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Good practice guide: control and measurement of nuisance dust and PM₁₀ from the extractive industries



**Report to The Mineral Industry Research
Organisation (MIRO)**

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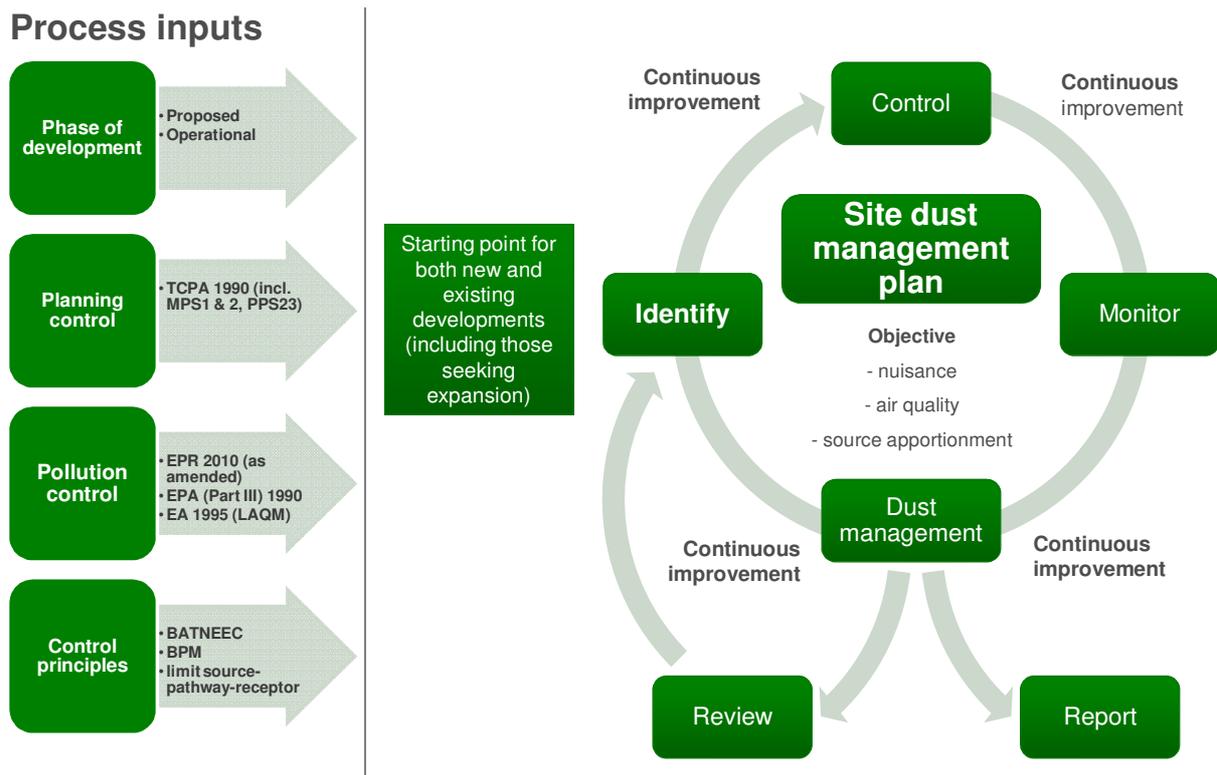
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Executive Summary

The objective of this Guide is to provide clear, concise and consistent methods for **reducing dust from mineral extraction**, and **measuring dust levels**, in the areas around minerals sites.

This Guide applies to both new and existing developments, as well as to existing developments seeking expansion.



The objectives of reducing dust and measuring dust levels are met through the development of a site specific Dust Management Plan.

The site Dust Management Plan can be used to demonstrate compliance with statutory requirements. It should:

- Identify dust sources; set out dust management and control methods; describe the dust monitoring strategy; explain how any failures will be addressed; and, describe the ongoing review process of continuous improvement.
- Be a 'living' document, which supports continuous review and improvement of dust management.
- Be continuously updated and amended to reflect changes and/or improvements due to the on-going process of continuous improvement.

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Appendix B	Environmental Permitting (England and Wales) Regulations 2010 (as amended)
Appendix C	Corrective action summary sheet
Appendix D	Complaint protocol
Appendix E	Site inspection and bowser deployment log
Appendix F	Site checklists

Abbreviations, Acronyms and Definitions

AAC	Absolute Area Coverage. Dust coverage, irrespective of mass and colour, on 'sticky pad' dust slides. Typically expressed as a percentage.
AQO	Air Quality Objectives
AQMA	Air Quality Management Area
BAT	Best Available Techniques (defined in the EU Directive on Integrated Pollution Prevention and Control 96/61/EC)
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BPM	Best Practicable Means. BPM places the onus on operators to take all reasonably practicable measures having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications. The means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures. BPM takes account of such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals. BPM is defined in the Environmental Protection Act 1990, c.43, Part III, s.79(9).
DMP	Dust Management Plan, the overall approach taken by a site operator to ensure that dust emissions are minimised, dust concentrations are measured, and any dust problems are dealt with satisfactorily.
Dust	Dust is a generic term commonly used to describe wind-borne earth, sand or household dirt in the form of a fine powder. More specifically dust is composed of air and surface-borne particulate matter up to 75 µm (BS 6069 – Part 2).
Dust Action Plan	The actions a site operator will take to remedy dust emissions arising during an abnormal event.
Dust deposition	The vertical passage of dust to a surface or the ground.
Dust flux	The horizontal passage of dust, usually driven by the wind, past a point.
EA	Environment Act 1995
EAC	Effective Area Coverage. Dust soiling (or obscuration), irrespective of mass, on 'sticky pad' dust slide, usually expressed as a percentage.
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPA	Environmental Protection Act 1990
EPR	Environmental Permitting Regulations 2010 (as amended)
ES	Environmental Statement
Fugitive dust	Particles suspended in the air due to man-made and natural activities such as the movement of soil, vehicles, equipment, blasting, and wind.
Grit	Particles ~50 µm to several hundred µm in diameter

LA	Local Authority (Authorities)
LAQM	Local Air Quality Management
LAQM.TG	Local Air Quality Management Technical Guidance Note
LPA	Local Planning Authority (Authorities)
Micron (µm)	1 µm = 1 millionth (1 × 10 ⁻⁶) of a metre
MPG	Minerals Planning Guidance
MPS	Minerals Policy Statement
NAQS	National Air Quality Strategy
Nuisance dust	Nuisance dust is the unreasonable or unwarranted intrusion of dust (e.g., through soiling of surfaces) which in some way materially interferes with the right of an individual to enjoy his or her property ¹ .
PGN	Process Guidance Note
PM _{2.5}	Particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 2.5 µm aerodynamic diameter.
PM ₁₀	Particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 10 µm aerodynamic diameter.
PPG	Planning Policy Guidance Note ²
PPS	Planning Policy Statement ²
Responsible person	A common expression used to describe the mechanism of dust pollution and other environmental risks. The source-pathway-receptor model can be used to identify what the source may affect (the receptor, e.g., a person, property, animal, plant, eco-system or body of water) and how the source may reach the receptor (pathway, i.e., air).
SU	Soiling Unit. Dust coverage, irrespective of mass, of an exposed glass microscope slide. Obtained by subtracting the reflectance value from 100.
Source-pathway-receptor	A common expression used to describe the mechanism of dust pollution and other environmental risks. The source-pathway-receptor model can be used to identify what the source may affect (the receptor, e.g., a person, property, animal, plant, eco-system or body of water) and how the source may reach the receptor (the pathway, e.g., the air).
TSP	Total Suspended Particulates. A measure of total airborne particulate matter by total weight.

¹ The construction of “nuisance” under Part III of the Environmental Protection Act 1990 is narrower, necessarily involving some impact on health.

² PPSs have gradually replaced PPGs.

Section 1. Introduction

Dust (defined for the purposes of this study as nuisance dust and PM₁₀) is ubiquitous and has a broad range of sources and concentrations. Natural sources of dust include particles derived from (in no particular order): wind-suspended sea salt; combustion; volcanic or geothermal activities; and, natural weathering of minerals. Man-made sources of dust include: agriculture (especially arable farming); industrial activities, e.g., mechanical handling of minerals and allied materials; and, road transport. The intensity of some sources also varies seasonally, as well as on the time of day. For example, dust emissions from agriculture, particularly arable farming, tend to be at their greatest in summer when agricultural land is being worked, crops are being harvested, and the soil is driest.

Dust arising from the extractive industries (quarrying and surface mines) is additional to background dust concentrations. If not adequately controlled dust emissions from the extractive industries may lead to increases in dust concentrations beyond the site boundary, which may affect local amenity. This could be due to a reduction in visibility and/or soiling of surfaces, buildings, cars, clothing or vegetation. Dust emissions from the extractive industries are site specific and broadly dependent on:

1. The material extracted,
2. Site operations, and
3. Local meteorology and topography.

The focus of this guide is to assist in the identification, control and management of dust arising from the extractive industries during:

- Site design and preparation of planning applications,
- Site opening and preparation (soil and overburden removal, handling and storage),
- Quarrying for the extraction of minerals,
- Extraction and mineral processing, and
- Site restoration and closure.

It is more effective to address dust emissions at the design and planning stage of new quarries and extensions, than to seek to deal with dust problems retrospectively. Likewise it is more effective to deal with potential dust emissions at source, rather than once airborne.

This Guide to dust management is accompanied by an Overview document (Management, mitigation and monitoring of nuisance dust and PM₁₀ emissions arising from the extractive industries: an overview), which provides more detailed information. The overview document provides additional practical information on dust management, mitigation and monitoring along with case studies.

This guide may also be relevant to waste management activities associated with the extractive industries, e.g., the recycling of construction waste, landfill and composting.

The effects of dust can be broadly characterised in terms of:

- Potential impact on local air quality, and
- Potential to create a nuisance.

The health effects of dust inhalation are of topical interest. Personal exposure and the occupational health aspects of respirable particles from mineral extraction activities are not covered by this guide, but advice can be obtained from the UK Health and Safety Executive (<http://www.hse.gov.uk/>). The health effects of fine dust particles within an environmental context are associated with the PM₁₀ fraction of dust.

The control and subsequent impact of dust from new and existing quarry facilities and related activities falls under four discrete regulatory regimes:

- **Land-use planning** via the Town and Country Planning Act 1990 (TCPA 1990). Planning conditions on dust should not duplicate controls placed on the developer under the relevant pollution control regime. Relevant matters for consideration in individual planning applications outlined in Appendix A of PPS23 and MPS2 Annex 1: Dust³, which supplements general planning policies and compliments controls under environmental legislation by providing information and examples of good practice. Of particular relevance are:
 - Environmental Impact Assessment (EIA)/Environmental Statements (ES) – the content of which can be fed into the Dust Management Plan (DMP), and
 - Community engagement – the need for regular dialogue between the site operator and the local community during the planning and operational phases of a site.
- **Control of industrial air pollution** via the Environmental Permitting (England and Wales) Regulations 2010 (EPR 2010, as amended) for some minerals processes (details of Defra's process guidance note series covering quarrying activities are given in Appendix B).
- **Control of nuisance** via the Environmental Protection Act 1990 (Part III) (EPA 1990), and
- **Control of local air quality** via Local Air Quality Management regulations invoked by the Environment Act 1990 (EA 1990) which sets statutory limits for airborne PM₁₀ concentrations.

Chapters 3 and 4 of the accompanying overview document provide detailed information on the regulatory and planning regimes used to control dust emissions from the extractive industries.

The guide has been designed to address all these regimes and is aimed at:

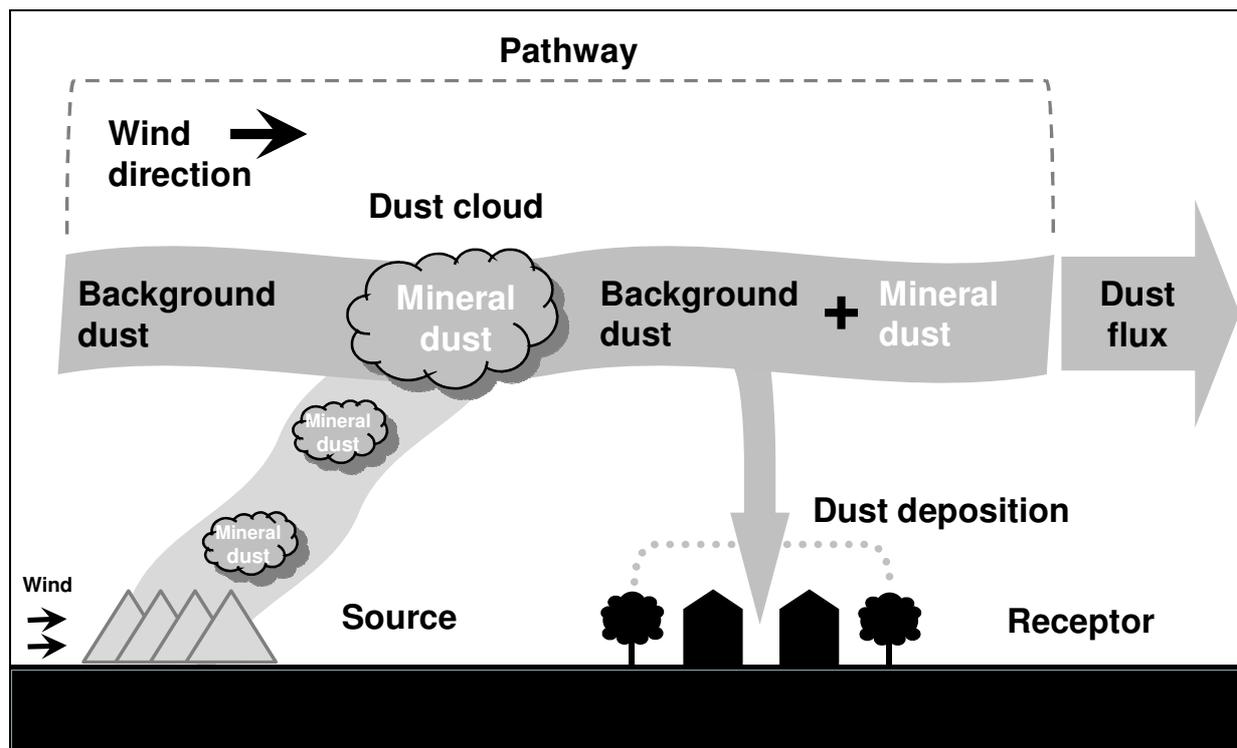
- **Operators:** who must consider the implications of dust arising from their site when making planning applications, and in the site's subsequent operation,
- **Regulators:** who are tasked with reviewing proposed and existing dust control measures. Officers may need to determine their suitability for planning applications, or for compliance with planning conditions. Officers need to consider the appropriateness of controls in the light of process guidance and the principles of Best Available Techniques (BAT). Officers may also need to consider proposed controls in order to fulfil the aims Local Air Quality Management (LAQM), particularly for sites located in or near an Air Quality Management Area (AQMA), and
- **Members of the public and other stakeholders:** who can use this guide to assess the suitability of proposed and existing dust management and monitoring methods at minerals sites.

³ Correct as of October 2010.

Section 2. Dust Management Plan

The site Dust Management Plan (DMP) should cover all aspects of dust management for a site where extraction is undertaken. The aim of the DMP is to interrupt the source-pathway-receptor relationship. Figure 2.1 provides a schematic representation of the source-pathway-receptor relationship. The DMP should contain a description of foreseeable events which may reasonably lead to elevated airborne emissions and the potential impact at sensitive locations (as defined in Table 5.1). The DMP should identify what actions are to be taken, in each case, to minimise the impact of dust from the extractive industries.

Figure 2.1 Summary of the source-pathway-receptor relationship.



The benefits provided by a standardised DMP approach are five-fold:

1. Improved performance through a reduction of dust levels on-site and off-site, and a reduction in the number of complaints received.
2. Emission and impact reductions providing an improved reputation with staff and the public.
3. Development of best practice by documenting the processes used to manage dust arising from extractive processes, together with outcome and performance.
4. Documentation of processes which can be integrated across a site or range of sites offering a standardised approach, reducing the duplication of effort across sites within a group.
5. Written procedures for reporting any failures of compliance (i.e., complaint procedure), enabling any issues to be managed, reviewed and audited, both internally, by the operator, and externally, by regulators.

The DMP provides a mechanism to judge the effectiveness of any in-use dust control techniques and therefore it should be reviewed regularly. The DMP should include a process used to deal with infrequent dust occurrences.

- Identify
- Control
- Monitor
- Manage
- Review, and
- Report.

Each component requires assessment and evaluation when preparing the DMP, and **periodic re-evaluation thereafter**.

For on-going operations the site operator should appoint a person responsible to compile the site DMP. For new sites a dust impact assessment will have been produced by the planning application stage. The dust assessment will dictate the complexity of the associated DMP, if required by planning conditions. The level of detail required will be proportional to **the level of potential perceived impact, frequency of occurrence and intensity**. This means that every DMP will be site-specific. Table 2.1 provides an example of the components of a DMP. This means that every DMP will be site-specific. The format shown in Table 2.1 is illustrative and can be amended, as appropriate, to reflect different situations.

The key elements of a DMP described in this Guide may be fulfilled through an existing Environmental Management System (EMS), e.g., ISO 14001. If such information is to be used then the formal DMP should, as a minimum, make reference to the relevant sections of the EMS.

Table 2.1 Suggested outline for a site DMP.

Source. Describe how generated	Identify possible failures or abnormal situations. Nature/cause of failure	Potential outcome if failure or an emissions event occurs	What measures have been put into place to prevent or reduce the risk of failure or an emissions event?	What actions have been taken and who is responsible?
Briefly describe the activity or process in which dust is generated. See Section 3.	For each source – identify particular difficulties which affect dust generation, abatement. See Section 4.	Identify the local receptors that are likely to be affected and the nature or degree of the impact.	List the relevant control measures and monitoring strategy. See Sections 4 and 5.	What actions are taken to minimise generation and emission? See Sections 4 and 6. Who (include post) is responsible for authorising the actions described and for recording the event.
Example 1: Jaw and cone crushers. Dust generated through the crushing of rock.	Damaged dust screen on rock crusher.	Increased dust emission from crusher. May lead to elevated boundary dust levels and/or at nearby houses. Occurs infrequently and for short periods until corrective action is taken.	Daily inspection of dust screens.	Cessation of crushing. (Crusher operator, site manager). Repair/replacement of screens. (Site manager).
Example 2: Site dust. Blown off-site due to the action of wind.	Strong winds following a period of dry weather.	Increased dust levels leading to the receipt of complaints from New Village. Occurs infrequently (once or twice a year).	Regular consultation of 7-day regional weather forecast on Met Office website. Recording of prevailing weather conditions in site log. Review monitoring data.	Increased attention to housekeeping measures under dry conditions. Increased deployment of water bowser. Cessation of site activities under high winds/very dry conditions. (Site manager).

Table 2.2 summarises the supporting information which could be included in a DMP.

Table 2.2 Supporting information to include in the site DMP

Site information
<ul style="list-style-type: none"> • Extent of site including site boundary. • Site operations including current/consented working. • Production (activity) rate. • Mineral type and characteristics (size, moisture content, friability, colour and opacity). • Scale and length of operations, including phasing. • Method of working. • Type of processing activities (frequency of movement and disturbance). • Material handling. • Location of storage areas and stockpiles. • Location and number of access routes and haul roads. • Dust control measures employed on-site, including any dust related planning controls. • Maps showing location of monitoring sites and sensitive receptors (as defined in Table 5.1) if appropriate.
Background information
<ul style="list-style-type: none"> • Geography & topography (surface features): <i>local topography influences wind speed and direction, hence the extent over which dust is dispersed. For example, hills act to channel and direct winds. Open, exposed sites lacking surface features are susceptible to dust blow. Surface features such as woodland, buildings or other structures influence dust deposition patterns.</i> • List other nearby dust-emitting land uses, e.g., arable farming. • Site hydrology and vegetation, if these contribute to reducing dust emissions. • Describe the character of the area surrounding the site, and list the name, location and type of locally sensitive receptors (as defined in Table 5.1), e.g., houses, farms, rivers, forest, recreational areas, SSSI, sites of historic importance. • Summarise the local meteorology if data are available, e.g., rainfall, wind speed & direction: <i>rainfall suppresses dust and increases dust 'wash-out', whereas dry conditions contribute to dust generation. Wind dries exposed materials and can initiate the dispersion of dust at wind speeds greater than about 5 m s⁻¹. Wind direction influences the range and extent to which dust is dispersed off-site.</i>

In the case of existing sites, the site operator will be aware of the existing sources of dust, based on a combination of observations and anecdotal evidence from staff. For both new quarries and extensions to existing sites the site operator can also rely on personal judgement based on previous experience. The local authority environmental protection department may be able to offer useful advice. The number and strength of on-site dust sources will vary over time due to a combination of non-operational indirect effects (e.g., wind, rain) and operational effects (e.g., output rate, changes in material handling and processing, changes in activity location). These variations underline the need to undertake continuous improvement of the site DMP.

Section 3. Identification

Dust generation is site-specific. The first step in preparing the site DMP is to identify all possible sources of dust attributable to the site and contributory factors (e.g., type of material, activity and frequency of occurrence) that influence dust generation, and their potential impacts. Table 3.1 sets out the typical range of sources.

Table 3.1 Source types and characteristics.

Activity	Relevance for mineral types	Duration of activity	Potential for dust emission
Soil handling	Most minerals	Relatively short	Significant but depends on dryness and silt or clay content of the material and transportation to stockpiles.
Overburden handling	Most minerals, but quantities vary considerably	Varies. Can be intermittent over life of site	Significant but depends on nature of overburden, particularly during unloading and haulage.
Drilling and blasting	Usually for hard rocks	Short, but can take place frequently	Without control, drill rigs can be significant . However, most drill rigs now use shrouds and any dust generation is very localised. Properly designed and controlled blasts have limited potential for the creation of dust.
Initial loading activities	All mineral types	Ongoing during extraction	Can be significant but varies depending on nature of material, whether wet or dry, volumes handled and equipment used.
Crushing and grading	Most minerals, but not always at the place of extraction	Varies, generally ongoing	Significance varies depending on type of equipment and exposure to wind. Controlled through the EPR permit at regulated sites.
Storage of minerals within site	Most mineral types	Usually ongoing during extraction	Significance varies depending on the volume of material stored, moisture content, exposure to wind, covering of stockpiles.
Transport and load-out within site	All mineral types	Usually ongoing	Significance varies depending on type of vehicle. If transported by road then the size of vehicle, speed and nature of roads (surfaced or unmade) are important factors.
Transport off-site (mainly by road)	All mineral types	Usually ongoing	Not generally significant (except near site exits due to the re-suspension of road dust) as lorries tend to be covered. Can be mitigated by road sweeping but this can also raise dust.

Section 4. Dust control

Dust control through good process and site design and subsequent good housekeeping, i.e., “avoidance”, is the key method of controlling dust emissions from extractive activities. The DMP should include a full list of all dust control measures employed to limit site dust emissions. The control hierarchy should be based on:

- Good operating and management practices to avoid emissions arising from extractive activities,
- Good process design or revision to minimise emissions,
- Abatement or control to reduce dust emissions, e.g., use of water bowsers and sprays, and
- Disrupting the emission pathway to sensitive receptors (as defined in Table 5.1), i.e., shielding receptors through the use of earth banks or vegetative screening.

“End-of-pipe” abatement solutions⁴ should be considered as a final option. Methods for the control of emissions are required to be stated in an ES and within the EPR permit, where applicable. The control approach selected should seek to exploit and optimise site topography and meteorology, as well as process design. The approach to control should adopt the principles of “Best Practical Means” under the terms of the Environmental Protection Act, and/or “Best Available Techniques” as defined under the Environmental Permitting Regime. The regulatory regime dictates that industry standards should be applied.

Dust control should be addressed at each phase of site development and operation. Careful thought should be given to planning and considering the relationship between site activities and sensitive areas beyond the site perimeter. Table 4.1 summarises the range of control measures that can be applied.

Annual evaluation of the site dust control measures should be undertaken to identify the success of dust control measures. This is particularly applicable to new sites where control measures may be unproven within the context of the site or operation.

Assessment of the success of the control measures should be based on a combination of site/procedural observations, monitoring results and complaints received. Appendix C provides a sheet for recording corrective actions. If improvement measures are to be undertaken the following information should be recorded:

- Proposed corrective measures,
- Justification for corrective measure and intended outcome,
- Name of the person (and post) responsible for completing the task, and
- Deadline for achievement (month and year).

A summary of corrective measures and improvements should be forwarded to the Mineral Planning Officer or Officers of the local environmental health department for their information or approval depending on the site planning conditions.

⁴ “End-of-pipe” abatement solutions are techniques used to remove contaminants from a process air flow and are typically implemented as the last stage of a process before the air is vented or delivered.

Table 4.1 Dust control techniques by source.

Source/process	Emission potential	Scope for control	Effectiveness
Hydraulic excavators and loaders (e.g., front loader, backhoe, face shovel, bulldozers) for the excavation, lifting and movement of material such as soil, overburden and mineral.	HIGH when dry or fine silty materials are being handled, particularly during strong windy weather.	Use of water sprays to moisten material being handled. Soils may be subject to a soil moisture content planning condition.	MODERATE
	LOW when coarse or wet materials are being handled during conditions of low wind speed.	Minimise drop heights when unloading material. Protect from exposure to wind where possible.	
Blasting to loosen rock to facilitate its removal by mechanical excavators.	LOW when coarse or wet materials are generated during conditions of low wind speed.	Avoid blasting under unfavourable weather conditions subject to safety consideration.	MODERATE
Tractor scrapers (soil strippers) for cutting, lifting, transporting and placing, spreading or shaping of soils.	MODERATE/HIGH - when dry silty materials handled during windy weather.	Use of water sprays to moisten material being handled. Soils may be subject to a soil moisture content planning condition.	LOW
Vehicles for transport of material within the site.	HIGH particularly when travelling over unsurfaced and dry site roads.	Minimise on-site transportation distances. Use of water sprays to moisten road surfaces during dry weather. Use mechanical road sweepers during working hours, especially during dry weather, to limit visible dust emissions. Restrict vehicle speeds through signage/staff training. Use of covered conveyors to transport materials around the site.	HIGH
Hydraulic breakers for size reduction of large rocks.	LOW	Water spraying of rock prior to fragmentation when high degree of control required.	MODERATE

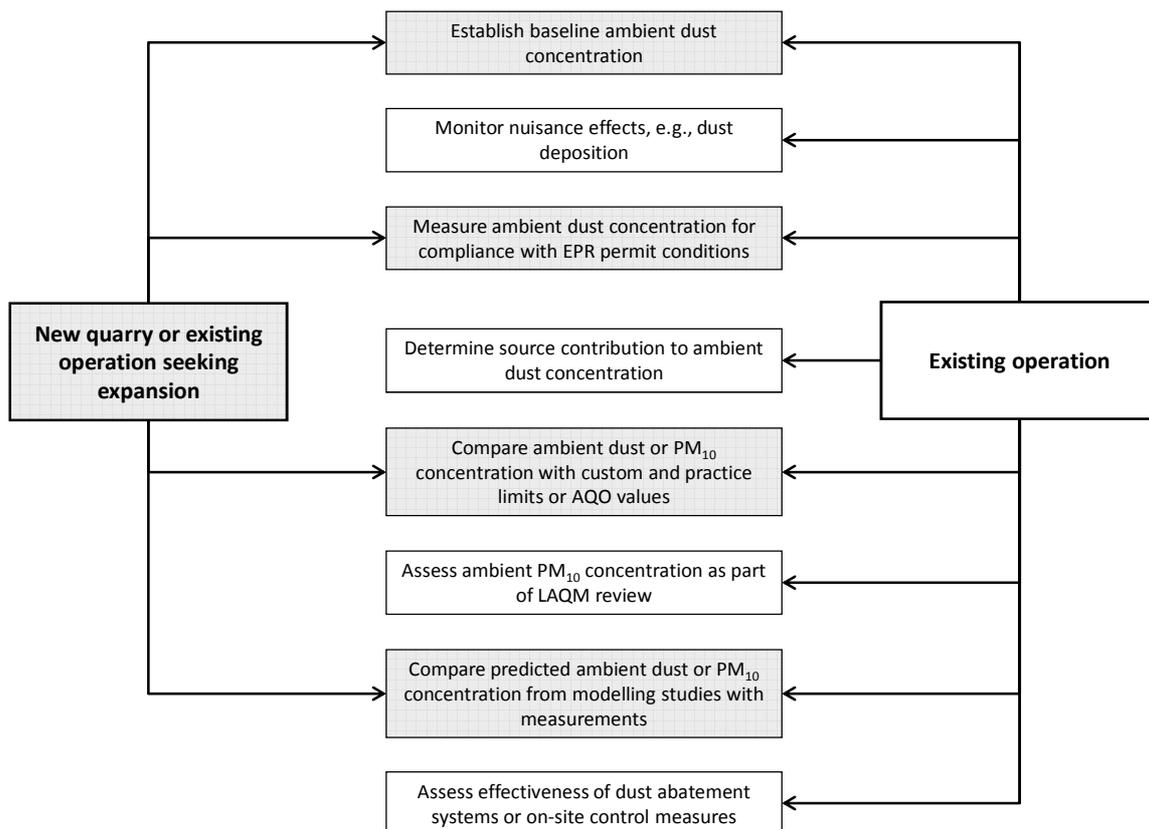
Table 4.1 (cont.) Dust control techniques by source.

Source/process	Emission potential	Scope for control	Effectiveness
Drill rigs for drilling holes for placement of explosive charges.	HIGH when unmitigated.	Enclosure of plant with shrouds. Use of dust suppression (filters) on waste air vented from equipment.	HIGH
Crushers & screens/ graders for size reduction of material to produce graded mineral products.	HIGH if unmitigated.	Dust suppression spraying of material to be crushed. Enclosure of plant.	HIGH
Exhausts and cooling fans on mobile plant processing quarried material.	HIGH if unmitigated.	Mobile plant exhausts and cooling fans will discharge above the horizontal to prevent dust mobilisation.	MODERATE
Conveyors for transporting material.	MODERATE if not protected from wind.	Enclosure of transfer points.	HIGH
		Wind boarding (inc. roofing) of conveyors.	HIGH
	MODERATE/HIGH for dry or fine silty materials, particularly during strong windy weather.	Water spraying of surfaces of material on conveyor	HIGH/MODERATE
		Cleaning belts with scrapers and collecting scrapings in container.	MODERATE
Stockpiles for storage of quarried materials and soil/overburden during extraction and site development phases.	HIGH when dry or fine silty materials are being stored/ handled, particularly during strong windy weather.	Seed surfaces of completed mounds of overburden and top soil (restoration materials). Limit mechanical disturbance. Shield from wind, e.g., through the use of tree planting or screening.	HIGH
		Use of water sprays to moisten surfaces during dry weather.	MODERATE

Section 5. Monitoring

Monitoring may be required for a new quarry, an existing quarry or an existing operation seeking extension. The monitoring strategy adopted on a site must be designed to address the needs of that site in the context of its locality. Possible reasons for implementing a monitoring programme are given in Figure 5.1. The need for monitoring can be based on one or multiple reasons.

Figure 5.1 Considerations for determining the implementation of a monitoring programme



Chapter 9 of the accompanying overview document provides detailed information on current, in-use techniques for the measurement and characterisation of nuisance dust and PM₁₀.

5.1 Defining the monitoring strategy

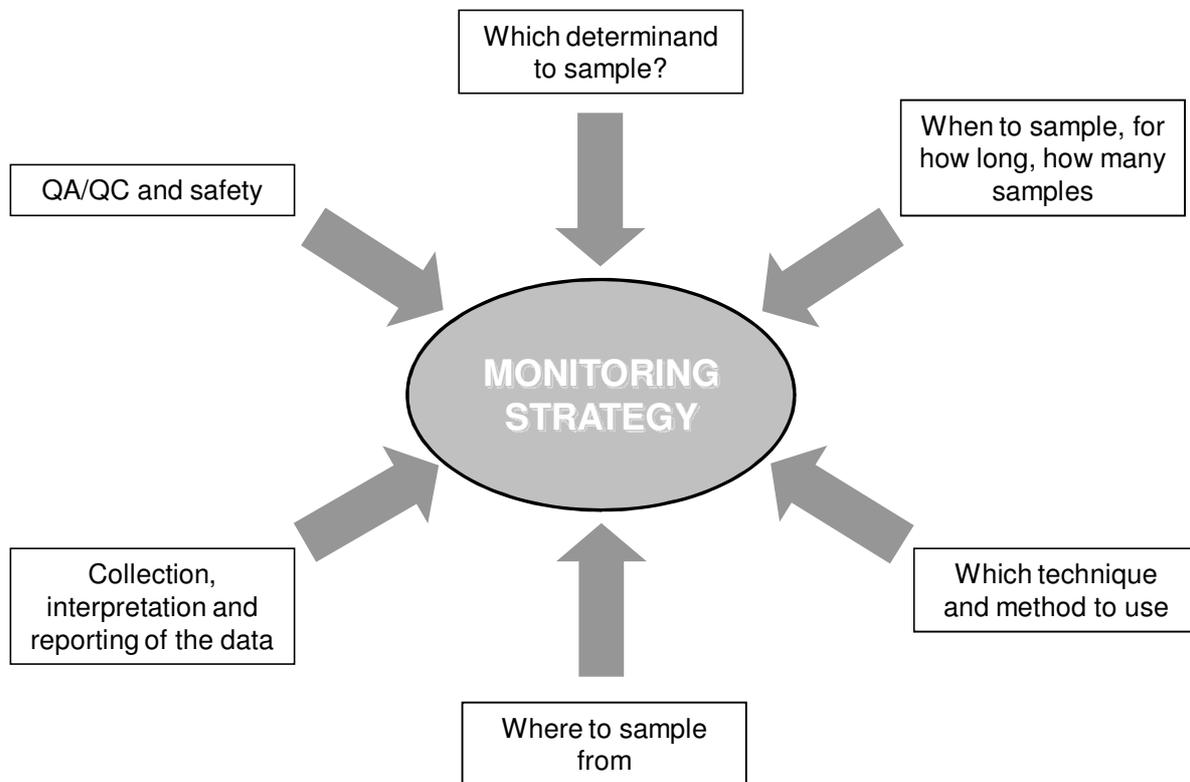
Understanding the aims of the monitoring strategy can assist in the assessment design stage. The design stage produces the monitoring strategy and requires decisions to be made on:

- What parameter should be measured (dust or PM₁₀) and which standard or criteria to monitor against?
- Where and when to sample?
- Duration of sampling.
- Number of samples.

- What technique and method to use?
- How the monitoring data will be verified?

The main elements of a monitoring strategy are summarised in Figure 5.2.

Figure 5.2 Main elements of a monitoring strategy.



The monitoring strategy, reason(s) and justification should be summarised in the DMP. Careful design and planning of a monitoring strategy is needed to avoid producing unsuitable data.

5.2 Modelling and prediction of dust concentrations

Predictive modelling techniques, such as Gaussian plume modelling packages, e.g., ADMS, and emission factors are available to predict the dispersion and airborne mass concentration of nuisance dust and PM₁₀. Currently the errors associated with such predictive tools can produce values of up to an order of magnitude of the observed mass concentration of dust or PM₁₀. The application of predictive modelling methods is examined in the Overview document accompanying this Guide.

5.3 Measurement methods

Dust emissions from the extractive industries have as range of impacts which result from short-term exposure (acute effects) or long-term exposure (chronic effects). Day-to-day operational procedures, including staff vigilance, are typically sufficient to limit short-term events (ranging from a few minutes to several hours), whereas monitoring can be used to provide a measure of long-term (ranging from a few weeks to many months) effects.

Due to the variable nature of dust (e.g., source type and magnitude, and, particle size, shape, and composition) it can be measured in a number of ways. Nuisance dust and PM₁₀ monitoring techniques can be classified as either:

- **Passive systems** are normally used for nuisance (or TSP) dust monitoring and generally do not require a power source and are relatively inexpensive. The amount of material sampled over a known period of time can be assessed either by determination of discolouration (visual assessment of staining or via reflectometry) or by measuring the mass of material deposited.
- **Active systems** require a power source and are used for measurement of nuisance dust and PM₁₀.

Custom-and-practice thresholds to assess potential amenity effects are widely used for both optical and mass methods, but data from visual and mass methods are not inter-changeable. It is advisable not to specify a particular method as an exclusive requirement for any monitoring programme (such as for a baseline study, or as part of Planning Conditions) unless there are clear and unambiguous reasons for doing so (such as a requirement to assess ambient PM₁₀ concentrations to demonstrate compliance with air quality objectives, AQOs). Instead, the site operator and the regulator should agree on the method(s) and threshold(s) to be used allowing the parallel objectives of effective site management and accountable regulation to be achieved.

The method used should be proportional to the perceived risk. This will enable both the site operator and the regulator to be confident that site dust thresholds will be appropriate for both the site and its surroundings.

The principle approaches to dust monitoring are:

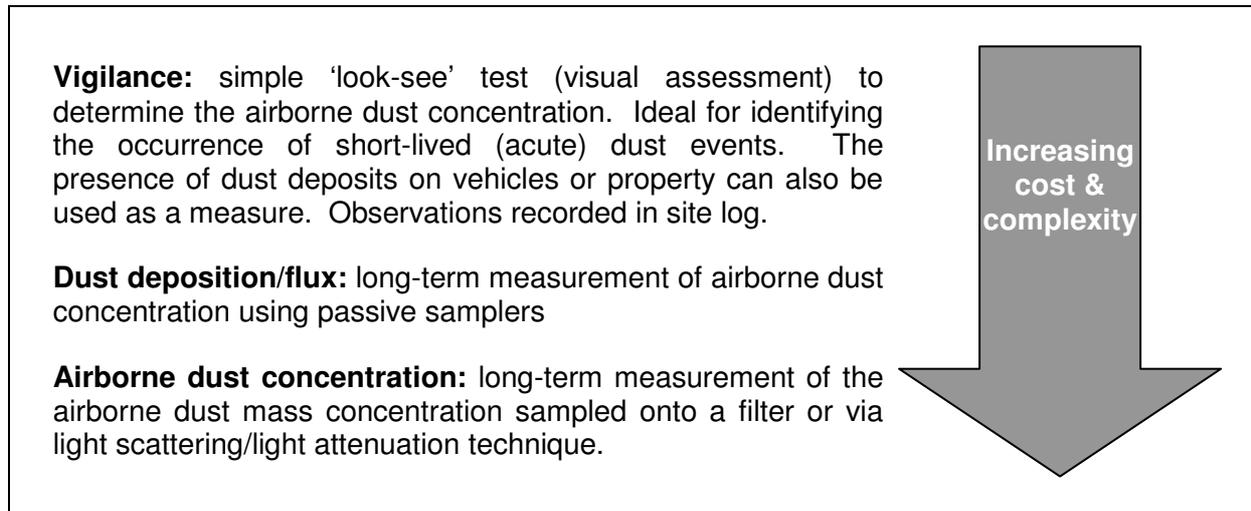
- **Visual monitoring** via simple observation of dust deposition onto a surface and dispersion on and off-site.
- Dust deposition
 - **Surface soiling:** discolouration (obscuration) of a surface caused by the accumulation of dust on a surface (such as glass microscope slide or sticky pad) due to the deposition of dust.
 - **Dust mass:** typically measured using a passive deposition gauge which appears similar to an inverted Frisbee.
- **Dust flux** is the measurement of the horizontal transport of dust. It can be measured as mass (using BS 1747: Part 5, CERL or quadruple collector) or with different types of cylindrical adhesive (sticky pad) dust sampler.

Dust deposition measurements and dust flux measurements are **not** inter-changeable. Nor is it necessarily possible to accurately determine the equivalent mass deposited on one deposition gauge type, based on measurements made with another type, as different deposition samplers have different dust collection efficiencies. Whichever dust monitoring method is used, it is essential that it is used in accordance with the supplier's recommendations and the appropriate assessment criteria are applied to the data (see Section 5.8).

PM₁₀ monitoring can be undertaken using a range of samplers. A guide to samplers appropriate for measurement of PM₁₀ for the purposes of LAQM is provided by Defra in Technical Guidance LAQM.TG(09). PM₁₀ measurement techniques are also described in the Review document accompanying this Guide. PM₁₀ and dust deposition and dust flux measurements are **not** inter-changeable.

Figure 5.3 summarises dust measurement methods by type, cost and complexity.

Figure 5.3 Summary of dust measurement methods by type, cost and complexity.



5.4 Directional sampling

Directional sampling permits improved source identification of nuisance dust and PM₁₀. This can be achieved by:

- **Wind sectoring:** comparison of the dependency of the measured dust and/or PM₁₀ concentration with wind speed and direction, and
- **Poly-directional sampling:** use of an appropriate sampler or sampling head that allows collection of dust or PM₁₀ across the full 360° range or four, 90° quadrants.

5.5 Background monitoring

Background dust concentrations vary seasonally and from location-to-location. In some locations background dust concentrations can be high due to contributions from a wide-range of diffuse natural and man-made sources as noted in Section 1. In the vicinity of areas of minerals extraction high dust concentrations can be incorrectly attributed to the mining and quarrying of aggregates, whilst the contribution from natural sources and other man-made sources, e.g., arable farming in rural areas, is over-looked. Background dust monitoring prior to the commencement of minerals extraction can provide clear indication of the input from minerals extraction to the background dust concentration when compared to the contribution from pre-existing natural and other man-made sources.

5.6 Source apportionment by compositional analysis

Compositional analysis of nuisance dust and PM₁₀ can offer improved source apportionment when compared to source apportionment simply based on sampling. The sampled particulate matter can be characterised using a range of geo-chemical techniques. These techniques permit unique source identification of the dust particles collected on the basis of dust grain size, shape and chemical composition. Samples should be archived in case they need to be re-assessed at a later date.

5.7 Factors to consider when defining a monitoring strategy

There are a number of factors which need to be considered when defining a monitoring strategy:

5.7.1 Sampling period

The most comprehensive dust monitoring will be a mix of continuous and intermittent sampling to establish long-term trends and capture transient events, respectively. Continuous sampling is relatively costly, requiring periodic inspection and servicing of equipment. It will provide good data capture with limited staff input. Single measurement points are insufficient to adequately monitor site operations, but ideal for intermittent spot sampling, e.g., the measurement of transient dust events. Typical sampling periods are:

- Short-term (transient) dust events of 1 hour or less,
- Daily mean PM₁₀ measurement for assessment of achievement of AQO,
- Amenity dust sampling of typically between one week to one month, and
- Longer term sampling to show seasonal and annual variations.

The sampling period should be sufficient to provide dust concentrations representative of the particular case under consideration.

5.7.2 Sampling location

Sampling sites should be located:

- At sensitive receptors (as defined in Table 5.1) in the case of nuisance dust.
- At a point in-between the source and receptor when measuring dust flux.
- Where there is likely to be human exposure in the case of PM₁₀.

Data from a variety of location types may be necessary to build up a reasonably complete picture of ambient exposure patterns in and around sites.

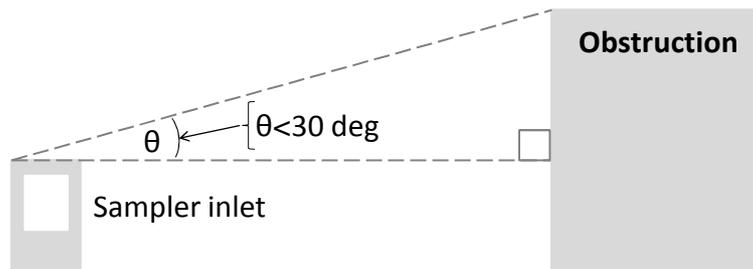
If the results of the initial monitoring programme indicate dust and/or PM₁₀ concentrations may exceed the custom and practice thresholds for dust or the statutory AQO for PM₁₀, sampling it may be necessary to carry out additional monitoring using methods which are capable of time resolution consistent with the pollutant averaging times specified in the objectives.

5.7.3 Practical considerations

Consideration should be given to the siting of dust monitoring equipment in order to provide accurate and representative measures of atmospheric dust and airborne PM₁₀ loadings. Due consideration should be given to:

- **Sampling height:** the sampling device must be securely fixed in position and installed so that the device is 1.5-2 metres from ground level, i.e., within the human breathing zone.
- **Obstructions:** nuisance dust and PM₁₀ samplers should not be located in the lee (downwind face) of tall buildings or walls. Avoid re-circulating air flows that (i) lead to the build-up of pollutants, or (ii) shield the pollution source. As a general rule, the (subtending) angle between the top of the sampler to the top of the nearest obstruction should be less than 30° as shown in Figure 5.4.

Figure 5.4 Subtending angle between top of sampler and the nearest obstruction.



- **Overhang:** the sampling position should be open to the sky, with no overhanging tress or structures. These can act as efficient pollutant sinks. The minimum distance of equipment from the leaf canopy, where moisture falls from tree leaves, should be 20 m.
- **Interfering sources:** the sampling position should not be subject to interference from sources not encompassed by the survey objectives, e.g., exhaust stacks. There should be no major sources of pollution within 50 m and no intermediate sources within 20 m. The surrounding area (within 100 m) should not be undergoing development that is not associated with the on-site activities. Unless monitoring of dust along roadways to the site is an objective, sampling should be undertaken at least 10 m from any site access roads. The use of directional sampling is advised in situations where these criteria cannot be met.
- **Accessibility:** sampling sites must be accessible for servicing calibration and/or data collection. Samplers should be sited in a secure location where the risks of vandalism or accidental damage (e.g., by wildlife, on-site activities) are minimised.
- **Services:** adequate services should be available, where required, to the monitoring site, e.g., air conditioning, electrical supplies for sampling equipment and a telephone line for data retrieval if automated sampling is required.
- **Station locations:** the number and location of sampling stations is very much dependent on objective, site complexity and proximity of sensitive receptors (as defined in Table 5.1).

5.7.4 Data and sample storage

Paper and electronic records and samples (where possible) should be safely stored for later consultation. This provides an audit trail from calibrations, sampling and analysis to reporting.

5.7.5 Monitoring reporting

A summary of the site's monitoring data should be reported periodically (at least annually) in the site's environmental report and assessed against previous performance and statutory or planning objectives, where applicable.

5.8 Assessment criteria

The results of the site dust assessment should be reviewed by a technically competent person who should assess the monitoring strategy. The review period may be governed by planning conditions, otherwise the period should be set based on the severity of dust impact. This will allow the DMP to be assessed and improved where necessary and should be considered an integral part of site DMP.

5.8.1 Dust

Currently no statutory nuisance dust limit exists in the UK. Discretionary ('custom and practice') thresholds tend to be imposed on the basis of perceived problem, i.e., as a

surrogate for dust nuisance. Consequently planning conditions often use non-specific phrases such as “reduce to a minimum level” pollution by “Best Practicable Means”.

Two basic approaches have been adopted for the determination of dust loading:

- Soiling (obscuration) of a surface based on dust deposition or flux measurements, and
- Mass of dust deposited based on dust deposition measurements.

Custom and practice thresholds applied to measure dust deposition and soiling tend to be considered alongside other criteria including the frequency of occurrence, location and effect on occupiers. This is undertaken to provide a balanced and objective view of the effects caused and determination of the existence of a statutory nuisance.

Surface soiling

The exposure of a glass slide or strip or pad of self-adhesive tape horizontally in the field for a week at a height of 1-2 m can provide a measure of surface soiling due to dust. The method is designed to replicate the behaviour of dust on outside surfaces which naturally involve dust re-distribution by rainfall and wind. The level of soiling due to dust deposition can be assessed in two ways:

1. Comparative assessment with shading cards, and
2. Measurement of the (loss of) surface reflectance or discolouration with a gloss-meter or similar (such as a ‘sticky pad reader’) to provide a measure of surface soiling. This can be expressed as Soiling Units (SU) or Effective Area Coverage (EAC%).

The first approach is highly subjective, but provides an instantaneous measure of surface soiling. Custom and practice thresholds apply for the second approach (although it should be noted that measurements obtained using different methods and equipment are not interchangeable). The custom and practice thresholds for surface soiling measured using a glass (dust) slide are 25 SU per week and the upper threshold for EAC is 5.0% EAC per day, the latter is considered the threshold for “serious complaints”.

Dust deposition rate

Dust mass deposition measurements are carried out by measuring the rate of mass of dust deposited on a fixed, horizontal surface over the period time, typically one month. Measurements are typically taken at fixed locations. This can be taken at a fixed location on the site perimeter or at off-site receptors, particularly at sensitive receptors adjacent to a site (as defined in Table 5.1), ideally at multiple sampling points.

Table 5.1 Examples of dust sensitive facilities.

High sensitivity	Medium sensitivity	Low sensitivity
Hospitals and clinics	Schools	Farms
Hi-tech industries	Residential areas	Light and heavy industry
Painting and furnishing	Food retailers	Outdoor storage
Food processing	Green houses and nurseries	
	Horticultural land	
	Offices	

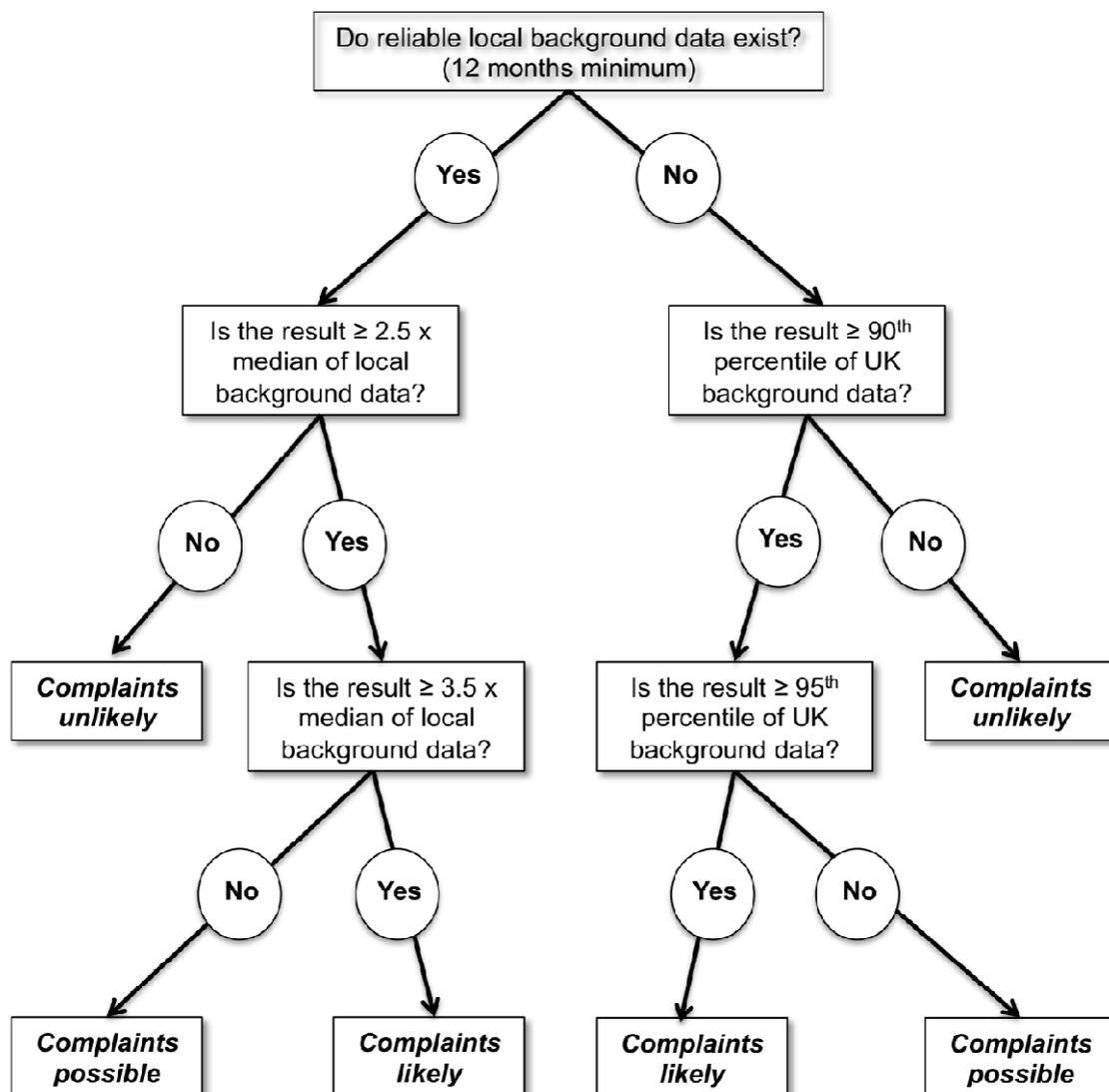
Custom and practice thresholds for dust mass deposition are of the order of 80 to 200 mg m⁻² day⁻¹ averaged over the period of a month. The lower threshold of 80⁵ mg m⁻² day⁻¹ is applicable to darker, high contrast dust, e.g., coal, whilst the higher threshold is applied to lighter-coloured materials which are less apparent to the eye. Such thresholds apply to dust mass deposition measured with a Frisbee dust deposition gauge and no other form of deposition gauge, as different deposition samplers have different dust collection efficiencies.

Figure 5.5 shows the commonly accepted procedure for determining the “likelihood of complaint” level for monthly dust deposit gauge results. Adherence to the procedure outlined in Figure 5.5 requires:

- (a) Knowledge of the background dust deposition rate, and
- (b) Long-term sampling, to provide comparative data.

In cases where no reliable background data exist, multiples of the percentiles of the background concentration can be used, depending on location. The suggested percentile values for a range of locations are given in **Error! Reference source not found.**

Figure 5.5 Procedure for determining the “likelihood of complaint” level for a given monthly dust deposit gauge result (Vallack & Shillito, 1998).



⁵ Bate and Coppin (1990).

Table 5.2 5-year means of the annual percentiles of monthly dustfall rates (mg m⁻² day⁻¹ insoluble deposits) determined using a dry Frisbee (foam) gauge⁶.

Location	Median (50 th percentile)	90 th percentile	95 th percentile
Open country	38	103	140
Residential areas and the outskirts of towns	56	146	203
Commercial centres of towns	90	199	261

Dust flux measurements

Dust flux measurements are normally taken on the pathway between dust sources and off-site receptors and are commonly undertaken at the site perimeter. For dust flux measurements made using a passive directional dust gauge consisting of quadruple dust collectors the dust flux is assessed by weighing the mass of material collected in each of the four cylindrical holders. The combined mass of dust collected in the four cylinders **does not** equate to the non-directional (deposited) dust mass, because the collection efficiency of the sample inlets varies due to the prevailing wind speed.

Dust flux measurements can also be made using a sticky sheet or pad mounted on a cylinder which is then exposed to a dust source. Dust flux measurements made using this method do not enable a gravimetric measurement of dust flux to be made (by means of measuring the mass of dust collected).

Instead the soiling, or obscuration, caused by dust is measured over an exposure period of typically 1-2 weeks. The dust coverage is often expressed as: **Effective Area Coverage** (EAC%), a measure of the colour-contrast of the dust calculated by comparing the change in greyscale of the slide where dust is present against the unexposed area, i.e., percentage reduction in reflectance per day, thus taking into account the perceived nuisance effect of darker dusts, or, **Absolute Area Coverage** (AAC%), a measure of the proportion of an area that has been obscured irrespective of dust colour. Measurements of surface soiling made using a sticky pad can be used to infer dust nuisance. The custom and practice threshold values for surface soiling assessed using a sticky pad range from 0.5% to 5% EAC per day, and are applied on a site-by-site basis as they are dependent on dust colour-contrast.

Table 5.3 is a proposed “dust nuisance risk matrix” that combines AAC and EAC measurements which allow an informal prediction of the potential risk of dust nuisance, as monitored with certain directional sticky pad samplers. By combining the two measures the potential dust nuisance can be inferred as shown in Table 5.3. For less precise assessment, an indicative visual assessment, by comparison to shade or colour charts may be sufficient to provide an approximate idea of dust deposition in an area.

⁶The values given in the table have been increased by a factor of 1.36 when compared to the values stated in Vallack & Shillito (1998) in order to account for the improved collection efficiency of the Frisbee deposition gauge when compared to the BS1747 Part 1 (British Standard) dust deposit gauge.

Table 5.3 Potential nuisance criteria based on weekly AAC and EAC measurements.

		AAC%: Dust source significance (AAC% value for a 45° wind sector given in brackets)				
		0 (<80%)	1 (80-95%)	2 (95-99%)	3 (99-100%)	4 (100%)
EAC: Dust nuisance potential (EAC% value given in brackets)	0 (<2.5%)	V Low	V Low	V Low	Low	Med
	1 (2.5-5%)	Low	Low	Low	Med	High
	2 (5-15%)	Med	Med	Med	High	High
	3 (15-25%)	High	High	High	High	V High
	4 (>25%)	V High	V High	V High	V High	V High

5.9 PM₁₀ Air Quality Objective

Under Part IV of the EA 1995 the Government produced a National Air Quality Strategy (NAQS) in 1997. The Strategy contains limit values controlling the mass concentration of airborne PM₁₀ based on the best available medical and scientific understanding of their effects on health, as well as taking into account relevant developments in Europe. Directive 1999/30/EC provides the current AQO for PM₁₀ in England and Wales:

- 24-hour mean of 50 µg m⁻³ not to be exceeded more than 35 times a year (90th percentile), and
- Annual mean of 40 µg m⁻³ to be met by 31 December 2004.

A provisional objective (annual mean) for the control of fine particulate (PM_{2.5}) has been proposed of 25 µg m⁻³ and has yet to be incorporated into the NAQS and LAQM though this is expected by mid-2011.

Section 6. Dust management

An effective system of management is essential for ensuring that all aims and objectives of the DMP are recorded and communicated reliably within the company and to stakeholders (regulators and local residents). The DMP is intended to be used by operational staff and contractors on a day-to-day basis. It should detail the person responsible for compiling the DMP and initiating action following an event which might lead to an increase in nuisance dust or PM₁₀. The person compiling the DMP should:

- Ensure the site operates in accordance with the site's planning permission and/or EPR permit conditions.
- Devise and implement the DMP.
- Co-ordinate the continuous development of the DMP.
- Drive improvement in dust performance.

This Guide has summarised the main areas of responsibility in order to compile and implement a DMP as being:

6.1 Identify

As outlined in Section Section 2 the key points are:

- Identify dust sources.
- Identify dust receptors.

6.2 Control

As outlined in Section 3 the key control issues are:

- Ensuring appropriate resources are available to meet the commitments made in the DMP.
- Ensuring good standards of housekeeping, i.e., that dust control equipment is well maintained and operational.
- Compile procedural and maintenance checklist (see Appendix F).
- Carry-out periodic checklist inspection (see Appendix F).
- Ensure control measures are implemented in line with the Dust Action Plan (see Section Section 4).

6.3 Manage

6.3.1 Training

- Communicate the contents of the DMP to all personnel.
- Describe the potential amenity problems and set out the benefits of good practice in this area for the site's neighbours, and for the minerals business and employees.
- Ensure personnel are aware of their obligations under the site's planning permission and/or EPR permit conditions.
- Provide resources to ensure employees are trained in the minimisation of dust, and the correct use of dust control equipment.

- Ensure employees involved with monitoring are trained in the correct use of dust monitoring equipment.
- Facilitate the flow of ideas and information to and from all employees to maintain and improve their ability to manage dust in all aspects of the operations.
- Undertake and record staff induction and training.

6.3.2 Dust Action Plan

A Dust Action Plan (DAP) is a protocol within the DMP for the control and reporting of the effects of specific dust events, e.g., wind-blown dust during times of strong winds and/or dry conditions, or receipt of dust complaints. The aim is to break the source-pathway-receptor linkage under these circumstances. In the event of high dust concentration or the receipt of more than a specified number of complaints, the responsible person should implement the DAP to reduce dust levels. The responsible person should respond in as timely fashion as practicably achievable. Once normal conditions have been restored, the responsible person can stop implementation of the DAP and take any steps necessary to minimise the risk of recurrence. The DAP should identify:

- The nominated individual responsible for implementing the DAP,
- Trigger for implementing the DAP (e.g., threshold dust or PM₁₀ level, number of complaints or observed/forecast weather patterns),
- Clear description of reporting procedures (including complaints reporting – see Appendix D for complaint reporting/investigation log form),
- Site parameters to be recorded, e.g., date, time, source, duration, wind speed & direction, number & type of any complaints received,
- The reason for the incident, e.g., haulage trucks travelling along site access roads during period of extended dry weather, and
- Any actions taken to mitigate the incident, and/or prevent its recurrence

Threshold concentrations could be defined on the basis of levels of dust which could affect local amenity, and/or levels of dust which could affect airborne PM₁₀ concentrations, particularly at sites in or near an AQMA.

The potential for the initiation of dust propagation based on soil type and wind speed is given in Table 5.1 and Table 5.2 of the accompanying Overview document.

The information recorded should be reported in the DMP and should be used to identify new or currently inadequately controlled dust sources.

Site staff should be informed of the content of the DAP as part of their on-going staff training. Site operators should check that where the threshold dust or PM₁₀ level at which the DAP will be implemented is at risk of being exceeded, best practice is in place as this could be used as a defence from prosecution under s.80 of the EPA 1990.

6.4 Monitor

There can be single or multiple reasons for undertaking dust monitoring:

- Baseline monitoring to establish current concentrations and sources.
- Routine assessment of dust concentrations during day-to-day operation of the site.
- Demonstrate compliance with AQO or planning permission condition.

As outlined in Section Section 5 it is important to:

- Record justification for site monitoring strategy (e.g., baseline monitoring, planning permission conditions, proximity to local AQMA) and assessment criteria.
- Keep clear, standardised records should be kept of the measurement methods, monitoring periods and results.
- Maintain the dust monitoring network and associated quality assurance programme.
- Record daily site conditions, including prevailing meteorology, e.g., rainfall, wind speed wind direction, site operations, site conditions and daily water bowser deployment (see Appendix D). For sites involved in the extraction of hard stone, the EPR permit normally requires that a log of the prevailing meteorology is kept.
- Undertake on-/off-site investigations following complaint reporting (see Appendix D for complaint reporting/investigation log form).
- Record the date and time of specific dust events (exceedence of threshold limits for dust or air quality objective values for PM₁₀) in the site log.
- Record the date and time of dust complaints in site log (examples of dust complaint and exceedence reporting forms are given in Appendix D).
- Compile a monitoring checklist (see Appendix F).
- Carry-out periodic checklist inspection (see Appendix F).
- Provide a traceable audit trail of calibration data, monitoring protocol, measured dust and/or PM₁₀ concentrations, and data analysis where required.

6.5 Reviewing and Reporting

The final component of the DMP is the periodic reviewing and reporting of the effectiveness of the control, management and measurement methods employed to limit and measure dust emissions from extractive activities. This phase allows corrective actions to be identified (if not already done so) and incorporated into the DMP. The review and reporting exercise should be undertaken by the person responsible for the implementation of the DMP, though this will be dependent on company size and structure.

6.5.1 Review

The review process can be divided into two components:

1. System review, and
2. Performance review.

The review process should encompass issues and items identified in the upgrade checklist. (see Appendix C).

System review

Perform an annual review of the suitability, adequacy and effectiveness of the DMP considering:

- The extent to which objectives and targets have been met.
- Any dust concerns or complaints from external stakeholders.
- Performance based on monitoring results.

- Periodic internal audit findings of dust management practices.
- Periodic internal technical reviews of dust control trials and investigations.
- Changing circumstances, including any developments in European, national or local statutory and policy requirements.
- Need for an external review of dust management practices and monitoring results.
- Any changes or recommendations for improvement identified are incorporated into the DMP.

Performance review

Perform annual review of performance of the current DMP against the previous year's performance. The performance review is intended to:

- Report on the site's performance against specified criteria, national objectives and targets.
- Provide a review and analysis of nuisance dust and PM₁₀ monitoring results for the reporting year. Monitoring data should be tabulated and plotted graphically to provide an indication of long-term trends for review purposes. All exceedences should be noted together with date, duration and reason, if known. In instances where statutory limits apply these should be indicated on the plots.
- Analyse trends in nuisance dust and PM₁₀ monitoring data in order to assess the effectiveness of the DMP.
- Evaluate the monitoring strategy.
- Evaluate the effectiveness of completed improvement plans, and compare data to standards and guidelines where relevant.
- Identify areas for improvement, clearly stating intended control method.
- Summarise complaints relating to dust received from the local community.
- Provide analysis of nuisance dust and PM₁₀ exceedences against agreed standards.

Any changes or recommendations for improvement identified can be incorporated into the DMP.

6.5.2 Report

Reporting can range from voluntary internal operator reporting to formal communication to regulators or the public. This can be a review of the performance of the dust management of the site against the aims and objectives of the DMP and this can be part of a wider annual environmental report. This could be incorporated into the EMS for the site. The dust performance report should:

- Include a summary of any baseline and continuous site monitoring data. The following information should be reported: instrument specification, method, number, location (preferably on a site map), measurement units and contractor or data supplier.
- An assessment of the performance of dust control measures and dust measurements against assessment criteria.
- The outcome of the system and performance review.
- Communicate dust performance to stakeholders: site team members, company management, regulators and the local community.

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Appendices

- Appendix A: PPS23 Appendix A: Relevant matters for individual planning applications
- Appendix B: Environmental Permitting (England and Wales) Regulations 2010 (as amended)
- Appendix C: Corrective action summary sheet
- Appendix D: Complaint protocol
- Appendix E: Site inspection and bowser deployment log
- Appendix F: Site checklists

Appendix A

PPS23 Appendix A: Relevant matters for individual planning applications

The following matters (not in any order of importance) should be considered in the preparation of development plan documents and may also be material in the consideration of individual planning applications where pollution considerations arise:

- The possible impact of potentially polluting development (both direct and indirect) on land use, including effects on health, the natural environment or general amenity.
- The potential sensitivity of the area to adverse effects from pollution, in particular reflected in landscape, the quality of air, nature conservation (including Sites of Special Scientific Interest (SSSIs), National Parks, Areas of Outstanding Natural Beauty (AONBs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Wetland of International Importance (RAMSAR sites), agricultural land quality, water supply (Source Protection Zones), archaeological designations and the need to protect natural resources.
- The need to identify land, or establish criteria, for the acceptable location of potentially polluting developments and the availability of alternative sites.
- The existing, and likely future, air quality in an area, including any AQMAs or other areas where air quality is likely to be poor (including the consideration of cumulative impacts of a number of smaller developments on air quality, and the impact of development proposals in rural areas with low existing levels of background air pollution). The findings of air quality reviews and assessments will be important in the consideration of local air pollution problems and the siting of certain types of development. The need for compliance with any statutory environmental quality standards or objectives (including the air quality objectives prescribed by the Air Quality 2000 and Amending Regulations 2002).
- Existing action and management plans with a bearing on environmental quality including: Air Quality Management Area Action Plans (prepared by Local Authorities under Part IV of the EA 1995), Biodiversity Action Plans (prepared by English Nature, local partnerships and the UK Biodiversity Steering Group), Noise Management Plans and Noise Action Plans (prepared by the Local Authority, and in London, the Mayor's London Ambient Noise Strategy), Local Agenda 21s (Sustainable Development initiatives prepared by the Local Authority), Community Strategies (prepared by the Local Authority under the Local Government Act 2000), State of the Environment Reports (prepared by some Local Authorities and the Mayor of London)*.
- The possibility that (whether or not some aspects of the development are subject to pollution control), emissions of smoke, fumes, gases, dust, steam, smell, vibration or noise from the development might nevertheless be seriously detrimental to amenity in addition to constituting a statutory nuisance under Part III of the EPA 1990.
- The objective perception of unacceptable risk to the health or safety of the public arising from the development.

* The Government White Paper *Strong Local Leadership "Quality Public Services"*, November 2002, contained proposals to reduce and rationalise the requirements for authorities to prepare plans to central government specifications.

Appendix B

Environmental Permitting (England and Wales) Regulations 2010 (as amended)

Under Environmental Permitting (England and Wales) Regulations 2010 (as amended) the Secretary of State has published a series of Process Guidance Notes that cover quarry activities and associated activities.

Process	
Prescribed	Not prescribed
Processing and drying of clay (PG 3/02).	Drilling/blasting/extraction of minerals.
General quarry processes associated with the processing of designated minerals including crushing and screening (PG 3/08). Mobile crushing and screening are covered by PG 3/16.	Handling of clay at quarries (unless crushing, grinding or screening is to take place – see PG 3/17).
Manufacturing plaster from gypsum (PG 3/12).	Removal of overburden.
Lime processing, e.g., for slaking (PG 3/14).	Extraction of sand and gravel.
Drying and cooling of sand and minerals (PG 3/15b).	Chalk processing.
China and ball clay processing (PG 3/17).	Cutting and dressing of stone.

PG Notes are reviewed periodically therefore these references may change in time.

Appendix C

Corrective action summary sheet

Below is an example form that can be used by site personnel to record dust complaints and corrective actions in order to mitigate site dust emissions. A column is included to allow comments to be recorded. Comments could include the reason why the completion of a suggested action has been delayed or follow-up actions. This form is a suggested outline and can be amended, as appropriate, to reflect different situations.

Site	<i>Old Quarry</i>			
Period started	<i>2010</i>			
Reason for proposal	Proposed action	Who will oversee implementation	Target date for completion	Comment
<i>Installation of automatic (wind activated) water sprays in stockpile yard.</i>	<i>Limit wind blown dust from stockpiles to adjacent houses and onto public foot path. Release staff for other duties.</i>	<i>Site manager</i>	<i>Before end of June (onset of dry weather).</i>	
<i>Seeding of overburden storage piles.</i>	<i>Limit wind blown dust from stockpiles to adjacent houses and onto public foot path.</i>	<i>Site manager</i>	<i>Before end of June (onset of dry weather).</i>	
<i>Site traffic not using agreed route around local village into site. This has lead to an increase in the number complaints received and fouling of roads.</i>	<i>Notify haulage companies and drivers of the requirement to use agreed route. Ensure site road sweeper periodically checks and cleans all routes into the site Hold meeting with local residents to apologise and inform them of site actions to remedy this problem. Distribute vehicle log sheets for residents to record details of offending vehicles. Ban hauliers from site that contravene this instruction.</i>	<i>Site manager</i>	<i>End of week (ASAP) as this breaches site planning permission conditions.</i>	<i>Prepare letter to hauliers. Prepare vehicle log sheets to distribute at residents' meeting.</i>

Appendix D

Complaint protocol

Below is an example form that can be used by on-site personnel to record dust complaints from local residents is given below. This is a suggested outline and can be amended, as appropriate, to reflect different situations.

Site dust complaint form		
Site:		Operator:
Complaint Ref.:		Date: Page of
Name and address of complainant:		
Tel no. of complainant:		
Time and date of complaint:		
Date, time and duration of offending dust:		
Location of dust, if not at above address:		
Weather conditions (i.e., dry, rain, fog, snow):		
Wind strength and direction (light, steady, strong, gusting):		
Complainant's description of dust (colour, origin):		
Intensity of dust (light, moderate, strong, persistent):		
Has complainant any other comments about the dust?		
For completion by site manager		
Are there any other complaints relating to the installation, or to that location? (either previously or relating to the same exposure)		
Any other relevant information:		
On-site activities at time the dust occurred (e.g., stock-pile movement):		
Operating condition at time dust occurred (e.g., normal, abnormal, maintenance/special):		
Remedial action taken		
Corrective action planned		
Corrective action completed		
Form completed by	Signed	Date

ORIGINATOR:

AUTHORISED BY:

DATE:

DATE:

The form below is an example of a simple site dust log that can be issued to local residents to record dust events. This is a suggested outline containing example entries and can be amended, as appropriate, to reflect different situations.

Residents' dust log

Please fill in the table below with as much detail as possible. The description box should contain information on significant dust events, including intensity and duration. Please use the sheet for all instances – this will enable cross checking against the site's log to provide appropriate and timely source apportionment. Please ensure the log is signed and dated before returning the sheet to the site office.

Thank you for your co-operation
A. N. Other
Site Manager
Site managers contact number (e.g., mobile number)

Date	Time (approx)	Description of event	Reported by
<i>01/07/09</i>	<i>All day</i>	<i>Soiling of window sills and laundry</i>	<i>Local resident</i>
<i>23/08/09</i>	<i>10-11 am</i>	<i>Visible dust cloud</i>	<i>Local resident</i>
Print name		Signature	Date

Appendix E

Site inspection and bowser deployment log

Below is an example of a form that can be used by on-site personnel to record daily site conditions. This is a suggested outline and can be amended, as appropriate, to reflect different situations. A site inspection sheet is required under EPR regime for hard rock sites; sand and gravel sites are excluded from needing a site inspection log.

Site environmental inspection log			
Weather conditions	<i>Dry, warm, sunny</i>	Wind direction	<i>S</i>
Ground conditions	<i>Dry</i>	Wind speed	<i>0-5 m s⁻¹</i>
Observation point	<i>Site office</i>	Date and time of inspection	<i>23 April 2010</i>
General notes			

<i>Stockpiles – consider dust and noise, fixed sprays effective, water bowser needed</i>	
<i>Stockpiles wetted this afternoon (prior to weekend) due to prolonged dry spell (> 2 days without rain)</i>	
<i>Primary crusher – consider noise and dust control, water sprays, doors closed</i>	
<i>Not in use – no comments</i>	
<i>Main processing plant – consider noise and dust control, water sprays, doors closed</i>	
<i>Water sprays on this morning when plant in use to minimise dust</i>	
<i>Haul roads and yard area – consider dust, fixed sprays, water bowser/sweeper, traffic</i>	
<i>Haul roads and yard wetted this morning (prior to weekend) due to prolonged dry spell (> 2 days without rain) and extensive on-site vehicle activity</i>	
<i>General comments – any other problems? maintenance items, e.g., new filter bags etc.</i>	
<i>N/A</i>	
<i>Remedial action taken – what/when/where.....</i>	
<i>N/A</i>	

Inspected by	Site manager	Signature	
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Daily water bowser deployment log

Date	Time	Area covered	Sprays working	Ground wet from sprays working	Material on stockpiles damp

Appendix F

Site checklists

The summary below shows the various measures put in place split into maintenance issues to ensure control equipment is working efficiently, procedural items developed to minimise dust generation, monitoring procedures to check compliance and a section to record progress with any identified upgrading items. This is a suggested outline containing example entries and can be amended, as appropriate, to reflect different situations.

Maintenance checklist

Item	Description	Frequency
A	Dust suppression sprays to be checked for correct operation.	Annually, during spring re-commissioning.
B	The condition of the fixed processing plant enclosures will be inspected for damage and efficiency and any problems rectified.	April
C	The dust collection plant will be inspected on a regular basis and corrective actions taken. The inspections and any follow up action will be recorded on the daily check sheet.	Quarterly
D	The water bowser will be subject to a thorough inspection and any problems rectified.	April
E	Powder silo vents and pressure relief valves will be inspected and any problems rectified.	Weekly
F		

Procedural checklist

Item	Description
1	Regular environmental awareness training will be conducted to ensure employees appreciate what are acceptable and unacceptable levels of airborne dust as well as their responsibilities within the sites Part B permit obtained under the EPR regime.
2	Material drop heights during loading of vehicles will be minimised by good operator awareness and the use of the luffing conveyor on the road load-out.
3	Stockpiles to be reviewed prior to first loading to check moisture content, weather conditions and resultant dust potential. If there is a risk of dust emissions crossing the site boundary the water bowser will be used to dampen down the "dry" stockpile before it is used.
4	Water bowser operation to be reviewed at the start of the day, in adverse conditions the bowser operation will be reviewed on a regular basis throughout the day.
5	

Monitoring checklist

Item	Description	Frequency
i	Site conditions and potential for dust emissions to be reviewed at start of quarry production (before 0900hrs).	Daily
ii	Dust generation and fugitive emissions will be observed along with weather conditions and other mitigating or contributory factors and recorded in a log book.	Daily
iii	Dust suppression sprays to be checked for efficient operation.	Monthly between April and October
iv	The effectiveness of the sites wheel washes will be assessed for material carry out onto the public highway.	Daily
v	Dust levels from the loading of stock from the stock-piles. Request water bowser as and when required.	As conditions change
vi	Check water level in the wheel-wash.	Daily
vii	Record date time and effectiveness of bowser operation.	Each bowser run
ix		

Consultation

The following organisations were consulted during the preparation of this document.

British Aggregates Association (BAA)

Minerals Products Association (MPA)

Silica and Moulding Sands Association (SAMSA)

The Chartered Institute of Environmental Health (CIEH)

Planning Officers Society (POS)

Derbyshire Dales District Council

Suffolk County Council

Teignbridge District Council

University of Exeter

University of Leeds

University of Nottingham

Aggregate Industries (AI)

Advance Environmental

DustScan Ltd.

CEMEX

Hanson

Johnsons Wellfield Quarries Ltd.

Sherburn Stone Co. Ltd.

Smith & Sons (Bletchington) Ltd.

Sibelco UK

Tarmac Ltd.

UK Coal



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