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1 Introduction

1.1.1 This document has been prepared in response to representations received with regard to the planning application for the proposed extraction of sand and gravel with low level restoration to meadow species rich grassland with an ephemeral water body at land off Crab Apple Lane, Haddiscoe, Norfolk, NR14 6SJ (Application No. FUL/2022/0056).

1.1.2 This document provides a response to matters raised by Haddiscoe Parish Council in a letter dated 18th December 2023, which includes a report undertaken by Michael Bull and Associates that reviews the air quality assessment from the Environmental Statement (ES) submitted in support of the planning application, and comments from Richard Buxton Solicitors.

1.1.3 The Michael Bull and Associates report is considered first, as Haddiscoe Parish Council and Richard Buxton Solicitors rely on the information in that report. Any further matters that need clarification with regards representations from Haddiscoe Parish Council and Richard Buxton Solicitors are then addressed.

2 Michael Bull and Associates Report

2.1. Introduction

2.1.1 This section considers matters raised in the report by Michael Bull and Associates. It sets out responses under the same headings as those used in the Michael Bull and Associates report in order to aid cross referencing.

2.2. Dust Assessment – Background, Guidance and Policy

2.2.1 The planning application for the proposed development was validated on 7th December 2022 and supporting documentation, including the ES, were uploaded to the Norfolk planning portal on 19th December 2022.

2.2.2 The Environment Act 2021 requires the government to set at least one long-term air-quality target, as well as a target for fine particulate matter ($PM_{2.5}$). New air quality targets were not implemented until the publication of the Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 and the updated Air Quality Strategy for England, published in April 2023, both of which occurred after the submission of the planning application.

2.2.3 The Air Quality Strategy also describes the system of Local Air Quality Management (LAQM), which was introduced in Part IV of the Environment Act 1995. LAQM requires every local authority to carry out regular review and assessments of air quality in its area and to assess concentrations against air quality objectives, which for PM_{10}, are the same numerically as the limit values set out below. Where an objective has not been, or is unlikely to be achieved, the local authority must declare an Air Quality Management Area (AQMA) and prepare an action plan which sets out appropriate measures to be introduced in pursuit of the objectives. $PM_{2.5}$ is not included in the LAQM framework; however, the government expects all local authorities to effectively use their powers to reduce $PM_{2.5}$ emissions from the sources which are within their control.

2.2.4 The Air Quality Standards Regulations 2010 (as amended) set legally binding limit values for concentrations of major air pollutants in outdoor air that impact public health, including fine particulate matter (PM_{10} and $PM_{2.5}$). The Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 set out two new legally binding targets for $PM_{2.5}$, with interim targets for each set out in the Environmental Improvement Plan 2023. The Air Quality Limit Values are shown in **Table 1** and the $PM_{2.5}$ targets are:

- 10µg/m^3 annual mean concentration $PM_{2.5}$ nationwide by 2040, with an interim target of 12µg/m^3 by January 2028; and
- 35% reduction in average population exposure by 2040, with an interim target of a 22% reduction by January 2028, both compared to a 2018 baseline.

Table 1: The Air Quality Limit Values for NO_2 and PM_{10} and the $PM_{2.5}$

Pollutant	Concentration Measured As	Limit Values
PM_{10}	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3
$PM_{2.5}$	Annual Mean	20 µg/m^3

2.2.5 Michael Bull and Associates state that:

"The focus of particulate matter regulation in England has therefore shifted from PM_{10} to $PM_{2.5}$ (no PM_{10} targets have been set) and as a minimum, the appropriate criterion should be 12µg/m^3 as an annual mean."

2.2.6 This statement is misleading. The government does not need to meet the new legally binding targets for $PM_{2.5}$ until 2040, with the interim targets used as a measure of the progress the government expects to make by 2028 towards meeting the 2040 targets. The $PM_{2.5}$ targets have made no difference to the assessment method with regards the health effects due to PM_{10} emissions from quarrying operations.

2.2.7 Health effects from dust are due to the inhalation of fine particulate matter. Fine particulate matter is everything in the air that is not a gas and consists of a variety of chemical compounds and materials. Fine particulate matter is everywhere and can come from a wide range of natural sources such as pollen, sea spray and wind blown desert dust as well as human sources such as smoke from domestic heating, agriculture, transport (including tyre and brake wear), and a wide variety of emissions from industry. The UK government is currently focused on measuring the fractions of fine particulate matter known as PM_{10} and $PM_{2.5}$ based on the latest evidence on the effects of fine particulate matter on health. PM_{10} are particles smaller than 10µm in diameter that can be inhaled into the lungs and are associated with a range of health effects. $PM_{2.5}$ are particles smaller than 2.5µm and make up a fraction of PM_{10}. PM_{10} particles emitted as part of dust from a quarry would mostly be in the coarse range, i.e., larger than $PM_{2.5}$; therefore, PM_{10} is the focus when assessing the potential health impacts due to quarry operations.

2.2.8 The 2040 $PM_{2.5}$ target values are a national target that the government must achieve. Local authorities are expected to effectively use their powers to reduce $PM_{2.5}$ emissions from local sources which are within their control; however, $PM_{2.5}$ is not included in LAQM as it is a regional pollutant, and PM_{10} remains the focus for local authorities with regards particulate pollution.

2.2.9 The use of the PM_{10} air quality objectives as a threshold for the assessment of health impacts from quarry operations is established in the Minerals national Planning Practice Guidance (nPPG). No changes have been made to the Minerals nPPG following the publication of the new target values for $PM_{2.5}$ as PM_{10} concentrations are the relevant metric. The Minerals nPPG states that:

"Operators should follow the assessment framework for considering the impacts of PM_{10} from a proposed site." [1]

2.2.10 The assessment framework is a site assessment flow chart, reproduced at **Figure 2**[2]. The assessment framework is clear that, where PM_{10} concentrations are not likely to exceed the air quality objectives, good practice measures should be sufficient, without the need for monitoring and specific controls on PM_{10} emissions.

2.2.11 Michael Bull and Associates also mention the World Health Organisation (WHO) air quality guidelines. The WHO guidelines provide a target for the worlds governments to work towards to improve air quality. The WHO guidelines are not air quality standards or legally binding recommendations; they provide WHO Member States with an evidence-informed tool that they can use to inform legislation and policy. The WHO guidelines are targets for national, regional and city governments to work towards improving air quality and should be used in different ways depending on technical capabilities, economic capacity, air quality management policies and other political and social factors. The WHO guidelines recognise that it is not possible to immediately achieve the guideline values and includes interim targets that are higher than the guideline levels, but which authorities in highly polluted areas can use to develop pollution reduction policies that are achievable within realistic time frames. The UK annual mean objectives/limit values for PM_{10} and $PM_{2.5}$ are lower than the WHO interim target 2 values of 50µg/m^3 and 25µg/m^3 respectively. The UK $PM_{2.5}$ annual mean interim target value is lower than the WHO interim target 3 value and the UK $PM_{2.5}$ annual mean target value is at the WHO interim target 4 value. Therefore, the UK government has taken steps to improve air quality and work towards the WHO air quality guideline values.

[1] Paragraph: 030 Reference ID: 27-030-20140306, Revision date: 06 03 2014
[2] Paragraph: 032 Reference ID: 27-032-20140306, Revision date: 06 03 2014

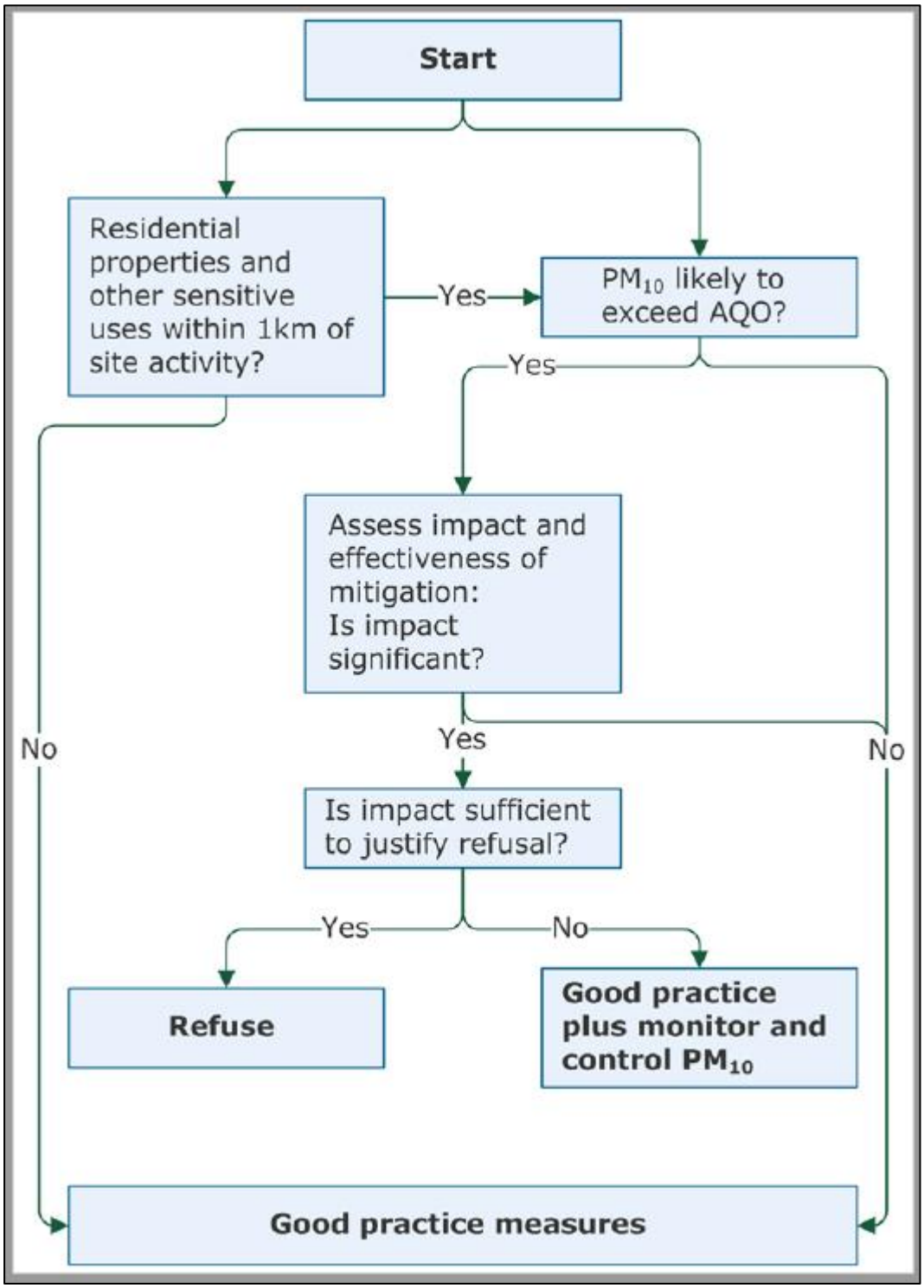

Figure 2: nPPG PM_{10} Assessment Framework

2.3. Review of Dust Assessment

Methodology

2.3.1 It should be noted that there are two separate elements to the air quality assessment, the impact on amenity due to visible dust deposition and the health impacts from PM_{10} emissions due to dust generating activities.

2.3.2 The use of the source-pathway-receptor (S-P-R) risk assessment approach from the Institute of Air Quality Management (IAQM)[3] minerals dust guidance is the appropriate method to use for the assessment of visible dust (IAQM, 2016). Computer modelling *can* be used to predict dust dispersion, but the opinion of the IAQM is that it shouldn't. The IAQM state:

"It[4] recognises that both qualitative and quantitative assessment approaches have their uses, noting that, "Computer modelling techniques can be used to understand how dust could disperse from a site. Alternatively, a more qualitative approach, relying on professional judgment, could be used...". Detailed dispersion modelling of dust impacts from minerals sites in the UK is extremely rare and is not generally recommended by the IAQM given the lack of accurate UK emissions data for this sector."

2.3.3 The IAQM further state:

"The collective view of the IAQM Working Group is that it is currently inappropriate to use a quantitative modelling approach to predict the impact in most cases and a qualitative risk-based approach using the S-P-R concept should usually suffice. This is primarily due to a lack of UK derived emission factors for minerals sites that could be used for modelling."

2.3.4 With regard to dust emissions, the Local Air Quality Management Technical Guidance published by Defra to support local authorities in carrying out their duties under LAQM states that (Defra, 2022):

"Emissions from these sources [dust emissions sources] *are not well quantified, and it is therefore difficult to predict PM_{10} concentrations with any accuracy."*

2.3.5 Comments made by Michael Bull and Associates with regards PM_{10}/$PM_{2.5}$ and the visible dust risk assessment are not relevant as the S-P-R approach is used to assess the impacts due to visible dust deposition only.

2.3.6 The approach to screening health risks relating to PM_{10} (of which $PM_{2.5}$ is a fraction) from minerals sites, set out in the IAQM minerals guidance and used in the Air Quality Chapter of the ES, is based on data provided in Appendix 2 of the IAQM minerals guidance. The screening approach is that there is little risk that a process contribution from a minerals site dust source would lead to an exceedance of the objectives where background ambient PM_{10} concentrations are below 17µg/m^3. The 17µg/m^3 screening threshold is conservative as it is used for screening impacts from all minerals sites, including those with higher dust emission potential, such as clay quarries and hard rock quarries using blasting, and assumes that there could be a process

[3] The IAQM is the professional body for air quality professionals https://iaqm.co.uk.
[4] The Minerals nPPG.

contribution of up to 15µg/m^3. The IAQM approach has been endorsed in a recent Appeal Decision from 2023 Appeal Ref: APP/E1855/W/22/3310099 for a sand and gravel quarry with progressive restoration using site derived and imported inert material. The Planning Inspector found that no further consideration of PM_{10} impacts from the proposed development was required as Defra background concentrations were below the 17µg/m^3 screening threshold. A quote from the Planning Inspector in that case is provided below:

"The IAQM Guidance on mineral dust advises that where the long-term background PM_{10} concentration is less than 17µg/m^3 there is little risk that additional contributions from a mineral site would lead to an exceedance of the annual mean air quality objective. The guidance advises that if this is the case then no further consideration is typically required. As noted above the Defra data predicts annual mean background concentrations of 11.18-12.01 µg/m^3 in the locality, i.e. well below the recommended screening value of 17 µg/m^3. On this basis, I accept that no further consideration of potential PM_{10} impacts from the proposed development would be required."

2.3.7 The IAQM approach has also been endorsed in another recent Appeal Decision from 2023 Appeal Ref: APP/T1600/W/23/3324695 for another sand and gravel quarry with restoration using inert material. A quote from the Planning Inspector in that case is provided below:

"The average background PM_{10} concentration for the grid squares in which the proposed site is located was estimated as 12.75µg/m^3 in 2019 and 12.5 µg/m^3 in 2021. This is well below the 17µg/m^3 threshold. On this basis, PM_{10} levels from the site would not be likely to exceed the relevant air quality objective. Consequently, in accordance with the PPG advice, good practice measures would suffice."

2.3.8 The IAQM minerals guidance also includes examples of planning appeal decisions where planning inspectors have based decisions on PM_{10} concentrations being below the air quality objectives.

2.3.9 Defra annual mean background PM_{10} concentrations within the area that may be affected by PM_{10} emissions from operations at the proposed quarry are set out in the Air Quality ES chapter and are 13.0-15.2µg/m^3 in 2022, with concentrations decreasing into the future. As the maximum PM_{10} concentration is below 17µg/m^3 the proposed development will have an insignificant effect on health due to emissions of PM_{10} from the quarrying operations.

2.3.10 PM_{10} particles emitted as part of dust from a quarry would mostly be in the coarse range, i.e., larger than $PM_{2.5}$; therefore, PM_{10} is the focus when assessing the potential health impacts due to quarry operations. However, to provide another level of certainty with regard to the potential health effects of the proposed quarry, the potential impact on $PM_{2.5}$ concentrations has been considered further.

2.3.11 The $PM_{2.5}$ target value is a national target which is not legally binding until 2040. The government will measure progress towards the 2040 target using the 2028 interim target of 12µg/m^3. It is the UK government's responsibility to achieve the targets; however, local authorities are encouraged to support delivery of the targets by taking action to reduce emissions from sources within their control. Achievement of the target values is determined by measurement at Automatic Urban and Rural Network

(AURN) monitoring sites operated on behalf of Defra. Achievement or failure to meet the targets can only be determined based on the results of the AURN monitoring.

2.3.12 An assessment of whether the proposed development would hinder the governments progress towards meeting the $PM_{2.5}$ target values can be undertaken by comparing an estimate of $PM_{2.5}$ concentrations at receptors close to the application site with the target values.

2.3.13 IAQM Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2024) suggest that, for construction as a whole, the $PM_{2.5}$ content of PM_{10} should be assumed to be 10%. The $PM_{2.5}$ content of PM_{10} from minerals sites is likely to be similar to that from a construction site overall, and less at a sand and gravel site, where the dust is coarse and there are no cementitious sources.

2.3.14 Evidence of PM_{10} concentrations close to UK quarries has been collated by the IAQM Minerals Guidance Working Group in Appendix 2 of Guidance on the Assessment of Mineral Dust Impacts for Planning. The IAQM minerals guidance includes graphs showing the fall-off in PM_{10} concentrations with distance from the source at mineral sites. A graph (Table A2-6 in the IAQM Guidance) showing the mineral site PM_{10} increment as a function of distance from quarry operations by mineral type has been reproduced in **Figure 1** below. **Figure 1** shows that sand and gravel quarries are unlikely to increase PM_{10} concentrations by more than 1µg/m^3 (almost zero) at distances of around 50m, 150m and 400m from quarry operations.

2.3.15 Appendix 5 of the IAQM Minerals Guidance also provides a range of other information sources that can be used to estimate a PM_{10} process contribution from a minerals site in the UK. The annual mean PM_{10} process contributions from the proposed development estimated using these sources would be in a range from 2-5µg/m^3.

2.3.16 Therefore, a very conservative maximum process contribution to $PM_{2.5}$ concentrations due to the proposed development can be estimated as 10% of 5µg/m^3, i.e., 0.5µg/m^3. Using Defra background maps, annual mean $PM_{2.5}$ concentrations within the area that may be affected by particulate emissions from operations at the proposed development are predicted to be 7.9-8.4µg/m^3 in 2024. Adding the background $PM_{2.5}$ concentration to the estimated maximum process contribution gives an annual mean of 8.9µg/m^3, well below the 12 µg/m^3 2028 interim target value, and the 10µg/m^3 2040 target value. Therefore, even assuming a very conservative process contribution to $PM_{2.5}$ concentrations, the proposed development would not hinder progress towards the $PM_{2.5}$ target values.

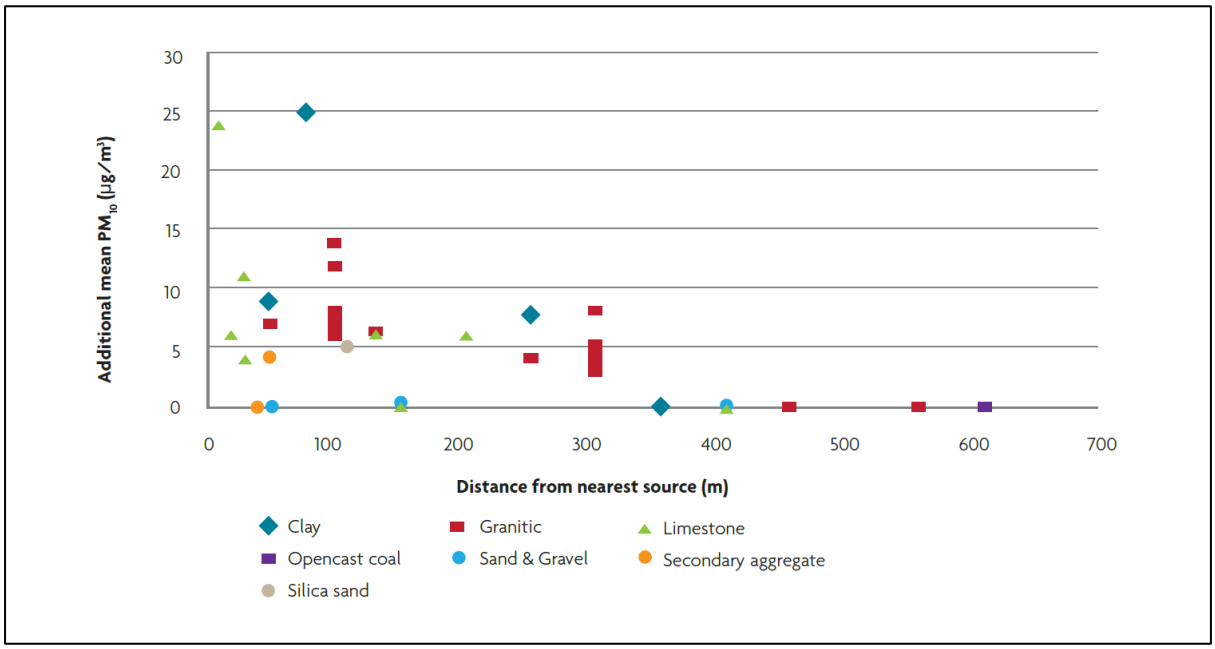

Figure 1: Mineral Site PM_{10} Increment as a Function of Distance from Quarry Operations by Mineral Type

Baseline Particulate Matter Concentrations

2.3.17 As described above PM_{10} is the focus when assessing the potential health impacts due to quarry operations and $PM_{2.5}$, a fraction of PM_{10}, does not need to be considered in isolation when considering dust from a sand and gravel quarry. However, baseline annual mean $PM_{2.5}$ concentrations within the area that may be affected by particulate emissions from operations at the proposed development are predicted to be 7.9-8.4µg/m^3 in 2024, using the Defra background maps.

2.3.18 Michael Bull and Associates compare background concentrations against the World Health Organisation (WHO) air quality guidelines. The WHO guidelines provide a target for governments to work towards to improve air quality. The WHO guidelines are neither air quality standards nor legally binding and are not included in UK legislation or policy. The WHO website states that:

"Governments across the world use the guidelines in different ways depending on their technical capabilities, economic capacity, air quality management policies and other political and social factors. Before adopting the WHO guideline values as legally based standards, governments should consider their unique, local conditions."

2.3.19 Comparisons with the WHO air quality guidelines are not relevant as the PM_{10} limit values/objectives are the relevant assessment criteria for health impacts from quarry operations.

2.3.20 Comparisons with the $PM_{2.5}$ 10µg/m^3 2040 target value are not relevant as the target value does not need to be achieved until 2040.

2.3.21 As described above, the use of the 17µg/m^3 screening threshold for PM_{10} is appropriate. The $PM_{2.5}$ target values are not appropriate when considering the

impacts due to particulates from minerals sites, and the WHO air quality guidelines do not form part of UK legislation.

Potential Impacts

2.3.22 As discussed above, the S-P-R method is the appropriate assessment methodology for visible dust due to the lack of accurate UK emissions data for minerals sites. The S-P-R method determines the magnitude of dust effects based on the dust impact risk (the magnitude of dust emissions from each activity at the quarry and the prevailing meteorological conditions) and the sensitivity of receptors to visible dust.

2.3.23 Dispersion modelling should not be used due to the lack of accurate UK emissions data, in accordance with IAQM guidance.

2.3.24 Michael Bull and Associates raise the fact that some local sensitive receptors were omitted from the assessment. The closest dust sensitive receptors in all directions were included in the assessment. 1 Gravel Pit Lane, Windy Ridge and Whitehouse Farm are all within 70m of receptor R5 (2 Gravel Pit Lane), but further from the proposed quarry; therefore, the impacts will be smaller at these receptors.

2.3.25 Hunters Lodge is non-residential. Hunters Lodge has planning use as class B8 storage and distribution of materials and equipment for building trade purposes and is therefore not considered to be sensitive to dust.

2.3.26 Some dust sensitive receptors are within 40m of the application site boundary; however, extraction works will take place no closer than 100m to the receptors. A 20m deep belt of trees and shrubs will be retained between the extraction works and the receptors, and screening bunds will be constructed between the extraction works and the vegetation belt where there are at risk dust sensitive receptors. With regards distances to receptors used for assessment purposes, the IAQM minerals guidance states:

"Note that distances refer to 'dust generating activities' rather than the site boundary and this may refer to extraction and processing areas or haul roads, for example."

Potential Impacts to Human Health

2.3.27 The IAQM threshold for assessing the potential health effects due to PM_{10} emissions from quarrying operations is relevant, as discussed above.

2.3.28 The Minerals nPPG is clear that impacts due to PM_{10} emissions should be assessed against the air quality objectives.

2.3.29 With regard to air quality, the NPPF states that, *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, …"*

2.3.30 Therefore, any planning decision concerning the potential air quality health impacts of the proposed development should be made with regard to the air quality limit values/objectives. It is not for the applicant to determine whether the air quality limit values/objectives set by the government are appropriate.

Mitigation Measures

2.3.31 The Minerals nPPG assessment framework is clear that, where PM_{10} concentrations are not likely to exceed the air quality objectives, good practice measures should be sufficient, without the need for monitoring and specific controls on PM_{10} emissions. The air quality assessment has shown that the air quality objectives for PM_{10} will be achieved by a wide margin; therefore, visual dust monitoring should be sufficient as part of mitigation at the proposed quarry.

Summary

2.3.32 The PM_{10} air quality objectives are the relevant assessment criteria for use when assessing the potential health effects due to quarry operations. The $PM_{2.5}$ target values should not be used; however, further details provided above indicate that the proposed development would not hinder progress towards the achievement of the target values.

2.3.33 Dust emission rates have been estimated qualitatively using the S-P-R approach, there is a lack of accurate UK emissions data for use in a dispersion model.

2.3.34 Distances used for assessment refer to distance from dust generating activities, not the site boundary.

2.3.35 The S-P-R assessment does rely on professional judgement and the assessor who completed the assessment, Bob Thomas, Director at AQA, is well qualified (BSc (Hons), PgDip, MSc, MIEnvSc, MIAQM, CSci) with more than twenty years working in the sciences and sixteen years' experience in the field of air quality management and assessment. A more objective assessment for dust emissions from a quarry using dispersion modelling is not recommended by the IAQM due to the lack of accurate UK emissions data.

2.4. Wind and Dust Modelling

Dust Screening Modelling

2.4.1 The report by Michael Bull and Associates includes what is referred to as dust screening modelling. Screening would imply a test to determine whether further detailed work needs to be undertaken.

2.4.2 The IAQM recommend that modelling is not undertaken to determine the impact due to emissions from quarrying operations due to the lack of accurate UK emissions data. Using inappropriate data for input to a dispersion model would result in a very high level of uncertainty in the model results. The quality of the results from the dispersion model is determined by the quality of the input data, including the emissions data, hence the phrase rubbish in, rubbish out. The use of an appropriate dispersion model is irrelevant, useful results can only be predicted if accurate emissions data are used. The effect of using inappropriate emissions data has been well illustrated by the modelling undertaken by Michael Bull and Associates.

2.4.3 Michael Bull and Associates have used an emission factor for particulates derived from data in the National Atmospheric Emissions Inventory (NAEI). The NAEI provides emission factors based on the operation of all quarrying and mining of minerals other than coal for the most recent year, 2021. The emission factors are in units of

kilotonnes per Megatonne of activity. The UK Informative Inventory Report (1990 to 2021) provides the methodology behind the NAEI emissions data, and states the following with regards PM_{10} emissions in the inventory:

"The emission inventory for PM_{10} is subject to high uncertainty. This stems from both uncertainties in the emission factors the activity data. For many source categories, emissions data and/or emission factors are available for total particulate matter only and emissions of PM_{10} must be estimated based on assumptions about the size distribution of particle emissions from that source. This adds a further level of uncertainty for estimates of PM_{10} and in some cases to an even greater extent for $PM_{2.5}$ and other fine particulate matter.

Many sources of particulate matter are diffuse or fugitive in nature e.g. emissions from coke ovens, metal processing, or quarries. These emissions are difficult to measure, and in some cases, it is likely that no entirely satisfactory measurements have ever been made, so emission estimates for these fugitive sources are particularly uncertain.

Emission estimates for combustion of fuels are generally considered more reliable than those for industrial processes, quarrying and construction. All parts of the inventory would need to be substantially improved before the overall uncertainty in PM could be reduced to the levels seen for SOX, NOX or NMVOC."

2.4.4 The UK Informative Inventory Report (1990 to 2021) goes on to state that:

"The UK currently has few active underground mines and most minerals in the UK are extracted from quarries. Production is dominated by aggregate minerals, clays, and industrial minerals; the production of metalliferous ores has been a very minor activity in the UK for many years. Emissions are predominantly from extraction of the minerals and primary processing stages such as crushing. Emissions are generally fugitive in nature and difficult to quantify. Emission estimates for particulate matter are based on the use of the EMEP/EEA Guidebook Tier 2 emission factor, assuming a medium to high level of emissions. Quarries in the UK are regulated, and many process stages are typically required to install dust suppression systems, so the alternative Tier 2 factor for low to medium emission levels might be appropriate for the UK. However, in the absence of any detailed comparison of the practices of the UK quarrying industry with those assumed for the two Guidebook factors, we have adopted the conservative approach of using the higher factor. Activity data are gathered from statistics published by the BGS and consist of production data for each product type: igneous rock, sandstone, limestone, clays, metalliferous ores of various kinds, etc. Data are not available for all mineral types for the latest year, and in some cases for other years also, and in these instances the Inventory Agency has extrapolated mineral production data from the latest year of data that are available. In most cases, the lack of data is because statistics are not published in time for the compilation of the NAEI, and therefore there is a one year time lag for the activity data. For certain mineral types, only a combined value is provided and therefore the split has been held constant from the latest year for which a breakdown is provided (2014)."

2.4.5 A number of observations can be made with regards the NAEI data:

- There is a high level of uncertainty with regards PM_{10} and $PM_{2.5}$ emissions data;
- Particulate emissions estimates from quarries are particularly uncertain;

- The particulate matter emissions factors provided in the NAEI are derived from all quarry and mining operations and all onsite activities.

2.4.6 Not only is there a high level of uncertainty with regards the NAEI emissions factors, but the emissions factors include all activities from all types of quarries, including operations that would emit high levels of particulates, such as hard rock blasting and clay mining. No operations that emit high levels of particulates will occur at the proposed quarry. The only processing at the site will be a mobile screen, used to separate the gravel from the sand, and particulate emissions from the proposed quarry would be significantly lower than those from most UK quarries.

2.4.7 To accurately model the impact from the proposed quarry, separate emissions factors would be required for all onsite activities, such as the movement and operation of plant, entrainment of dust from the surface, etc. These emissions factors would need to be specific to operations at a sand and gravel quarry in the UK. Using an emission factor derived from all quarry and mining activities in the UK to estimate emissions from a relatively small scale sand and gravel quarry, with a small residual source emission would result in an extremely uncertain model output.

2.4.8 Also, the specific emission factor used by Michael Bull and Associates needs to be considered. The NAEI provides 2021 emissions factors as shown in **Table 2**. Michael Bull and Associates used the emission factor for total particulates of 0.1 kilotonnes per megatonne of mineral extracted to derive an emission factor for use in the dispersion model and presented results showing that residential properties would be subject to annual mean particulate concentrations from quarrying operations of 10µg/m^3.

2.4.9 Michael Bull and Associates mention that the value of 10µg/m^3 is for total particulates, not PM_{10} or $PM_{2.5}$, but provide concentration isopleths for total particulates to overstate the potential impact on health predicted from the dispersion model. Based on the NAEI emissions factors, PM_{10} and $PM_{2.5}$ concentrations predicted by the model would be 50% and 5% of the predicted total particulate concentration, i.e. 5µgPM_{10}/m^3 and 0.5µg$PM_{2.5}$/m^3 where a total particulate concentration of 10µg/m^3 is predicted.

Table 2: The NAEI Particulate Matter Emissions Factor

Particulate Fraction	Emission Factor (kilotonnes/Megatonne of activity)
PM_1	0.0014
$PM_{2.5}$	0.0050
PM_{10}	0.050
Total Particulates	0.10

2.4.10 Michael Bull and Associates estimate a fraction of $PM_{2.5}$ concentrations from PM_{10} concentrations close to sand and gravel works using data from a report published in support of a planning application for another sand and gravel quarry near Wasperton,

Warwickshire (DustScanAQ, 2022). An estimate of 56% of PM_{10} as $PM_{2.5}$ has been presented; however, this is incorrect.

2.4.11 The Wasperton dust assessment includes data from real-time particulate monitoring undertaken at Wolston Fields Quarry, near Coventry. Wolston Fields Quarry is a sand and gravel quarry, and monitoring was undertaken to provide proxy data for the proposed new sand and gravel quarry as Wasperton. **Figure 2**, reproduced from the Wasperton dust assessment, shows that the monitoring site at Wolston Fields Quarry was located approximately 40m from quarrying activities, at a point downwind of the quarry with regards prevailing wind conditions. The report confirms active mineral extraction was taking place during the monitoring period. The monitoring was undertaken for 90 days from July to November in 2021 and the average data from the monitoring period is compared to the air quality limit values/objectives in **Table 3**.

Table 3: Monitoring Data from Wolston Fields Quarry

Particulate Fraction	90 Day Average (µg/m³)	Annual Mean Limit Value/Objective (µg/m³)	Defra Predicted Annual Mean Background Concentration (µg/m³)
$PM_{2.5}$	4.8	20	8.3
PM_{10}	8.5	40	12.9

Figure 2: Wolston Fields Quarry Monitoring Site

2.4.12 The contribution to particulate concentrations due to operations at the Wolston Fields Quarry is not equivalent to the average concentration measured at the monitoring site. The measured concentration includes contributions from all other sources in the area, including road and rail traffic, industry, farming, domestic and background contributions from the local region, the UK and Europe. Michael Bull and Associates have estimated that $PM_{2.5}$ emissions from the quarry are 56% of PM_{10} emissions based on the fractions of $PM_{2.5}$ and PM_{10} measured at the monitoring site (4.8/8.5 = 56%). However, this is not a measure of the fraction of $PM_{2.5}$ in PM_{10} from the quarry, it is the fraction of $PM_{2.5}$ in PM_{10} from all sources that contribute to the measured concentrations.

2.4.13 To find the contributions to $PM_{2.5}$ and PM_{10} from the quarry, a period of monitoring would have needed to be completed prior to the start of quarrying operations at Wolston Fields Quarry to be subtracted from the measured concentrations after the quarry became active. This has not been done, and so it is not possible to separate the contribution from the quarry from other sources. Background concentrations estimated by Defra for the grid square in which the monitoring site was located are higher than the measured concentrations, and it is not possible to use this data to remove the contribution from other sources from the measured concentrations. Therefore, it is not possible to estimate the fractions of $PM_{2.5}$ and PM_{10} due to quarry operations at Wolston Fields Quarry from the monitoring data, nor is it possible to estimate the percentage of $PM_{2.5}$ in PM_{10} from the data presented by Michael Bull and Associates in their dust screening modelling using this data.

2.4.14 The particulate monitoring data from Wolston Fields Quarry does provide useful information with regards particulate concentrations close to an active sand and gravel quarry. The monitoring site was located approximately 40m from quarrying activities and there does not appear to be any vegetation or a bund between the monitor and the quarrying activity. Measured mean PM_{10} and $PM_{2.5}$ concentrations were 8.5µg/m^3 and 4.8µg/m^3 respectively during the monitoring period, which are significantly lower than the limit values/objectives. Therefore, the monitoring data indicate that, even without bunds and screening from vegetation, and at a distance of 40m, particulate concentrations due to sand and gravel quarrying operations are very low.

2.4.15 The dispersion modelling undertaken by Michael Bull and Associates indicates that total particulate concentrations due to quarry emissions at 40m from quarrying activity would be considerably higher than 10µg/m^3, and it is likely that the modelled PM_{10} concentration due to quarry emissions at 40m is higher than the total measured PM_{10} concentration at Wolston Fields Quarry. The modelled concentration is the contribution from the proposed quarry at Haddiscoe alone, whereas the measured concentration at Wolston Fields Quarry includes contributions from the quarry and all local and background sources. Therefore, it is clear that particulate concentrations modelled by Michael Bull and Associates significantly overestimate the contribution to PM_{10} concentrations from the proposed quarry at Haddiscoe. This confirms that the emissions factor derived from the NAEI data is not suitable to use to estimate emissions from the proposed quarry. The modelling undertaken by Michael Bull and

Associates results in a significant overestimate of particulate concentrations due to the use of an inappropriate emissions factor.

2.4.16 Regardless of whether it is appropriate to use dispersion modelling or the NAEI emissions factors, the results of the screening model actually show that the proposed development would not have an adverse impact on health due to particulate emissions.

2.4.17 Based on the NAEI emissions factors, PM_{10} and $PM_{2.5}$ concentrations at local receptors predicted by the model would be 50% and 5% of the predicted total particulate concentration, i.e. a maximum of 5µgPM_{10}/m^3 and 0.5µg$PM_{2.5}$/m^3. The NAEI $PM_{2.5}$ emissions are 10% of the PM_{10} emissions, which is the same estimate made by the IAQM in their construction dust guidance (see Paragraph 2.3.13). The 2024 Defra predicted maximum background concentrations at receptors that may be affected by emissions from the proposed quarry at Haddiscoe are 14.8µgPM_{10}/m^3 and 8.4µg$PM_{2.5}$/m^3. Therefore, with the extremely conservative assumption that the output from the Michael Bull and Associates model is correct, total annual mean concentrations at local receptors would be 19.8µgPM_{10}/m^3 and 8.9µg$PM_{2.5}$/m^3. These predicted total concentrations are well below the annual mean limit values/objectives of 40µgPM_{10}/m^3 and 20µg$PM_{2.5}$/m^3. The total annual mean $PM_{2.5}$ concentration is also below the 10µg$PM_{2.5}$/m^3 2040 target value. Therefore, the Michael Bull and Associates dust screening model has shown that there would not be an adverse effect on health due to particulate emissions and that further detailed work should not be necessary.

2.4.18 Visible dust monitoring was also undertaken at Wolston Fields Quarry at the same time as the particulate monitoring using directional and dust settlement sticky pad monitors at the locations shown in **Figure 2**. DustScanAQ analysed the visible dust monitoring data from Wolston Fields Quarry and concluded that, even during the summer months, dust control measures effectively mitigated dust generation at the quarry. Local arable agricultural activities resulted in greater amounts of dust than the sand and gravel quarrying operations.

Impact of Local Terrain Heights

2.4.19 This is not relevant to the air quality assessment completed for the ES chapter as dispersion modelling was not undertaken due to the lack of accurate UK emissions data, in accordance with IAQM guidance.

Use of Site Specific Meteorological Data

2.4.20 When using the S-P-R approach it is appropriate to use long term average wind data to determine the prevailing conditions and define whether a receptor is “downwind” or “upwind” of quarrying activities. Some receptors at Haddiscoe were found to be frequently downwind and close to works at the quarry; therefore a highly effective pathway effectiveness determined. This is the most conservative pathway effectiveness in the S-P-R approach, and so the worst case has been assessed in the air quality ES chapter.

2.4.21 Guidance on assessment suggests using 3-5 years of meteorological data and selecting the worst case year when dispersion modelling, which was not undertaken due to the lack of accurate UK emissions data, in accordance with IAQM guidance.

2.4.22 The comparison between the site specific (NWP data, Paragraph 3.2.9) and Norwich 2020 meteorological data presented in the Michael Bull and Associates report shows close agreement between the data sets, with the prevailing wind from the southwest.

2.5. Summary and Conclusions

2.5.1 PM_{10} particles emitted as part of dust from a quarry would mostly be in the coarse range, i.e., larger than $PM_{2.5}$; therefore, PM_{10} is the focus when assessing the potential health impacts due to quarry operations. The use of the PM_{10} air quality objectives as a threshold for the assessment of health impacts from quarry operations is established in the Minerals national Planning Practice Guidance (nPPG). Although PM_{10} should be the focus when assessing the health effects due to quarry operations, further information provided in this document shows that the proposed development would not hinder progress towards the $PM_{2.5}$ target values. The WHO guidelines are not air quality standards or legally binding and do not apply in the UK.

2.5.2 Some dust sensitive receptors are within 40m of the application site boundary; however, extraction works will take place no closer than 100m to the receptors and IAQM minerals guidance is clear that distances refer to dust generating activities rather than the site boundary.

2.5.3 Dispersion modelling has not been undertaken due to the lack of accurate UK emissions data for minerals sites, in accordance with IAQM guidance. The modelling undertaken by Michael Bull and Associates results in a significant overestimate of particulate concentrations due to the use of an inappropriate emissions factor. The unrealistically conservative modelling undertaken for the Michael Bull and Associates dust screening model actually shows that there would not be an adverse effect on health due to particulate emissions and that further detailed work should not be necessary.

2.5.4 The S-P-R approach undertaken for the visible dust risk assessment in the air quality ES chapter assessed impacts at receptors where a highly effective pathway effectiveness was determined. This is the most conservative pathway effectiveness in the S-P-R approach, and so the worst case impact on visible dust has been assessed in the air quality ES chapter.

2.5.5 The comparison between the site specific NWP data and Norwich 2020 meteorological data presented in the Michael Bull and Associates report shows close agreement between the data sets, with the prevailing wind from the southwest. Substituting the Norwich meteorological data with the NWP data to undertake the S-P-R assessment would not change the conclusions of the assessment. When using the S-P-R approach it is appropriate to use long term average wind data to determine the prevailing conditions and define whether a receptor is “downwind” or “upwind” of quarrying activities.

2.5.6 A DMP has been provided by Breedon. The assessment framework in the Minerals nPPG is clear that, where PM_{10} concentrations are not likely to exceed the AQOs, good

practice measures should be sufficient, without the need for monitoring and specific controls on PM_{10} emissions.

3 Haddiscoe Parish Council

3.1. Introduction

3.1.1 Most of the comments made by Haddiscoe Parish Council are based on the erroneous data in the Michael Bull and Associates. Where further information is required, it is set out below.

3.2. Dust

3.2.1 The areas of extraction at the proposed quarry are 100m or more from dust sensitive receptors.

3.2.2 Health impacts have been addressed by screening the requirement for detailed assessment based on the IAQM minerals guidance screening threshold.

3.2.3 Silicosis is a lung disease caused by inhaling *large* amounts of crystalline silica dust due to occupational exposure. The Health and Safety Executive (HSE) website provides information relating to workplace exposure to silica and states (HSE, 2023):

"It usually takes a number of years of regular daily exposure before there is a risk of developing silicosis. Silicosis is a disease that has only been seen in workers from industries where there is a significant exposure to silica dust, such as in quarries, foundries, the potteries etc. ***No cases of silicosis have been documented among members of the general public in Great Britain, indicating that environmental exposures to silica dust are not sufficiently high to cause this occupational disease****."*

3.2.4 Members of the public not occupationally exposed to crystalline silica dust are not at risk of silicosis. Crystalline silica dust will form a part of PM_{10} and public health is protected when PM_{10} concentrations are less than the limit values/objectives.

3.2.5 The Workplace Exposure Limit (WEL) for respirable silica dust is 0.1mg/m^3 averaged over 8 hours, which would equate to 100µg/m^3. The WEL is set to protect workers health; therefore, a worker exposed to silica dust concentrations of less than 100µg/m^3 for 8 hours/day over a working lifetime should be protected from silicosis.

3.2.6 WELs are concentrations of hazardous substances in the air, averaged over a set period of time. Therefore, the WEL is the ambient concentration of silica dust in the workplace, not the concentration in the air breathed by a worker who is wearing protection. A worker would need to use protection to avoid being exposed to silica concentrations above the WEL.

3.2.7 It is clear that members of the public would not be exposed to silica concentrations anywhere near the level that would risk silicosis and the statement that residents will be exposed to workplace levels of exposure 24-7 with no protective equipment is false.

3.2.8 No gases will be emitted during excavation.

3.2.9 Inaccurate wind data has not been used. Norwich Airport is the closest source of measured meteorological data and provides a good estimate of prevailing wind conditions in the area. The most conservative pathway effectiveness has been used at some receptors using the S-P-R approach, and so the worst case meteorological

conditions have been assessed in the air quality ES chapter. Site specific measured Met Office data is not available for Haddiscoe, the wind data presented in the Michael Bull and Associates report is Numerical Weather Prediction (NWP) data. NWP data is modelled data, i.e., predicted data based on measured data from observations from other locations. The comparison between the site specific NWP data and Norwich 2020 meteorological data presented in the Michael Bull and Associates report shows close agreement between the data sets, with the prevailing wind from the southwest.

3.2.10 The air quality and dust impacts associated with the operation of the proposed quarry have been assessed in the air quality chapter of the ES, and the additional information provided in this document confirms that the impacts will not be significant.

3.3. Stopit Campaign

3.3.1 Each point raised by the Stopit Campaign is addressed below.

Failure to address the requirements of the Environmental Act 2021 and specifically new targets for $PM_{2.5}$.

3.3.2 This has been considered in the response to the Michael Bull and Associates Report.

Failure to complete a Phase by Phase analysis of the dust impacts of the development.

3.3.3 Each extraction phase was not considered as a separate entity; however, the air quality chapter of the ES considered the impact of the extraction phase as a whole, which provides a more conservative assessment than a phase by phase assessment. Site preparation and restoration has been considered separately.

The impact of terrain height has not been considered or modelled.

3.3.4 This is not relevant to the air quality assessment completed for the ES chapter as dispersion modelling was not undertaken due to the lack of accurate UK emissions data, in accordance with IAQM guidance.

Although some dust mitigation measures are included in the Regulation 25 Dust Management Plan, there are no proposals for continuous monitoring during operations that would provide a valuable tool for minimising dust emissions.

3.3.5 The Minerals nPPG assessment framework is clear that, where PM_{10} concentrations are not likely to exceed the air quality objectives, good practice measures should be sufficient, without the need for monitoring and specific controls on PM_{10} emissions. The air quality assessment has shown that the air quality objectives for PM_{10} will be achieved by a wide margin and that there is no risk to health; therefore, visual dust monitoring should be sufficient as part of mitigation at the proposed quarry.

Dr Bull has demonstrated that a dust cloud has the potential to engulf 69 houses and 132 people with dust and particulate matter. This number would rise by approximately 35 houses and 70 people to 104 houses and 202 people, if the proposed housing development for Haddiscoe is passed as part of the Norfolk Village Clusters Housing Plan.

3.3.6 This statement is false. The report by Michael Bull and Associates has used an unrealistically high emissions factor for particulates to demonstrate that annual mean concentrations of PM_{10} and $PM_{2.5}$ will remain well below the air quality limit values/objectives, and for $PM_{2.5}$, the future target values. The report by Michael Bull and Associates does not include any assessment of visible dust, and a dust cloud would certainly not engulf any dwellings. Effective mitigation, with bund construction, a 20m wide band of retained vegetation and the use of water suppression, when necessary, should ensure that no visible dust occurs beyond the site boundary. Should visible dust emissions occur beyond the site boundary, corrective actions will be taken and operations will cease if visible dust beyond the site boundary continues, as set out in the Dust Management Plan.

4 Richard Buxton Solicitors

4.1.1 The submission from Richard Buxton Solicitors relies on the erroneous information in the Michael Bull and Associates report to conclude that the proposed development is not compliant with national and local planning policy.

4.1.2 The air quality chapter of the ES and additional information provided in this report confirms that there will not be a significant effect with regards air quality and dust due to the operation of the proposed quarry and that the proposed development is consistent with the relevant parts of:

- The NPPF and nPPG;
- Policies SC14, CS15, DM12 and DM13 of the Norfolk Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026;
- Policies MW1, MW2 MPSS1 and MIN 25 of the Norfolk Minerals and Waste Local Plan Review Draft Publication Document; and
- Policies DM 3.13 and DM 3.14 of the South Norfolk Local Plan Development Management Policies Document.

5 References

Defra. (2022). *Local Air Quality Management Technical Guidance (TG22).*

DustScanAQ. (2022). *Dust Assessment for a Proposed Quarry Near Waspterton, Warwickshire.*

HSE. (2023). *Silica*. Retrieved from Health and Safety Executive.

IAQM. (2016). *Guidance on the Assessment of Mineral Dust Impacts for Planning.*

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