	54.8	51.7	50	46.5
2019-11-12	11:30:00	00:30:00.0	52.8	43.5	72	57	54.7	51.1	49.7	46.6

2019-11-12	12:00:00	00:30:00.0	53.1	43.3	69.5	57.8	55.7	51.5	50.1	46.5
2019-11-12	12:30:00	00:30:00.0	52.8	40.5	71.4	57.2	54.8	50.8	49.3	45.6
2019-11-12	13:00:00	00:30:00.0	51.1	38.7	69.4	55.8	53.1	49.6	47.8	43.2
2019-11-12	13:30:00	00:30:00.0	51.1	39.1	71.2	56.1	52.7	48.1	46.5	43
2019-11-12	14:00:00	00:30:00.0	50.2	36.3	68	54.8	52.1	47.8	46.2	41.8
2019-11-12	14:30:00	00:30:00.0	51.3	38.2	71	56.2	52.8	48.8	47.2	43.2
2019-11-12	15:00:00	00:30:00.0	51.2	37.2	75.4	56.2	52.2	47.5	46.2	42.2
2019-11-12	15:30:00	00:30:00.0	48.6	36.5	67.4	51.8	49	46	44.7	41.1
2019-11-12	16:00:00	00:30:00.0	50.8	38.6	71	55.5	51.7	47.2	45.7	42.1
2019-11-12	16:30:00	00:30:00.0	50.2	37.8	70.2	55.5	51.8	45.7	44.5	41.8
2019-11-12	17:00:00	00:30:00.0	50.3	40	69.2	55.2	51.5	47.7	46.6	43.6
2019-11-12	17:30:00	00:30:00.0	49.3	38.2	65	54.2	50.5	47.6	46.5	43.7
2019-11-12	18:00:00	00:30:00.0	48.7	38.6	65	53.7	49.8	47	45.8	43.2
2019-11-12	18:30:00	00:30:00.0	48.3	39	63.6	52.6	50	47.1	46	42.8
2019-11-12	19:00:00	00:30:00.0	46.7	37.3	61.7	49.8	48.3	45.7	44.7	41.6
2019-11-12	19:30:00	00:30:00.0	47.2	34.1	66.9	52	47.5	44.6	43.1	39.1
2019-11-12	20:00:00	00:30:00.0	45.2	33.2	66	47.3	46.1	43.6	42.3	38.6
2019-11-12	20:30:00	00:30:00.0	44.5	32.8	66.5	47.2	45.6	42.2	40.8	37.2
2019-11-12	21:00:00	00:30:00.0	44.2	33.3	61.8	48.7	46.3	42.6	40.8	36.7
2019-11-12	21:30:00	00:30:00.0	43.1	28.3	60.7	47.7	46.1	42.5	40.7	36
2019-11-12	22:00:00	00:30:00.0	40.7	27.6	51.2	44.8	43.7	41.2	39.8	33.3
2019-11-12	22:30:00	00:30:00.0	42.2	25.8	64.2	46.3	44.3	39.2	36.6	30.8
2019-11-12	23:00:00	00:30:00.0	39.2	24.5	57.2	43.7	42.3	38.8	36.2	29.8
2019-11-12	23:30:00	00:30:00.0	36.5	21.6	50.7	42.5	40.6	35.8	32.8	25.3
2019-11-13	00:00:00	00:30:00.0	36.7	21	51.2	43.1	41.2	35.2	31.5	24.1
2019-11-13	00:30:00	00:30:00.0	31.5	20.8	48.3	38.3	36.2	28.3	25.6	22.1
2019-11-13	01:00:00	00:30:00.0	38.2	20.1	64.7	39.3	36.8	26.8	23.8	21.1
2019-11-13	01:30:00	00:30:00.0	34.8	21.3	61.7	41.2	38.2	31.6	28.5	22.8
2019-11-13	02:00:00	00:30:00.0	37.7	22.1	55.2	43.6	41.6	36	33.1	24.5
2019-11-13	02:30:00	00:30:00.0	34.3	20.6	51.7	40.8	39	30.5	26.1	21.8
2019-11-13	03:00:00	00:30:00.0	35.6	20.6	51.1	42.5	39.8	32.7	25.6	21.6
2019-11-13	03:30:00	00:30:00.0	38.3	20.8	53.5	44.2	42.5	37.5	34.2	21.8
2019-11-13	04:00:00	00:30:00.0	37.2	21.1	56.2	43.7	41.2	33.6	30	23
2019-11-13	04:30:00	00:30:00.0	34.8	22.3	53.5	41.7	39.3	31.1	28	23.8
2019-11-13	05:00:00	00:30:00.0	38.5	23.3	57.7	43.3	41.8	38.1	35.2	26.3
2019-11-13	05:30:00	00:30:00.0	44.3	25.8	63.7	46.8	45.6	42.5	40.2	34.2
2019-11-13	06:00:00	00:30:00.0	45.1	30.6	66.9	47.1	44.8	42.1	40.7	36
2019-11-13	06:30:00	00:30:00.0	49	36.1	70.7	52.3	48.1	44.6	43.2	40
2019-11-13	07:00:00	00:30:00.0	51.2	36.7	70.2	55.6	51.3	45.8	44.6	41.2
2019-11-13	07:30:00	00:30:00.0	50.7	39.2	68.2	55.7	50.7	46.2	45.2	42.3
2019-11-13	08:00:00	00:30:00.0	51.7	39.8	71.2	57.2	51.8	47.3	46.3	43.3
2019-11-13	08:30:00	00:30:00.0	50.2	41	70.5	53.2	50.2	47.1	46.1	43.6
2019-11-13	09:00:00	00:30:00.0	50.6	38	70.2	54.7	50.1	45.8	44.7	42.1
2019-11-13	09:30:00	00:30:00.0	50.8	37.1	68	56.2	51.6	46.2	44.7	41.2
2019-11-13	10:00:00	00:30:00.0	50.5	34.3	70.9	55.2	51.1	44.7	43	39.5
2019-11-13	10:30:00	00:30:00.0	49.7	35	70.2	54	49.8	44.7	43.3	39.8
2019-11-13	11:00:00	00:30:00.0	51.1	33.1	70.7	54.8	50.7	46.8	45.2	40.1
2019-11-13	11:30:00	00:21:49.0	49.8	40.2	68.9	55	51.2	45.7	44.6	42.2

Table 2								Locn	NSL2	
Date	Time	Duration	LAeq	LAFmin	LAFmax	LAF5	LAF10	LAF33	LAF50	LAF90
2019-11-11	12:02:13	00:27:46.4	53.5	37.4	78.5	60.8	55.3	47.0	45.4	41.9
2019-11-11	12:30:00	00:30:00.0	49.7	37.1	68.5	53.8	49.3	45.5	44.4	40.7
2019-11-11	13:00:00	00:30:00.0	51.1	37.5	72.5	53.7	48.9	45.7	44.5	40.8
2019-11-11	13:30:00	00:30:00.0	52.9	36.7	74.3	59.2	52.9	45.8	44.2	40.6
2019-11-11	14:00:00	00:30:00.0	52.3	37.5	72.9	57.4	51.5	46.2	44.9	41.7
2019-11-11	14:30:00	00:30:00.0	51.0	38.4	69.3	54.9	50.9	46.9	45.6	42.7
2019-11-11	15:00:00	00:30:00.0	52.6	38.2	70.7	59.0	52.9	47.4	46.1	42.9
2019-11-11	15:30:00	00:30:00.0	52.1	38.9	70.6	56.8	51.7	47.2	46.0	43.2
2019-11-11	16:00:00	00:30:00.0	53.7	38.5	79.7	57.9	51.1	46.0	44.7	41.8
2019-11-11	16:30:00	00:30:00.0	52.7	38.1	70.0	59.6	52.7	45.8	44.6	41.9
2019-11-11	17:00:00	00:30:00.0	50.8	37.9	68.0	57.4	51.3	45.5	44.4	41.2
2019-11-11	17:30:00	00:30:00.0	49.3	38.4	69.0	53.9	48.3	44.5	43.4	41.2
2019-11-11	18:00:00	00:30:00.0	47.4	37.2	68.5	48.4	45.6	42.9	42.0	39.6
2019-11-11	18:30:00	00:30:00.0	46.5	31.7	68.0	47.7	45.4	42.7	41.7	39.1
2019-11-11	19:00:00	00:30:00.0	45.4	34.1	67.1	46.6	44.6	42.1	41.0	38.2
2019-11-11	19:30:00	00:30:00.0	46.5	32.0	68.3	46.8	44.8	41.5	40.3	37.0
2019-11-11	20:00:00	00:30:00.0	47.0	33.8	66.8	49.8	46.1	42.5	41.2	37.5
2019-11-11	20:30:00	00:30:00.0	46.4	33.1	67.9	47.5	45.2	41.6	40.1	36.7
2019-11-11	21:00:00	00:30:00.0	44.6	33.2	66.6	45.9	44.1	41.2	39.6	36.4
2019-11-11	21:30:00	00:30:00.0	43.9	31.1	67.4	45.5	43.6	40.3	38.7	35.0
2019-11-11	22:00:00	00:30:00.0	38.9	30.0	51.8	42.8	41.9	39.3	37.6	33.0
2019-11-11	22:30:00	00:30:00.0	37.5	27.1	54.0	42.2	40.6	37.0	35.8	31.6
2019-11-11	23:00:00	00:30:00.0	41.8	31.9	65.8	44.1	42.5	38.7	37.4	35.0
2019-11-11	23:30:00	00:30:00.0	39.4	29.5	62.8	41.6	40.2	37.2	35.6	32.2
2019-11-12	00:00:00	00:30:00.0	34.7	25.6	50.3	39.6	37.9	34.5	32.8	28.4
2019-11-12	00:30:00	00:30:00.0	32.6	25.1	47.2	37.5	36.1	32.0	30.3	26.9
2019-11-12	01:00:00	00:30:00.0	40.8	25.1	69.1	39.9	38.1	34.2	31.6	27.2
2019-11-12	01:30:00	00:30:00.0	36.4	26.3	55.0	40.8	39.3	36.3	34.4	30.2
2019-11-12	02:00:00	00:30:00.0	36.9	27.2	51.4	42.7	40.9	36.0	33.4	30.2
2019-11-12	02:30:00	00:30:00.0	39.9	27.1	67.5	42.3	40.0	36.1	34.0	30.0
2019-11-12	03:00:00	00:30:00.0	38.2	28.1	53.2	43.7	41.5	37.3	35.8	31.1
2019-11-12	03:30:00	00:30:00.0	37.3	25.2	51.2	42.3	40.9	37.1	34.9	28.6
2019-11-12	04:00:00	00:30:00.0	39.1	30.1	51.4	44.2	42.6	38.5	36.9	32.8
2019-11-12	04:30:00	00:30:00.0	38.2	28.1	50.8	43.1	42.0	37.9	36.2	31.2
2019-11-12	05:00:00	00:30:00.0	40.5	29.2	58.0	45.5	43.7	39.8	38.0	33.7
2019-11-12	05:30:00	00:30:00.0	45.6	34.2	69.6	47.6	45.7	41.8	40.5	37.4
2019-11-12	06:00:00	00:30:00.0	47.1	32.3	67.8	49.3	46.0	42.6	41.2	37.5
2019-11-12	06:30:00	00:30:00.0	50.3	34.4	69.9	53.4	47.5	43.5	42.3	38.6
2019-11-12	07:00:00	00:30:00.0	51.7	37.0	71.7	56.4	51.0	45.7	44.4	41.3
2019-11-12	07:30:00	00:30:00.0	54.1	39.4	72.1	61.6	55.6	48.2	46.8	43.6
2019-11-12	08:00:00	00:30:00.0	51.8	40.3	70.1	56.4	51.6	47.7	46.6	43.9
2019-11-12	08:30:00	00:30:00.0	53.1	40.7	71.0	59.8	53.1	47.7	46.6	43.9
2019-11-12	09:00:00	00:30:00.0	51.2	38.8	70.0	57.0	51.4	46.8	45.7	42.9
2019-11-12	09:30:00	00:30:00.0	51.7	40.4	70.0	56.9	52.7	48.0	46.4	43.4
2019-11-12	10:00:00	00:30:00.0	52.1	40.1	70.7	57.1	52.2	47.0	45.7	43.3
2019-11-12	10:30:00	00:30:00.0	51.9	41.2	70.0	56.3	52.9	48.9	47.5	44.6
2019-11-12	11:00:00	00:30:00.0	52.3	42.2	69.4	56.7	53.5	49.8	48.3	45.0
2019-11-12	11:30:00	00:30:00.0	53.1	41.4	73.3	58.2	53.8	49.2	47.7	44.5
2019-11-12	12:00:00	00:30:00.0	53.0	40.0	69.0	59.3	55.9	49.6	47.8	44.5
2019-11-12	12:30:00	00:30:00.0	52.4	40.3	70.6	57.2	53.0	48.2	46.6	43.5

2019-11-12	13:00:00	00:30:00.0	51.0	37.9	69.2	56.2	51.9	46.5	45.0	41.3
2019-11-12	13:30:00	00:30:00.0	51.9	35.8	70.8	57.3	52.7	45.8	44.1	40.4
2019-11-12	14:00:00	00:30:00.0	51.4	36.3	70.4	56.4	51.5	45.1	43.3	39.8
2019-11-12	14:30:00	00:30:00.0	52.1	36.8	70.5	57.9	52.3	46.0	44.5	40.8
2019-11-12	15:00:00	00:30:00.0	51.7	34.9	70.6	57.0	51.6	44.6	42.7	39.3
2019-11-12	15:30:00	00:30:00.0	48.6	35.4	68.6	50.6	47.0	42.3	41.1	38.3
2019-11-12	16:00:00	00:30:00.0	51.2	35.4	69.2	56.0	49.7	43.6	42.3	39.2
2019-11-12	16:30:00	00:30:00.0	51.7	36.1	72.3	57.6	51.3	44.2	42.8	39.9
2019-11-12	17:00:00	00:30:00.0	50.7	36.6	68.4	56.5	50.3	44.1	43.0	40.4
2019-11-12	17:30:00	00:30:00.0	48.8	37.4	65.8	53.1	48.4	44.4	43.5	40.8
2019-11-12	18:00:00	00:30:00.0	49.1	36.9	67.9	53.4	47.8	43.8	42.7	40.0
2019-11-12	18:30:00	00:30:00.0	47.3	37.2	66.5	50.0	47.0	43.5	42.4	40.0
2019-11-12	19:00:00	00:30:00.0	46.1	34.5	66.4	47.9	45.6	42.6	41.4	38.6
2019-11-12	19:30:00	00:30:00.0	46.7	33.0	68.9	49.0	45.3	41.5	40.3	36.8
2019-11-12	20:00:00	00:30:00.0	46.4	32.9	69.7	46.1	43.5	40.5	39.2	36.4
2019-11-12	20:30:00	00:30:00.0	42.0	31.2	65.7	44.3	42.0	39.1	38.0	34.6
2019-11-12	21:00:00	00:30:00.0	42.5	30.1	66.4	44.6	42.6	39.5	37.9	34.1
2019-11-12	21:30:00	00:30:00.0	41.1	27.5	63.5	44.4	42.6	39.0	37.7	34.2
2019-11-12	22:00:00	00:30:00.0	38.7	26.6	61.0	41.4	40.2	37.9	36.8	31.9
2019-11-12	22:30:00	00:30:00.0	41.0	24.3	67.4	42.4	40.7	36.2	34.4	29.6
2019-11-12	23:00:00	00:30:00.0	36.8	22.6	58.0	40.7	39.3	35.8	33.5	28.3
2019-11-12	23:30:00	00:30:00.0	33.6	20.2	46.1	39.1	37.3	33.1	31.0	24.0
2019-11-13	00:00:00	00:30:00.0	32.9	19.0	48.1	38.2	36.8	32.4	29.6	22.9
2019-11-13	00:30:00	00:30:00.0	28.7	18.7	46.8	34.4	32.5	27.1	24.8	20.3
2019-11-13	01:00:00	00:30:00.0	38.4	17.8	67.4	37.4	34.2	26.2	23.3	19.5
2019-11-13	01:30:00	00:30:00.0	31.6	20.0	50.2	37.4	35.2	30.0	27.8	22.1
2019-11-13	02:00:00	00:30:00.0	35.2	20.7	51.7	40.6	39.0	34.8	31.7	23.8
2019-11-13	02:30:00	00:30:00.0	32.1	19.0	48.5	38.2	36.1	28.7	24.2	20.4
2019-11-13	03:00:00	00:30:00.0	32.2	18.9	47.2	38.6	36.6	30.2	24.6	20.2
2019-11-13	03:30:00	00:30:00.0	35.9	19.1	52.6	42.0	39.7	34.7	30.9	20.2
2019-11-13	04:00:00	00:30:00.0	35.4	19.4	54.2	42.0	38.2	30.9	27.4	21.4
2019-11-13	04:30:00	00:30:00.0	32.6	20.6	52.0	38.6	35.7	29.6	26.8	22.7
2019-11-13	05:00:00	00:30:00.0	37.3	21.8	63.3	40.7	38.8	34.6	32.1	25.3
2019-11-13	05:30:00	00:30:00.0	43.8	25.0	68.2	44.4	42.7	38.8	36.8	30.8
2019-11-13	06:00:00	00:30:00.0	46.1	29.4	68.9	45.9	43.6	40.7	39.5	33.7
2019-11-13	06:30:00	00:30:00.0	49.8	34.2	69.6	52.1	46.2	42.9	41.8	38.6
2019-11-13	07:00:00	00:30:00.0	52.4	35.3	71.6	57.9	49.5	43.4	42.2	39.0
2019-11-13	07:30:00	00:30:00.0	52.2	37.5	70.7	59.1	51.3	44.2	42.9	40.3
2019-11-13	08:00:00	00:30:00.0	54.1	37.1	78.8	60.4	52.9	44.9	43.4	40.6
2019-11-13	08:30:00	00:30:00.0	50.7	37.6	71.4	54.8	47.9	43.4	42.5	40.4
2019-11-13	09:00:00	00:30:00.0	51.2	36.3	70.6	55.3	48.9	42.8	41.8	39.5
2019-11-13	09:30:00	00:30:00.0	52.4	34.6	70.9	59.0	52.1	43.8	41.9	38.6
2019-11-13	10:00:00	00:30:00.0	52.3	34.3	73.0	58.5	51.4	42.6	40.7	37.8
2019-11-13	10:30:00	00:30:00.0	52.4	34.8	70.5	60.3	54.6	43.0	41.3	38.2
2019-11-13	11:00:00	00:30:00.0	54.4	34.3	70.5	62.1	58.3	46.4	44.6	38.9
2019-11-13	11:30:00	00:21:49.0	52.7	39.4	72.4	59.1	51.6	45.0	43.6	41.3

Appendix 10.3: Barrier Effect Calculation.

Appendix 11.3: Calculations of barrier effects

Sketches not to scale

The source is taken as 2m height denoted by s. R is receptor and the berm/barrier effect is calculated by the *path difference*= *a+b-c*

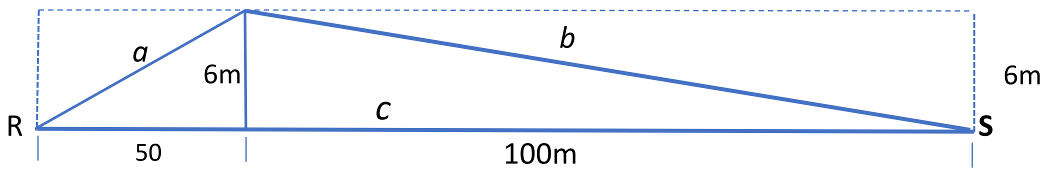
Berm is 6m height and the nearest receptor NSL1 is approx. 2m below the level of extraction. The source is taken as 2m above pit base (level of extraction).

Path difference of 0.54m = 13.4dB when the barrier is from 50m receptor and 100m from source

Path difference of 2m = in excess of 18.4dB when the barrier is 50m from receptor and 10m from the source at nearest point of excavation.

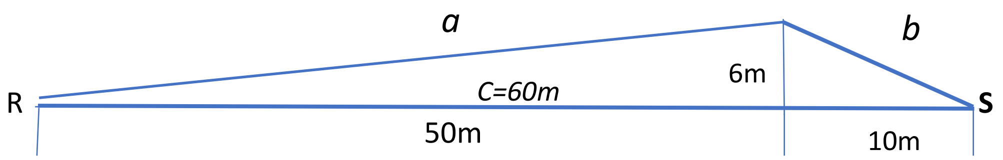
When a noise source is invisible from a receptor by an earth berm/barrier then 10dBA can be assumed without calculation.

Figure 1: **Example given below of *path difference* of 0.54m when source is 100m from earth berm**



NB When the path difference is 0.54m then 13.4 dBA is barrier/berm effect attenuation. The distance of receptor to source is 150 m and distance from berm to source is 100m.

Figure 2: Example given below of *path difference* of 5.72m when source is 10m from earth berm



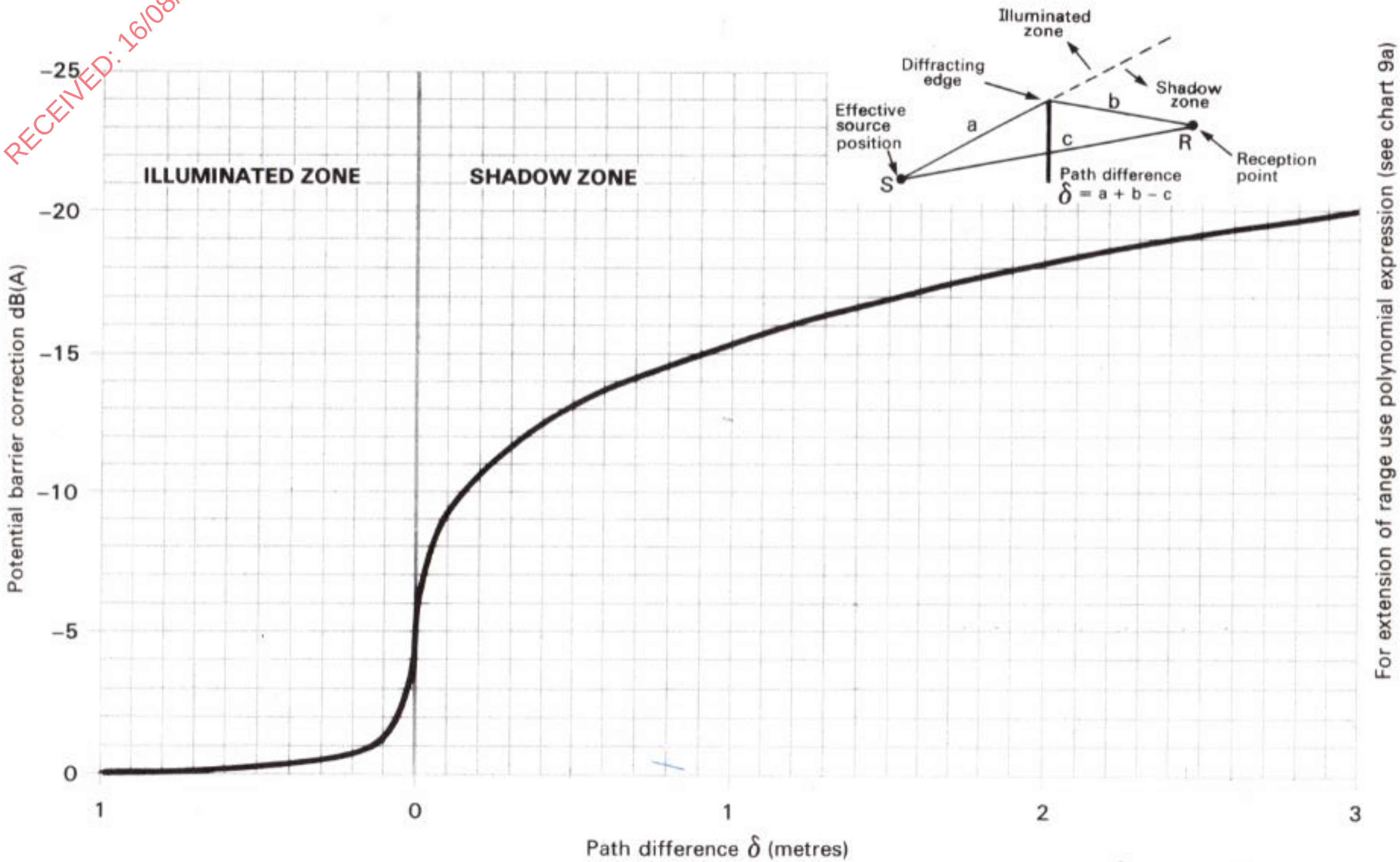
NB When the path difference is 5.72m then barrier/berm effect attenuation is greater than 18.4 dBA. The distance from receptor to source is 60 m and distance of berm to source is 10m. This is approximately the distance of the near receptor NSL1 to the nearest point of operation in Phase 1.

When the path difference is in excess of 2m then the berm attenuation provided is in excess of 18.2 dBA.

The closer a berm/barrier is to either the source or receptor means the attenuation provided is at its maximum. The higher the path difference the greater the attenuation.

See following two pages 'Chart 9b Potential barrier correction'.

Chart 9 POTENTIAL BARRIER CORRECTION AS A FUNCTION OF PATH DIFFERENCE δ



(See next page for functional form)

Chart 9b Potential barrier correction A* dB(A) for path differences (δ = i + j) calculated to the nearest 0.01 metres.**

j	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
i	*SHADOW ZONE*									
0.0	5.0	6.4	7.1	7.6	7.9	8.2	8.5	8.7	9.0	9.2
0.1	9.3	9.5	9.7	9.8	10.0	10.1	10.3	10.4	10.5	10.6
0.2	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7
0.3	11.7	11.8	11.9	12.0	12.1	12.1	12.2	12.3	12.4	12.4
0.4	12.5	12.6	12.6	12.7	12.8	12.8	12.9	13.0	13.0	13.1
0.5	13.1	13.2	13.3	13.3	13.4	13.4	13.5	13.5	13.6	13.6
0.6	13.7	13.7	13.8	13.8	13.9	13.9	14.0	14.0	14.1	14.1
0.7	14.2	14.2	14.3	14.3	14.4	14.4	14.5	14.5	14.5	14.6
0.8	14.6	14.7	14.7	14.7	14.8	14.8	14.9	14.9	14.9	15.0
0.9	15.0	15.1	15.1	15.1	15.2	15.2	15.3	15.3	15.3	15.4
1.0	15.4	15.4	15.5	15.5	15.5	15.6	15.6	15.6	15.7	15.7
1.1	15.7	15.8	15.8	15.8	15.9	15.9	15.9	16.0	16.0	16.0
1.2	16.1	16.1	16.1	16.2	16.2	16.2	16.3	16.3	16.3	16.3
1.3	16.4	16.4	16.4	16.5	16.5	16.5	16.6	16.6	16.6	16.6
1.4	16.7	16.7	16.7	16.8	16.8	16.8	16.8	16.9	16.9	16.9
1.5	16.9	17.0	17.0	17.0	17.1	17.1	17.1	17.1	17.2	17.2
1.6	17.2	17.2	17.3	17.3	17.3	17.3	17.4	17.4	17.4	17.4
1.7	17.5	17.5	17.5	17.5	17.6	17.6	17.6	17.6	17.7	17.7
1.8	17.7	17.7	17.8	17.8	17.8	17.8	17.8	17.9	17.9	17.9
1.9	17.9	18.0	18.0	18.0	18.0	18.1	18.1	18.1	18.1	18.1
2.0	18.2	18.2	18.2	18.2	18.3	18.3	18.3	18.3	18.3	18.4
	ILLUMINATED ZONE									
0.0	5.0	3.5	2.8	2.3	2.0	1.8	1.6	1.5	1.3	1.2
0.1	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6
0.2	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.3
0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2
0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

* Values of A are negative

** e.g. where the reception point is in the shadow zone and δ = 1.45 metres:
then i = 1.4 and j = 0.05
from the table the value of A is − 16.8 dB(A).

Appendix 10.4: Copy of Calibration Certificates.

Appendix 10.4: Copy of Calibration certifaces

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01624 876 410

CERTIFICATE OF CALIBRATION

Issued by: **MTS Calibration Ltd**

Approved Signatory:

Tony Sherris

Date of Issue: **24 January 2019** **Certificate Number:** **32818**

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements on behalf of Brendan O'Reilly
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0004643

10

Associated Equipment	Make	Model	Serial number
Preamplifier	PCB	PRMLxT1L	042742
Microphone	PCB	377B02	173111
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	by MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	Only one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	
Additional tests performed				
Microphone		32820		See additional certificate
Filter, third octave or octave		32818F		See additional certificate

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013

MTS Calibration

MTS Calibration Ltd,
The Grange Business Centre,
Belasis Avenue,
Billingham TS23 1LG,
England
Telephone: 01624 876 410

CERTIFICATE OF CALIBRATION

Approved Signatory:

Tony Sherris

Issued by: MTS Calibration Ltd

Date of Issue: 25 January 2019 **Certificate Number:** 32815

Sound Level Meter

Sound Level Meter Periodic Tests to EN 61672-3: 2013 Class 1

Client: Environmental Measurements on behalf of Brendan O'Reilly
Unit 12, Tallaght Business Centre
Whitestown Business Park
Co.Dublin 24, Ireland

Instrument Make: Larson Davis
Instrument Model: LxT1L
Serial Number: 0004647

9

Associated Equipment	Make	Model	Serial number
Preamplifier	PCB	PRMLxT1L	042725
Microphone	PCB	377B02	171552
Calibrator	Larson Davis	CAL200	9175
Calibrator supplied by	by MTS for this calibration		

Test results summary, detailed results are shown on subsequent pages.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 Class 1

Tests performed	Section	Results of test	Page	Comments
Calibration Certificate	22		1	
Additional information			2	
Indication with Calibrator Supplied	10	No Limit	3	
Self-Generated Noise	11	No Limit	3	
Frequency and Time-weightings at 1kHz	14	Complies	3	
Long term stability	15	Complies	3	
High stability	21	Complies	3	
Acoustic Tests	12	Complies	4	
Frequency Weighting A	13	Complies	5	
Frequency Weighting C	13	Complies	6	
Frequency Weighting Z	13	Complies	7	
Level Linearity	16	Complies	8	
Level Linearity Range Control	17		n/a	Only one range
Tone-burst Response	18	Complies	9	
Peak C sound level	19	Complies	10	
Overload indication	20	Complies	11	
Additional tests performed				
Microphone		32817		See additional certificate
Filter, third octave or octave		32815F		See additional certificate

The instrument was within the above specification as received - no modifications were made

The sound level meter submitted for testing has successfully completed the periodic tests of IEC 61672-3: 2013 for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2: 2013, to demonstrate that the model of sound level meter fully conformed to the Class 1 specifications in IEC 61672-1: 2013, the sound level meter submitted for testing conforms to the Class 1 specifications of IEC 61672-1: 2013