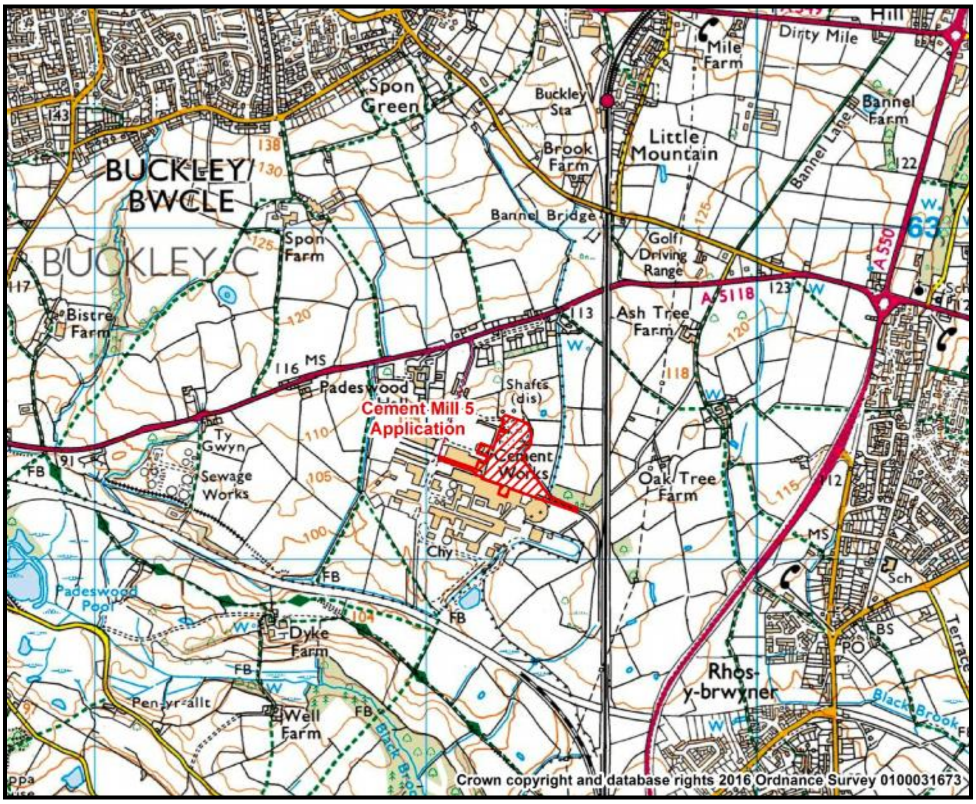
# HANSON CEMENT

## AIR QUALITY ASSESSMENT OF MILL 5:

## *PADESWOOD CEMENT WORKS*

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Independent Air
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CONTENTS

# 1 INTRODUCTION

## 1.1 PURPOSE OF THE ASSESSMENT

Gair Consulting Ltd has been commissioned by Hanson Cement to undertake an air quality assessment of a new cement mill at the Padeswood Cement Works in Flintshire. The assessment is principally in support of the planning application for the proposed new cement mill but also provides information to support the variation to Environmental Permit for the site.

This assessment provides an assessment of the potential air quality impacts of the operation of Mill 5. It focuses on emissions of fine particles. As the Padeswood Cement Works is a source of particle emissions from a wide variety of sources, a cumulative assessment is provided of existing emissions and the additional emissions to air from the operation of the new mill.

## 1.2 SCOPE OF THE ASSESSMENT

The main focus of the assessment is to provide the following:

- The quantification of particle emissions from the cement works for the various sources.
- A dispersion modelling assessment of emissions of particles from the Padeswood Cement Works with and without the additional emissions from Mill 5.
- An assessment of other emissions associated with the proposed new cement mill including changes in vehicle movements.

## 1.3 BACKGROUND TO THE STUDY AREA

The Padeswood Cement Works is located approximately 500 m west of Penyffordd and around 1,500 m south of Buckley. The village of Padeswood is directly to the north of the works and there are a number of residential properties on the southern periphery of the village that are in close proximity to the boundary of the Works. The location of the Padeswood Cement Works is presented in *Figure 1.1*.

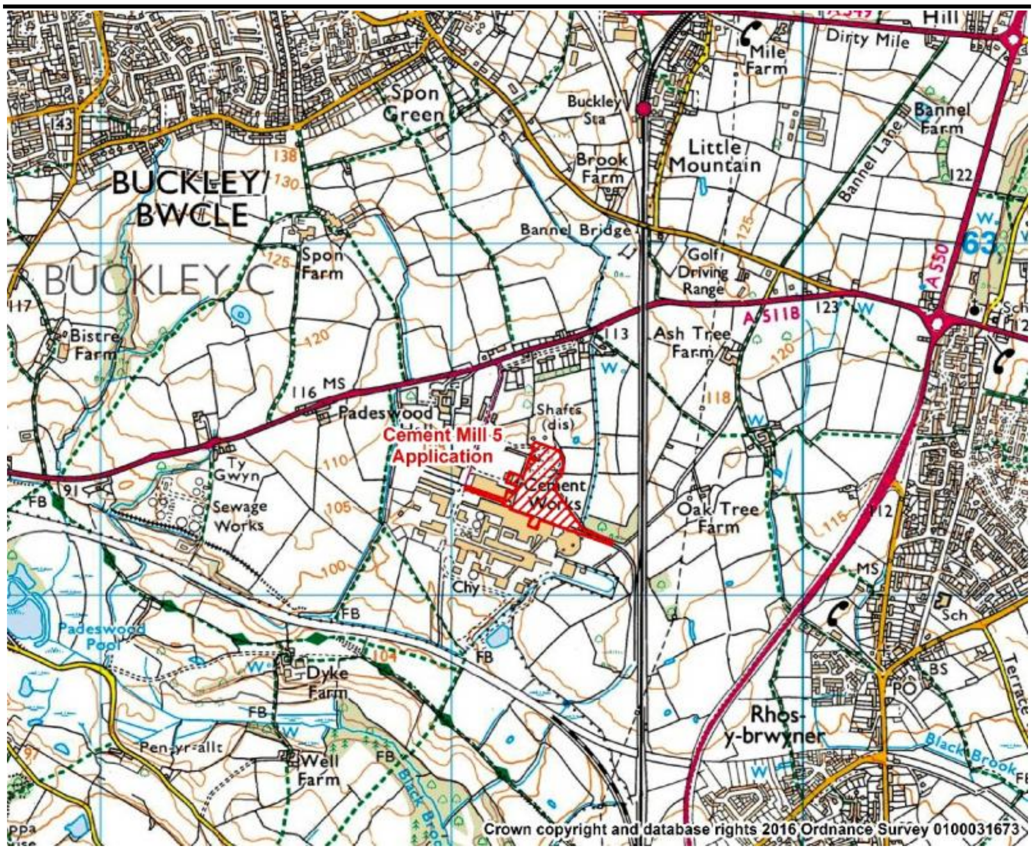
The Works manufactures cement and the installation includes:

- raw material handling and processing;
- clinker manufacturing, handling, grinding and storage;
- cement handling, storage and bulk despatch; and
- fuel handling, storage and processing.

All of these activities have the potential to generate particle emissions either from various emission control systems (e.g. bag filters) and here referred to as point sources, or from fugitive releases (i.e. unintended releases from uncontrolled sources).

The project will involve the demolition of existing cement storage and loading facilities and the erection of a new vertical roller mill, rail loading facility and modification to (and extension of) the existing railway line, together with ancillary development (including three steel cement storage silos, belt conveyors and pneumatic pipelines). The application area extends to approximately 3.1 hectares.

**FIGURE 1.1 LOCATION OF THE PADESWOOD CEMENT WORKS**




## 1.4 SCOPE OF WORK

The assessment has considered the impact of the Cement Mill 5 emissions during operation. The main emission from the cement mill is total suspended particles (TSP) which will comprise a range of particle sizes. For human health effects, fine particles (i.e. particles of less than 10 µm in diameter, termed $PM_{10}$ or less than 2.5 µm termed $PM_{2.5}$) are of most concern. Therefore, as a worst-case it is assumed that particle emissions from the cement works comprise entirely of these finer fractions. The larger particles will settle quicker and be less likely to remain airborne as well as being of less concern for human health effects.

There is a hot gas generator (HGG) associated with the new cement mill. This is used to dry the material during grinding mainly due to the moisture content of the gypsum and limestone. The HGG would utilise gas oil, kerosene or processed fuel oil and will result in combustion emissions (e.g. oxides of nitrogen, carbon monoxide and sulphur dioxide). However, the HGG would only be used at start-up from cold and during grinding of some products during the winter.

To support the permit variation an assessment of emissions from the HGG using the H1 tool has been carried out. This was carried out assuming that the HGG operates continuously and represents very worst-case conditions as it is anticipated that it will only operate up to a maximum of 20% and likely to be much less than this. The results of the H1 assessment under these worst-case operating conditions, indicate that annual mean $NO_2$ concentrations would be less than 1% of the long term Environmental Assessment Level (EAL) and short term concentrations would be less than 10% of the short term EAL. Therefore, it is concluded that a detailed assessment of emissions of the oxides of nitrogen, as well as other pollutants associated with the combustion process is not required. Furthermore, background concentrations of $NO_2$ (key pollutant from combustion processes) in the local area are very low (refer *Section 2.4.1*). Therefore, the assessment of emissions from the cement mill has considered particle emissions only.

It is considered that fugitive emissions from the new cement mill and associated facilities will be minimal as all transport and storage of product will be covered or enclosed. Therefore, it is concluded that the impact of fugitive emissions on human and habitat receptors would be minimal and is not considered further.

In addition to operational impacts of the cement mill, it will be necessary to assess the potential impact on air quality of the construction phase and associated activities. These include the following:

- Construction activities associated with the cement mill, associated silos and upgrading of the railway sidings; and
- Increases in vehicle movements (e.g. road and rail) associated with the commissioning of the new cement mill.

As a result of the introduction of the new cement mill, it is anticipated that there will be a reduction in road traffic vehicle movements but an increase in rail movements. The reduction in road traffic is estimated as 31 vehicles per day (62 vehicle movements into and out of the site).

The number of heavy duty vehicles (HDV's) accessing the site is estimated at an average of 35 movements per week (approximately 6 per day for a 6 day working week) over the duration of the construction period. At worst, there would be around 28 HDV movements per day due to the movement of materials off site (estimated as 675 HDV vehicles, 1,350 movements, over an eight-week period). Construction personnel will result in an additional 85 vehicles (170 movements) per day assuming each worker travels in their own vehicle. The number of additional rail movements is estimated to be 175 trains (350 rail movements) per year. Therefore, there would be approximately one movement per day on average. Therefore, it is concluded that the impact of rail traffic and road traffic on local air quality can be screened out of the assessment.

## 1.5 STRUCTURE OF THE REPORT

The remainder of this report is presented as follows:

- *Section 2* summarises the relevant assessment criteria, reviews air quality monitoring data in the vicinity of the proposed cement mill and provides a discussion of local meteorological conditions affecting the dispersion and dilution of emissions.
- *Section 3* provides an assessment of the potential air quality impacts associated with the construction of the cement mill and associated activities (e.g. construction dust impacts).
- *Section 4* provides an overview of the assessment methodology for operational impacts.
- *Section 5* provides an assessment of the potential air quality impacts arising from the operation of the cement mill.
- *Section 6* summarises and concludes the assessment and provides recommendations for further work or consultation, where necessary.

## 2 BASELINE CONDITIONS

### 2.1 INTRODUCTION

This section of the report defines the baseline environment for the assessment and provides the following:

- a discussion of appropriate ambient air quality assessment criteria for $PM_{10}$ and $PM_{2.5}$;
- a review of background monitoring data for the local area;
- a description of local conditions that will affect the dispersion and dilution of emissions arising from the installation.

The construction of the cement mill and associated infrastructure will have the potential to generate dust from construction activities and also the generation of combustion-type pollutants (e.g. oxides of nitrogen and fine particles) from construction traffic accessing the site and from on-site construction plant.

During the operation of the development there is the potential for impacts to arise from the operation of the cement mill and emissions of particles as other potential sources (e.g. road and rail transport) have been screened out of the assessment.

### 2.2 ASSESSMENT CRITERIA

#### 2.2.1 Oxides of Nitrogen ($NO_x$)

The oxides of nitrogen comprise principally of nitric oxide (NO) and nitrogen dioxide ($NO_2$). The oxides of nitrogen (NOx) in combustion processes may be formed from the oxidation of nitrogen in the fuel or from the reaction of nitrogen and oxygen at high temperatures. The majority of NOx is emitted from combustion processes as NO (typically over 90%), a relatively innocuous substance that rapidly oxidises to $NO_2$ in ambient air. Health based standards for NOx generally relate to $NO_2$.

A Directive (2008/50/EC of the European Parliament and of the Council of 21st May 2008, on ambient air quality and cleaner air for Europe) was adopted in June 2008. The Directive streamlines the European Union's air quality legislation by replacing four of the five existing Air Quality Daughter Directives within a single, integrated instrument.

Directive 2008/50/EC retains the existing air quality standards for $NO_2$, but provides greater clarity on where to assess air quality, so that the focus is on areas of potential public exposure. The Directive has been transposed into the

Air Quality Standards Regulations 2010, which came into force on the 11th June 2010. Air quality limits and objectives for $NO_2$ are summarised in *Table 2.1*

**TABLE 2.1 AIR QUALITY OBJECTIVES AND LIMIT VALUES FOR NITROGEN DIOXIDE**

| Pollutant | Description | Averaging Period | Value («g $m^{-3}$) |
|---|---|---|---|
| **Air Quality Standards (a)** | | | |
| Nitrogen dioxide ($NO_2$) | Objective for the protection of human health | 1-hour mean, not to be exceeded more than 18 times a year (b) | 200 |
| | | Annual mean | 40 |
| **EC Directive on Ambient Air Quality (c)** | | | |
| Nitrogen dioxide ($NO_2$) | Limit value | 1-hour mean, not to be exceeded more than 18 times a year (b) | 200 |
| | | Annual mean | 40 |

(a) Air Quality Standards Regulations 2010
(b) This corresponds to the 99.8th percentile of hourly means
(c) Directive 2008/50/EC of the European Parliament

### 2.2.2 Fine Particles ($PM_{10}$ and $PM_{2.5}$)

Air quality standards for particulate matter generally refer to particles of less than 10 micrometres in diameter, termed $PM_{10}$ and particles of less than 2.5 micrometres in diameter, termed $PM_{2.5}$. Current air quality objectives and limit values for $PM_{10}$ and $PM_{2.5}$ applicable to the assessment are summarised in *Tables 2.2* and *2.3* respectively.

**TABLE 2.2 AIR QUALITY OBJECTIVES AND LIMIT VALUES FOR $PM_{10}$**

| Pollutant | Description | Averaging Period | Value («g $m^{-3}$) |
|---|---|---|---|
| **Air Quality Standards (a)** | | | |
| Fine particles ($PM_{10}$) | Objective for the protection of human health | 24-hour mean, not to be exceeded more than 35 times a year (b) | 50 |
| | | Annual mean | 40 |
| **Directive on Ambient Air Quality (c)** | | | |
| Fine particles ($PM_{10}$) | Limit value | 24-hour mean, not to be exceeded more than 35 times a year (b) | 50 |
| | | Annual mean | 40 |

(a) Air Quality Standards Regulations 2010
(b) This corresponds to the 90.4th percentile of 24-hour means.
(c) Directive 2008/50/EC of the European Parliament

**TABLE 2.3 AIR QUALITY OBJECTIVES AND LIMIT VALUES FOR $PM_{2.5}$**

| Set In 2010 UK Regulations? (a) | Description | Averaging Period | Value («g m$^{-3}$) |
|---|---|---|---|
| **Air Quality Strategy (b)** | | | |
| No | Objective for 2020, UK except Scotland | Annual mean | 25 |
| | Exposure reduction target for urban background areas | Annual mean | 20% reduction in annual mean concentration between 2010 and 2020 |
| **Directive on Ambient Air Quality (c)** | | | |
| No | Target value to be achieved by 1 Jan 2010 | Annual mean | 25 |
| Yes | Stage 1 limit value (by 1 Jan 2015) | Annual mean | 25 |
| No | Stage 2 limit value (by 1 Jan 2020 – to be reviewed in 2013) | Annual mean | 20 |

(a) Air Quality Standards Regulations 2010
(b) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007
(c) Directive 2008/50/EC of the European Parliament

## 2.2.3 Impact Significance Criteria

Environmental Protection UK's Planning for Air Quality 2010 guidance [1] has been updated in association with the Institute of Air Quality Management (IAQM [2]). This provides some changes to the impact descriptors and the assessment of significance. The impact descriptors for individual receptors are presented in *Table 2.4*. The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers. Changes of 0% (i.e. less than 0.5%) would be described as Negligible.

The assessment of significance is principally left to professional opinion and guidance is provided on the factors that need to be considered when judging significance and include the following:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to impacts;
- the worst-case assumptions adopted when undertaking the prediction of impacts; and
- the extent to which the proposed development has adopted best practice to eliminate and minimise emissions.

1 Environmental Protection UK, Development Control: Planning for Air Quality, 2010 Update.

2 Land-Use Planning & Development Control: Planning for Air Quality, EPUK and IAQM (January 2017)

**TABLE 2.4 IMPACT DESCRIPTION FOR INDIVIDUAL RECEPTORS**

| Concentration with Development | Percentage Change in Air Quality Relative to the Air Quality Assessment Level (AQAL) | | | |
|---|---|---|---|---|
| | 1% | 2 to 5% | 6 to 10% | >10% |
| 75% or less of AQAL | Negligible | Negligible | Slight | Moderate |
| 76 to 94% of AQAL | Negligible | Slight | Moderate | Moderate |
| 95 to 102% of AQAL | Slight | Moderate | Moderate | Substantial |
| 103 to 109% of AQAL | Moderate | Moderate | Substantial | Substantial |
| 110% or more of AQAL | Moderate | Substantial | Substantial | Substantial |

In relation to short-term impacts, the IAQM/EPUK guidance states:

> *'6.39 Where such peak short term concentrations from an elevated source are in the range 11-20% of the relevant AQAL, then their magnitude can be described as small, those in the range 21-50% medium and those above 51% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. That is not to say that background concentrations are unimportant, but they will, on an annual average basis, be a much smaller quantity than the peak concentration caused by a substantial plume and it is the contribution that is used as a measure of the impact, not the overall concentration at a receptor. This approach is intended to be a streamlined and pragmatic assessment procedure that avoids undue complexity.'*

Therefore, the following descriptors for assessing the impact magnitude resulting from short term impacts are applied in this assessment:

- 10% or less: negligible;
- 11-20%: small;
- 21-50%: medium; and
- 51% or greater: large.

## 2.3 LOCAL AIR QUALITY MANAGEMENT

Local Authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met within the relevant time period, the authority must designate an Air Quality Management Area (AQMA) and produce a local action plan. Flintshire County Council are responsible for reviewing air quality within the County and their latest air quality management and review report was issued in October 2016 [3]. The Annual Progress Report considers all new monitoring data and assesses the data against the air quality guidelines and objectives. It also considers any changes that may have an impact on air quality.

Previous rounds of review and assessment of air quality have identified areas in the County where exceedances of the annual mean objectives have occurred. Detailed Assessments have been carried out in 2004 and 2010 for $PM_{10}$ and $NO_2$. Both Detailed Assessments concluded that no AQMA was required in the assessment area. Therefore, no AQMAs have been declared in the County.

## 2.4 LOCAL MONITORING

### 2.4.1 Nitrogen Dioxide ($NO_2$)

Automatic monitoring of $NO_2$ was carried out at one site in the County during 2015 at a location near Mold. Measured concentrations at this location would not be characteristic of $NO_2$ concentrations at the cement works site.

Monitoring of $NO_2$ using passive diffusion tubes was carried out at 52 sites in 2015. The nearest location to the cement works is Diffusion Tube 41. This is located approximately 1 km to the west of the cement works and is a kerbside site at a distance of 15 m from the kerb. Measured concentrations of $NO_2$ as the annual mean for the last five years are as follows:

- 15.9 µg $m^{-3}$ (40% of the air quality objective) for 2011;
- 14.5 µg $m^{-3}$ (36%) for 2012;
- 11.8 µg $m^{-3}$ (30%) for 2013;
- 10.6 µg $m^{-3}$ (27%) for 2014; and
- 9.9 µg $m^{-3}$ (25%) for 2015.

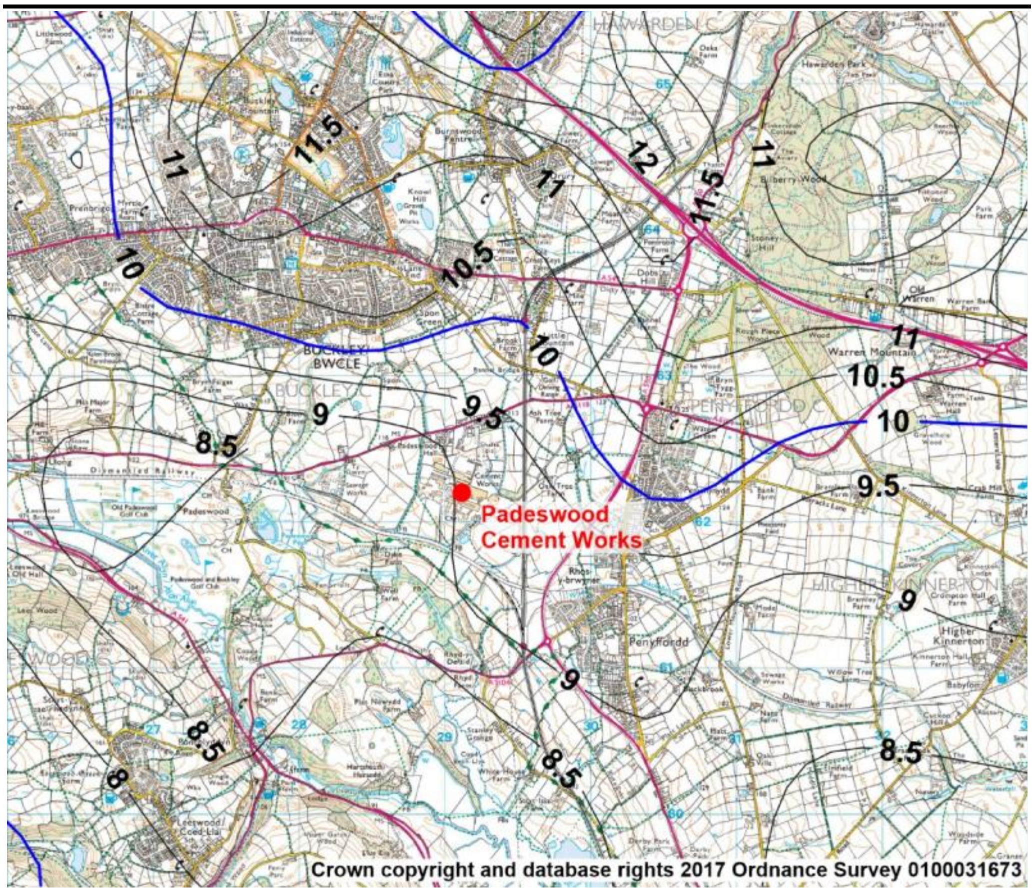
There would appear to have been a gradual decrease in measured $NO_2$ concentrations at this monitoring site over the five-year period.

Ambient background concentrations of $NO_2$ have also been obtained from the Defra UK Background Air Pollution Maps [4]. These 1 km grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites. Annual mean background mapped $NO_2$ concentrations for 2017 are presented in *Figure 2.1*.

3 Flintshire County Council 2016 Air Quality Progress Report (October 2016)

4 https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013

**FIGURE 2.1 ANNUAL MEAN $NO_2$ BACKGROUND CONCENTRATION FOR 2017 ($\mu g\ m^{-3}$)**




Mapped annual mean $NO_2$ concentrations around the cement works are between 8.5 and 10 $\mu g\ m^{-3}$ and are consistent with the measured concentrations using diffusion tubes in 2015. Therefore, for the purposes of the assessment a background $NO_2$ concentration of 12.5 $\mu g\ m^{-3}$ (mean of the five years at the diffusion tube site) has been assumed. This is well below the air quality objective of 40 $\mu g\ m^{-3}$.

### 2.4.2 Fine Particles ($PM_{10}$ and $PM_{2.5}$)

Monitoring of $PM_{10}$ by Flintshire County Council is carried out at the Mold monitoring site but as for $NO_2$ this would not be representative of measured $PM_{10}$ at the cement works site.

There has been some historic monitoring of $PM_{10}$ and $PM_{2.5}$ carried out by both Castle Cement and the Environment Agency. Data obtained by Castle Cement is considered to be less reliable than that obtained by the Environment Agency. Concentrations of $PM_{10}$ and $PM_{2.5}$ were measured by the Environment Agency between 10 February 2006 and 3 December 2007 [5]. Assuming the period of monitoring is representative of the measured concentrations in 2006 and 2007,

5 Study of Ambient Air Quality at Pen-y-ffordd, 10 February 2006 and 3 December 2007, Environment Agency Report (July 2008)

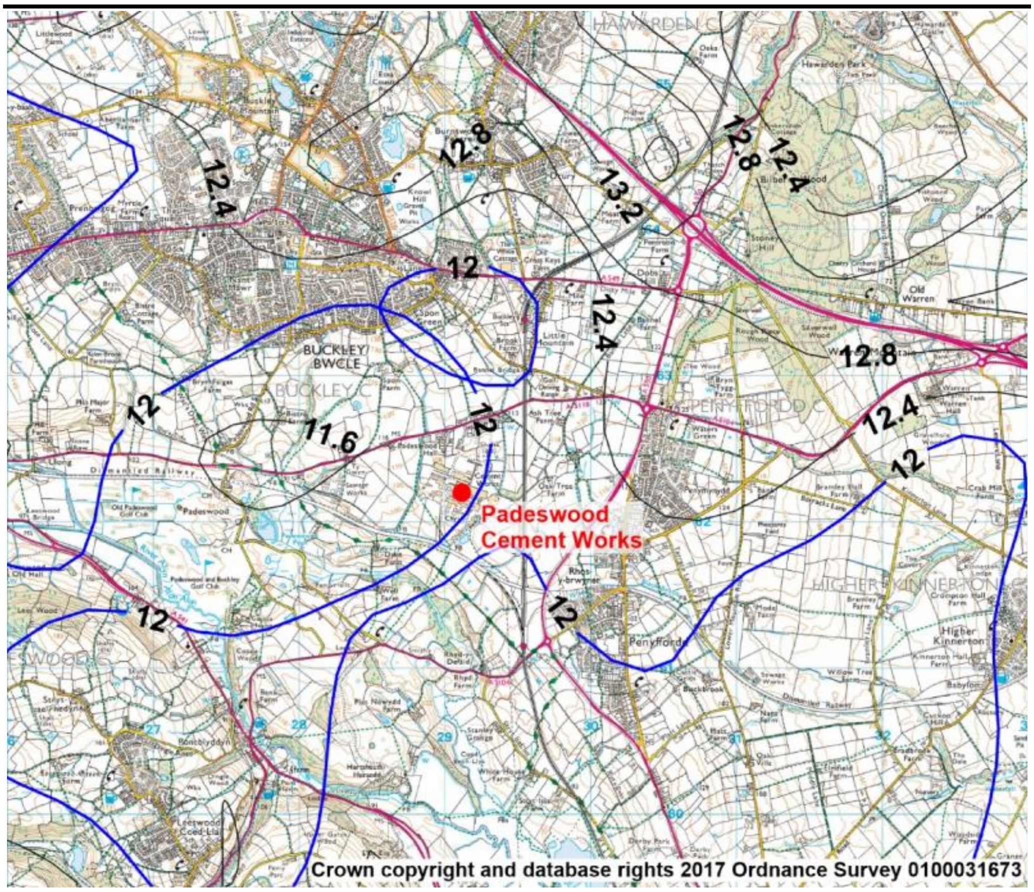
a summary of measured concentrations is presented in *Table 2.5*. Measured concentrations were well below the relevant air quality objectives (AQO's).

**TABLE 2.5 MEASURED $PM_{10}$ AND $PM_{2.5}$ CONCENTRATIONS AT THE ENVIRONMENT AGENCY'S PENYFFORDD MONITORING STATION**

| Statistic/ Year | 2006 | 2007 | AQO |
|---|---|---|---|
| Annual Mean $PM_{10}$ | 21.1 | 20.4 | 40 |
| Number of Exceedances of 24-hour Mean | 9 | 8 | 35 (a) |
| Annual mean $PM_{2.5}$ | 11.9 | 11.7 | 25 |
| (a) 35 allowable exceedances per annum | | | |

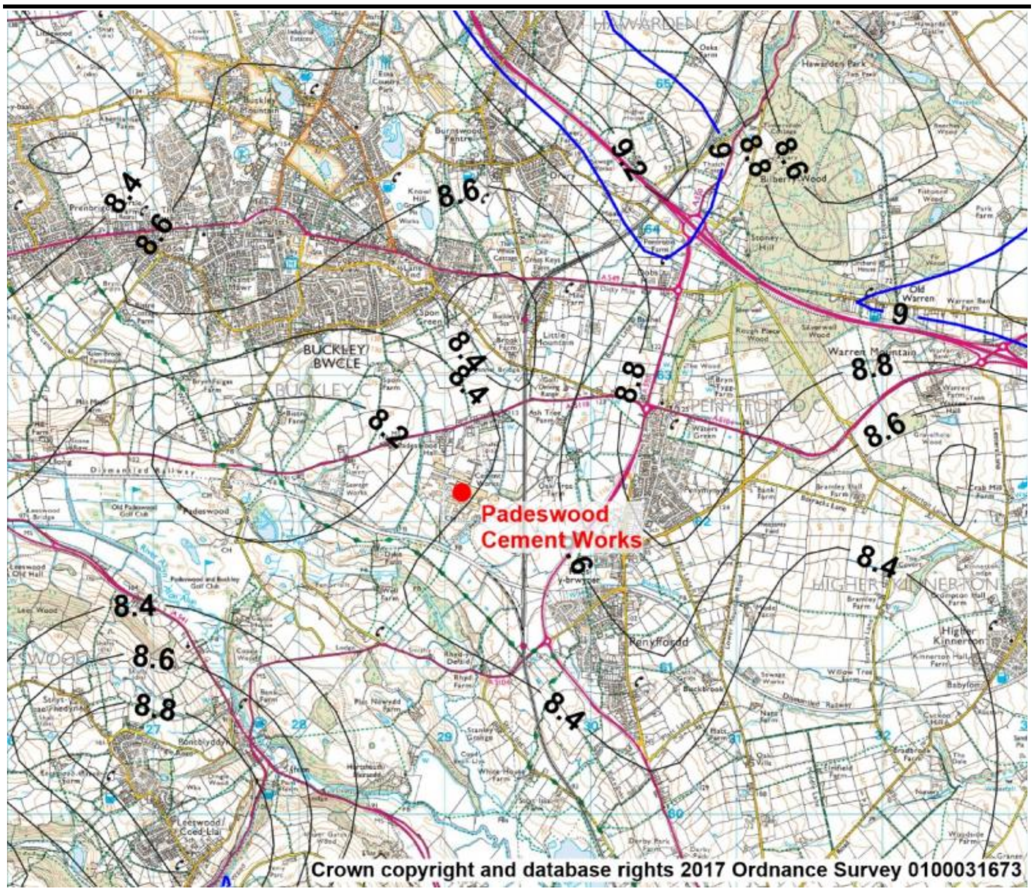
Mapped background concentrations of $PM_{10}$ and $PM_{2.5}$ are presented in *Figure 2.2* and *Figure 2.3*, respectively. However, it should be noted that these will include a contribution from the cement works.

**FIGURE 2.2 ANNUAL MEAN $PM_{10}$ BACKGROUND CONCENTRATION FOR 2017 ($\mu g\ m^{-3}$)**




Measured concentrations of $PM_{10}$ around the cement works are around 12 to 13 $\mu g\ m^{-3}$ and are well below the air quality objective of 40 $\mu g\ m^{-3}$. For the purposes of the assessment an annual mean concentration of 13 $\mu g\ m^{-3}$ has been assumed which is the higher mapped background level. Measured concentrations at Penyffordd are higher but these measurements were obtained over ten years ago and there have been significant reductions in emissions from the cement works since that time.

**FIGURE 2.3 ANNUAL MEAN $PM_{2.5}$ BACKGROUND CONCENTRATION FOR 2017 ($\mu g\ m^{-3}$)**




Measured concentrations of $PM_{2.5}$ around the cement works are around 8 to 9 $\mu g\ m^{-3}$ and are well below the air quality objective of 25 $\mu g\ m^{-3}$. For the purposes of the assessment an annual mean concentration of 9 $\mu g\ m^{-3}$ has been assumed which is the upper mapped background concentration.

## 2.5 LOCAL CONDITIONS

### 2.5.1 The Dispersion and Dilution of Emissions

For meteorological data to be suitable for dispersion modelling purposes a number of meteorological parameters need to be measured, on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature. There are only a limited number of sites where the required meteorological measurements are made. In the UK, all of these sites are quality controlled by the Met Office.

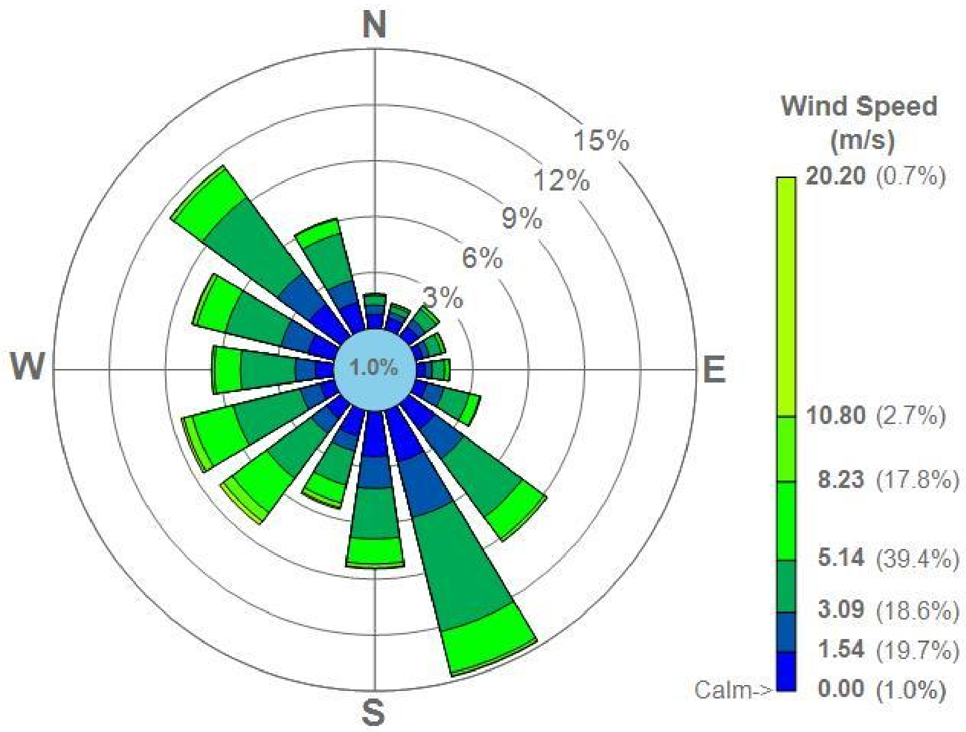
The most important climatological parameters governing the atmospheric dispersion of pollutants are as follows.

- **Wind direction** determines the broad transport of the emission and the sector of the compass into which the emission is dispersed.
- **Wind speed** will affect ground level emissions by increasing the initial dilution of pollutants in the emission.
- **Atmospheric stability** is a measure of the turbulence, particularly of the vertical motions present.

### 2.5.2 Local Wind Speed and Direction Data

Five years (2012 to 2016) of meteorological data were obtained for Hawarden and a wind rose for the five years is presented in *Figure 2.4*.

**FIGURE 2.4 WIND ROSE FOR HAWARDEN (2012 TO 2016)**



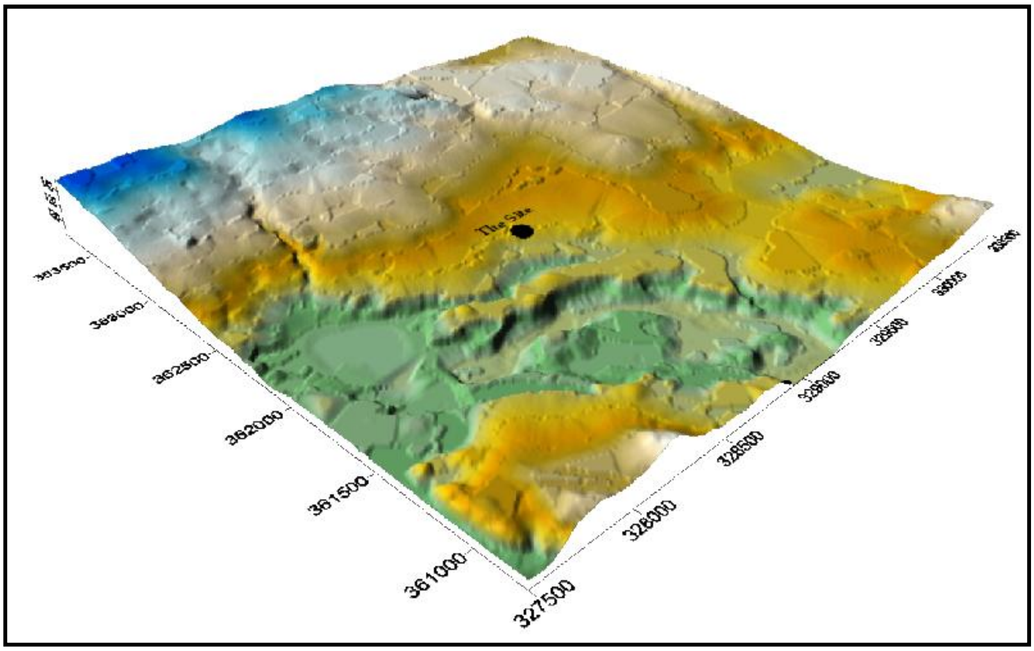

There are two dominant wind directions for Hawarden from the south-southeast (14.7%) and from the northwest (11.5%). The north-westerly to south-easterly bias is likely due to the channelling of winds along the Dee Estuary and Dee Valley. Calm conditions occur for around 1.0% of the time.

### 2.5.3 Topography

The presence of elevated terrain can significantly affect the dispersion of pollutants in a number of ways. For stack emissions, the presence of elevated terrain reduces the distance between the plume centre line and the ground level, thereby increasing ground level concentrations. Elevated terrain can also increase turbulence and, hence, plume mixing with the effect of increasing concentrations near to an elevated source and reducing concentrations further away. For low level sources such as from the cement works (excluding the main kiln stack), increased turbulence will result in improved dilution and dispersion but could also result in an increase in emissions from sources that are susceptible to wind erosion.

The works is located in an area of relatively complex terrain. Consequently, information relating to the topography of the area surrounding the site has been used in the dispersion modelling to assess the impact of terrain features on the dispersion of emissions from the Works. A three-dimensional visualisation of the terrain around the cement works is presented in *Figure 2.5*. It should be noted that the height scale has been accentuated four-fold to highlight the areas of elevated terrain. The cement works is located in the centre of the area and the most prominent terrain rises towards Buckley to the north.

**FIGURE 2.5 3D VISUALISATION OF TERRAIN AROUND THE WORKS**



# 3 IMPACT OF DUST-GENERATING ACTIVITIES DURING THE CONSTRUCTION PHASE

## 3.1 DUST ANNOYANCE

### 3.1.1 Introduction

Dust in the community is normally perceived as an accumulated deposit on surfaces such as washing, window ledges, paintwork and other light coloured horizontal surfaces, e.g. car roofs. When the rate of accumulation is sufficiently rapid to cause noticeable fouling, discoloration or staining (and thus decrease the time between cleaning) then the dust is generally considered to be an annoyance. However, the point at which an individual makes a complaint regarding dust is highly subjective.

Any form of demolition or construction activity has the potential to generate dust emission and thereby cause annoyance to people in the vicinity.

### 3.1.2 Characterisation of Particles

Principally, particles are characterised by their size and their chemical composition. Particle emissions arising from construction activities will vary, particularly with regard to their size. Large particles (in excess of 10 µm) are associated with annoyance nuisance impacts, as these particles are rapidly removed from the atmosphere and deposit onto horizontal surfaces where they may cause a soiling affect.

Smaller particles (less than 10 µm) are of concern due to their potential impact on human health. The size distribution of particles in urban air is conventionally characterised by three modes. The smallest of these, below 0.1 µm in diameter, is called the nucleation mode and is formed by condensation of hot vapour from combustion sources and from chemical conversion of gases to particles in the atmosphere. Particles of this size have a high chance of deposition in the gas-exchanging (alveolar) part of the lung; they are relatively short-lived and grow into larger particles between 0.1 and about 1 µm in diameter, known as the accumulation mode. These particles remain suspended for up to several weeks in the air, and are not readily removed by rain. The third, coarse, mode comprises particles greater than about 2 µm in diameter. These are generally formed by the break-up of larger matter, and include wind-blown dust and soil, particles from construction and sea spray. Their size means that they remain in the air for relatively short periods. Conventionally, for the classification of health impacts, fine particles are referred to as $PM_{2.5}$ (particles with an aerodynamic diameter of less than 2.5 µm).

Particles are also frequently referred to as $PM_{10}$ (aerodynamic diameter of less than 10 μm); these include the coarse (greater than 2 μm in diameter) and the fine fraction. Particles larger than $PM_{10}$ are mainly associated with annoyance impacts and tend to be generated by mechanical processes. A large proportion of the particle releases from construction activities will comprise this larger fraction (i.e. larger than $PM_{10}$), particularly from the handling and processing of materials. Finer particles may also arise from on-site mobile and fixed construction plant.

## 3.2 METHODOLOGY

The impact of dust generated during the construction phase of the Development has been assessed using the methodology described by the Institute of Air Quality Management (IAQM) Construction Dust Guidance [6].

The most common air quality impacts relating to construction activities are as follows:

- dust deposition, resulting in the soiling of surfaces;
- visible dust plumes, which are evidence of dust emissions;
- elevated $PM_{10}$ concentrations, as a result of dust generating activities on site; and
- an increase in concentrations of airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery, NRMM) and vehicles accessing the site.

The risk of dust emissions from a demolition/construction site causing loss of amenity and/or health or ecological impact is related to:

- the activities being undertaken;
- the duration of these activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall);
- the proximity of receptors to the activities;
- the adequacy of the mitigation measures applied to reduce or eliminate dust; and
- the sensitivity of the receptors to dust.

6 Guidance on the Assessment of Dust from Demolition and Construction, Institute of Air Quality Management, February 2014.

The IAQM methodology considers four aspects that may give rise to dust emissions:

- demolition of existing structures;
- construction of the new facilities;
- earthworks; and
- 'trackout' of dust on vehicles.

The potential for dust emissions is assessed for each activity that is likely to take place. If an activity is not taking place (e.g. demolition) then it does not need to be assessed. The assessment methodology considers three separate dust impacts as follows:

- annoyance due to dust soiling;
- the risk of health effects due to an increase in exposure to $PM_{10}$; and
- harm to ecological receptors.

Step 1 of the IAQM Guidance is to screen the requirement for a more detailed assessment. An assessment will normally be required where there is a human receptor within:

- 350 m of the construction site boundary; or
- 50 m of a road used by construction traffic up to 500 m from the site entrance.

For ecological receptors, an assessment will be required where a sensitive habitat site is within:

- 50 m of the boundary of the site; or
- 50 m of a road used by construction traffic up to 500 m from the site entrance.

It should be noted that the criteria are deliberately conservative and detailed assessments are required for most proposed developments, recognising that dust arising from construction activities within urban areas is a significant source of airborne particles.

Where appropriate, the four potential sources of dust and $PM_{10}$ (demolition, construction, earthworks and track-out) are considered individually, adopting the methodology in the IAQM guidance to assess the risk of dust annoyance (soiling), adverse impact on human health due to elevated $PM_{10}$ concentrations and adverse impact on habitat sites from dust deposition.

In Step 2, a site is allocated a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large; and
- the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

The dust emission magnitude is based on the scale of the anticipated works and example definitions are presented in *Table 3.1*.

The sensitivity of the area takes account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of $PM_{10}$, the local background concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

**TABLE 3.1 POTENTIAL DUST EMISSION MAGNITUDE**

| Activity | Large | Medium | Small |
|---|---|---|---|
| Demolition | Building volume >50,000 m$^3$, potentially dusty construction materials, demolition at above 20 m in height | Building volume 20,000 to 50,000 m$^3$, potentially dusty construction materials, demolition height 10-20 m in height | Building volume <20,000 m$^3$, material with low potential for dust release, demolition height <10 m |
| Earthworks | Site area >10,000 m$^2$, potentially dusty soil type, >10 heavy earth moving vehicles, bunds >8 m in height, total material moved >100,000 tonnes | Site area of 2,500 to10,000 m$^2$, moderately dusty soil type, 5-10 heavy earth moving vehicles, bunds 4-8 m in height, total material moved 20,000 to 100,000 tonnes | Site area <2,500 m$^2$, low dust potential soil type, <5 heavy earth moving vehicles, bunds <4 m in height, total material moved <20,000 tonnes |
| Construction | Total building volume >100,000 m$^3$, on site concrete batching, sandblasting | Total building volume 25,000 to 100,000 m$^3$, potentially dusty construction material | Total building volume <25,000 m$^3$, material with low potential for dust release |
| Trackout | >50 outbound HGV movements in any day, potentially dust surface material, unpaved road length >100 m | 10-50 outbound HGV movements in any day, moderately dusty surface material, unpaved road length 50 to100 m | <10 outbound HGV movements in any day, surface material with low potential for dust, unpaved road length <50 m |

The IAQM document provides guidance on the categorisation of receptors into high, medium and low sensitivities for dust soiling, health effects and ecological effects. For dust soiling, the sensitivity of people and their property to soiling will depend on the level of amenity and the appearance aesthetics and value of property. For health effects from exposure to $PM_{10}$, sensitivity will depend on whether or not the receptor is likely to be exposed over relevant timescales to elevated concentrations over a 24-hour period. For ecological effects, the sensitivity will depend on the type of the habitat designation (e.g. European site, national or local designations) and the sensitivity of the habitat to dust deposition effects.

## 3.3 ASSESSMENT OF IMPACTS

### 3.3.1 Description of Development and Surroundings

*The Development Site*

The development site extends to approximately 3.1 hectares and lies within the north-eastern part of the existing Padeswood Cement Works. The development area currently comprises of hardstanding and disturbed ground, used for vehicle and rail access. The proposed development is for the demolition of existing cement storage silos and loading facilities and the erection of a new vertical roller mill, rail loading facility and modification to (and extension of) the existing railway line, together with ancillary development (including three steel cement storage silos, belt conveyors and pneumatic pipelines).

The area is bounded to the north by a belt of mature woodland and agricultural land with the residential properties on Padeswood Drive lying approximately 200 m beyond. To the east lies natural woodland and agricultural land bisected by the Liverpool to Wrexham railway line, which runs in a north-south direction. The site lies within the industrial setting of the Cement Works, which itself lies within open countryside, to the west of the villages of Penyffordd and Penymynydd.

*Construction Activities*

To allow the installation of the new vertical roller mill and rail loading silos, some existing plant must be removed or demolished. The main items to be removed are four existing steel silos (Silos 7, 8, 9 and 10) and Silos 11 and 12.

In addition, to the above, a small railway cabin situated adjacent to the existing railway track will be demolished to allow the railway line to be realigned.

The removal of the silos and associated structures allows the new rail loading facility to be installed in a location that facilitates access to the existing cement distribution system and allows good traffic and pedestrian segregation.

A plant storage and assembly area will be established adjacent to the proposed vertical roller mill. The area upon which the new vertical roller mill is to be situated will first be levelled and then piled (45 piles expected) to form the foundations for the vertical roller mill equipment and building.

A new vertical roller mill with associated covered conveyors will be erected, with the capacity to produce 95 tonnes of cement per hour or 650,000 tonnes per annum. Other construction activities include the provision of a new rail loading facility which will comprise the following:

- static rail tanker weighbridge facilities;
- three 1000 tonne steel cement storage silos;
- silo aeration including blowers;
- rail tanker loading facilities rated at 250 tonne/hour per outlet;
- road tanker loading facility rated at 250 tonne/hour from silo; and
- silo level and safety systems.

The Liverpool to Wrexham railway line runs adjacent to the Cement Works and includes a set of signals and rail points. The rail line is currently used for importing coal. This operation will continue and therefore, once the rail loading facility and track modifications are complete, the Cement Works will be able to both receive deliveries of coal and export cement.

The works required to the railway line will involve approximately 600 m of new rail track, which will either directly renew, realign or extend the existing railway line and will include a curve through the proposed location for the new rail loading facility and proceed towards the main site road.

Therefore, demolition, earthworks and construction proposed for the development are as follows:

- site profiling to achieve required ground levels;
- civil foundations, services and access roadways for Mill 5;
- the demolition of silos 11 and 12, the existing rail loading facility (including silos 7, 8, 9 and 10) and a small railway cabin;
- the construction of a new vertical roller mill with an associated stack with a height of approximately 47 m.
- ancillary development, comprising mainly belt conveyors and pneumatic pipelines, required to feed clinker and other raw materials to the mill and feed the resulting cement to existing and proposed cement storage silos and rail loading facility;
- erect three new steel cement storage silos approximately, each with a storage capacity of 1,000 tonnes, fitted with rail and road loading facilities; and
- the laying of approximately 445 m of new or realigned railway track to service the proposed rail loading facility.

### 3.3.2 Meteorological Influences

In addition to the magnitude of the release, dust impacts in the vicinity of the development site will be dependent on the frequency of wind speeds capable of carrying airborne dust (i.e. greater than 3 m/s [7]) and frequency of rainfall considered sufficient to effectively suppress wind-blown dust emissions (greater than 0.2 mm/day [8]).

Based on the average wind rose for Hawarden (see *Figure 2.1*) wind speeds in excess of 3 m/s, occur for 61% of the time. Daily rainfall of less than 0.2 mm occurs for 47% of the time. Combined, hourly wind speeds of greater than 3 m/s and daily rainfall of less than 0.2 mm (i.e. capable of exacerbating dust impacts) occur for 25% of the time. Therefore, there is a moderate risk of dust emissions from the site under ambient conditions.

### 3.3.3 Screening of Impacts

Buffer distances (20 m, 50 m, 100 m, 200 m and 350 m) from the site boundary are provided in *Figure 3.1*. In addition, this provides a 50 m buffer distance for the construction traffic route for a distance of 500 m from the site.

Based on the IAQM Guidance there are sensitive receptors within 350 m of the construction site boundary and within 50 m of a road used by construction traffic. Therefore, a more detailed assessment of construction dust impacts will be required to assess the impact on dust soiling and human health.

The nearest habitat site to the proposed development site is the locally designated site Black Brook Plantation, located approximately 700 m to the south of the construction site boundary. This is sufficiently far (less than 50 m of the construction site boundary) that construction impacts will be negligible. Furthermore, this site is not located within 50 m of roads used by construction vehicles. Therefore, the impact of construction activities on habitat sites can be screened out from further assessment.

Activities at the site will included demolition, earthworks, construction and there will be vehicles accessing the site for the delivery of materials and for the removal of excess soil and demolition material and rubble. Therefore, the assessment has considered the following:

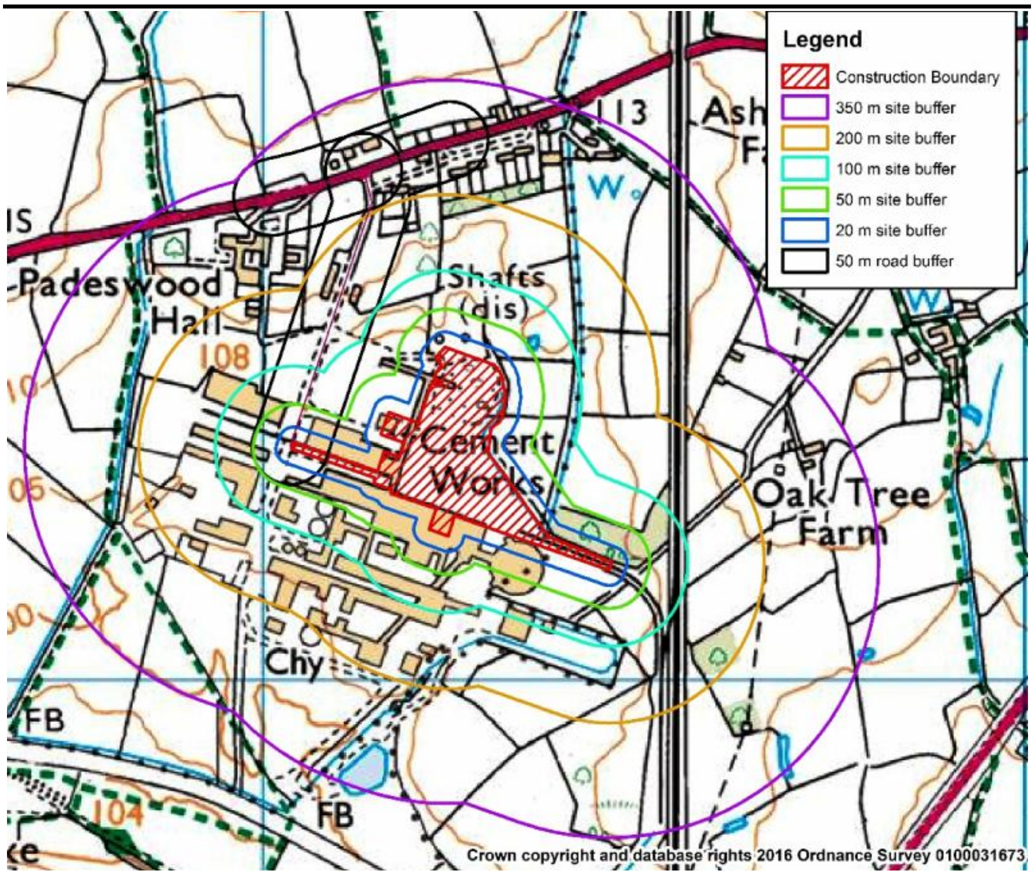
- the impact of demolition on human receptors;
- the impact of earthworks on human receptors;
- the impact of construction on human receptors; and

7 K. W. Nicholson (1988) A review of particle re-suspension. Atmospheric Environment Volume 22, Issue 12, 1988, Pages 2639-2651

8 Arup Environmental and Ove Arup and Partners (Dec 1995), The Environmental Effects of Dust from Surface Mineral Workings Volume 2. Prepared for Department of the Environment Minerals Division

- the impact of trackout on human receptors.

**FIGURE 3.1 BUFFER DISTANCES FOR THE CONSIDERATION OF CONSTRUCTION DUST IMPACTS**




### 3.3.4 Define the Potential Dust Emission Magnitude

The assessment has considered the overall construction of the development such that any mitigation measures can be focussed where required for each activity. A description of the emission magnitude for the anticipated works is provided in *Table 3.2*.

**TABLE 3.2 ASSESSMENT OF POTENTIAL DUST EMISSION MAGNITUDE**

| Demolition | Earthworks | Construction | Trackout |
|---|---|---|---|
| Building volume is greater than 50,000 m3 and demolition height is greater than 20 m. However, the majority of structures to be demolished have a low potential for dust (e.g. steel silos). Therefore, the potential dust emission magnitude is defined as *Medium* assuming that the silos are emptied before demolition commences. | Area of the site for earthworks is greater than 10,000 $m^2$. Piling will be required for the cement mill building. There are likely to be up to six heavy earth moving vehicles on-site. Therefore, the potential dust emission magnitude is defined as *Medium*. | Total building volume is medium between 25,000 $m^3$ and 100,000 $m^3$. However, there will be no on site concrete batching plant. The silos will be constructed of steel and the building will be constructed of steel and cladded. Therefore, construction methods are considered to have low dust potential. Therefore, potential dust emission magnitude is defined as *Small*. | HDV movements assumed to be less than 10 outbound except for a short duration when excavated material is removed. Minimal unpaved road length and certainly less than 50 m. Surface material with low potential for dust release. Therefore, the potential dust emission magnitude is defined as *Small* given the number of vehicles accessing the site and the condition of access roads. |

For demolition earthworks, construction and trackout the assessment of the potential dust emission magnitude is summarised in *Table 3.3*.

**TABLE 3.3 SUMMARY OF DUST EMISSION MAGNITUDE**

| Demolition | Earthworks | Construction | Trackout |
|---|---|---|---|
| Medium | Medium | Small | Small |

### 3.3.5 Define the Sensitivity of the Area

*Dust Soiling*

The sensitivity of the area to the potential impacts assessed (dust soiling) have been defined using the IAQM guidance as presented in *Table 3.4*. Receptors are identified as being of High, Medium or Low sensitivity as follows:

- High – users can reasonably be expected to enjoy a high level of amenity or the appearance or aesthetics or value of their property would reasonably be expected to be present continuously. These would include dwellings, museums, car show rooms etc.
- Medium - users would expect to enjoy a reasonable level of amenity but not at the same level as in their home or the appearance, aesthetics or value of their property could be diminished by soiling. People or property would not be expected to be present continuously. Examples include places of work and parks.

- Low – the enjoyment of amenity would not reasonably be expected or property would be expected to diminish in appearance, aesthetics or value and there would be transient exposure. Examples include playing fields, farmland, footpaths and short term car parks.

**TABLE 3.4 METHODOLOGY ON ASSESSING THE SENSITIVITY OF THE AREA TO DUST SOILING**

| Phase/ Receptor Sensitivity | No. of Receptors | Distance from the Source | | | |
|---|---|---|---|---|---|
| | | < 20 m | <50 m | < 100 m | <350 m |
| High | > 100 | High | High | Medium | Low |
| | 10 - 100 | High | Medium | Low | Low |
| | 1 - 10 | Medium | Low | Low | Low |
| Medium | > 1 | Medium | Low | Low | Low |
| Low | > 1 | Low | Low | Low | Low |

Using GIS and the buffer distances provided in *Figure 3.1*, the number of receptors located within the distances identified by the IAQM has been determined and the sensitivity of these to dust soiling has been assessed. This is summarised in *Table 3.5*.

**TABLE 3.5 SUMMARY OF SENSITIVITY OF THE AREA TO DUST SOILING**

| Demolition | Earthworks | Construction | Trackout |
|---|---|---|---|
| Low | Low | Low | Medium |

There are no sensitive receptors within 100 m of the proposed construction area. Therefore, the sensitivity of the area to dust soiling for demolition, earthworks and construction would be assessed as *Low*. For trackout, the sensitivity of the area to dust soiling has been assessed as *Medium* given the proximity of residential properties on Padeswood Drive to construction traffic.

*Human Health Impacts*

The sensitivity of the area to human health impacts is assessed on the distance of receptors from the various activities and the existing background $PM_{10}$ concentration. Background $PM_{10}$ for the local area has been obtained from the Defra background maps which indicate that background concentrations for the area are 13.0 µg $m^{-3}$ for 2017. However, the existing sources at the cement works contribute around 6 µg $m^{-3}$ (refer *Section 5.3*). Therefore, the background $PM_{10}$ concentration is assumed to be 19 µg $m^{-3}$. Therefore, the sensitivity of the area to human health impacts is determined based on the IAQM guidance as presented in *Table 3.6* for background $PM_{10}$ concentrations of less than 24 µg $m^{-3}$. Receptors are identified as being of High, Medium or Low sensitivity as follows:

- High – locations where members of the public are exposed over a time period relevant to the air quality objective (e.g. exposed for 8 hours or more per day). Indicative examples include residential properties, hospitals, schools and residential care homes.
- Medium – locations where people exposed are workers and are exposed for 8 hours or more per day. Receptors would include office and shop workers but not workers occupationally exposed to $PM_{10}$.
- Low – locations where human exposure is transient and would include public footpaths, playing fields, parks and shopping streets.

**TABLE 3.6 METHODOLOGY FOR ASSESSING THE SENSITIVITY OF THE AREA TO HUMAN HEALTH IMPACTS**

| Phase/ Receptor Sensitivity | No. of Receptors | Distance from the Source | | | |
|---|---|---|---|---|---|
| | | < 20 m | <50 m | < 100 m | <350 m |
| High<br>$PM_{10}$ less than 24 µg $m^{-3}$ | > 100 | Medium | Low | Low | Low |
| | 10 - 100 | Low | Low | Low | Low |
| | 1 - 10 | Low | Low | Low | Low |
| Medium | > 10 | High | Medium | Low | Low |
| | 1- 10 | Medium | Low | Low | Low |
| Low | > 1 | Low | Low | Low | Low |

Using GIS and the buffer distances provided in *Figure 3.1*, the number of receptors located within the distances identified by the IAQM has been determined and the sensitivity of these to human health impacts has been assessed. This is summarised in *Table 3.7*.

**TABLE 3.7 SUMMARY OF SENSITIVITY OF THE AREA TO HUMAN HEALTH IMPACTS**

| Demolition | Earthworks | Construction | Trackout |
|---|---|---|---|
| Low | Low | Low | Low |

There are less than 100 high sensitivity receptors (e.g. residential) within 20 m of the construction boundary (as discussed above) and would be assessed as *Low* sensitivity for health impacts. Therefore, overall demolition, construction and earthworks would be assessed as of *Low* sensitivity to health impacts. For trackout, the sensitivity of the area to health impacts has also been assessed as *Low* given the small number of properties located in close proximity to the construction route.

### 3.3.6 Define the Risk of Impacts

The dust emission magnitude and sensitivity of the area are combined to determine the risk of impacts using Table 6 (demolition), Table 7 (earthworks), Table 8 (construction) and Table 9 (trackout) of the IAQM guidance. A summary of the risks is presented in *Table 3.8*. These are defined on the basis of no mitigation beyond that required by legislation. Where the risk is assessed as 'negligible' no additional mitigation is considered necessary.

**TABLE 3.8 SUMMARY OF DUST SOILING RISK AND HUMAN HEALTH RISK TO DEFINE SITE-SPECIFIC MITIGATION**

| Impact | Demolition | Earthworks | Construction | Trackout |
|---|---|---|---|---|
| Dust soiling | Low risk | Low risk | Negligible risk | Negligible risk |
| Human health | Low risk | Low risk | Negligible risk | Negligible risk |

For dust soiling and human health, the risk is identified as 'low risk' or 'negligible risk'. Therefore, additional mitigation measures may be required to alleviate dust annoyance and elevated fine particles for sensitive receptors but for demolition and earthworks only.

## 3.4 CONSTRUCTION DUST MITIGATION MEASURES

It is not possible to eliminate emissions of dust from the construction activities completely. In order to minimise the impacts of construction activities, a mitigation programme will be required and should include the following.

- The name and contact details of person(s) accountable for air quality and dust issues will be displayed on the site boundary/construction main access
- The head office contact information will also be displayed at the site boundary.
- A Dust Management Plan (DMP) should be developed and implemented for the construction site. This should include the requirement for visual inspections to be carried out to ensure mitigation measures are effective.
- All dust and air quality complaints should be recorded, the cause identified and appropriate measures taken to reduce emissions in a timely manner. The complaints log should be made available to the local authority when requested.
- Any exceptional incidents giving rise to dust and or air emissions, either on or off-site should be recorded and the action taken to resolve the situation should be recorded.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results and make an inspection log available for the local authority when required.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to

produce dust are being carried out and during prolonged dry or windy conditions.

- Plan site layout so that machinery and dust causing activities are located away from receptors (including habitat receptors) as far as possible.
- Erect solid screens or barriers around dusty activities.
- Avoid site runoff of water or mud.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction.
- Ensure an adequate supply water supply on the site for the effective dust/particle suppression/ mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment where appropriate.
- Avoid bonfires and burning of waste material.
- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Ensure water suppression is used during demolition operations.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives for demolition.
- Bag and remove any biological debris or damp down such material before demolition.
- Ensure cement bags are sealed after use and stored appropriately to prevent dust.
- Ensure sand and other aggregates are stored in bunded areas and are not allows to dry out.
- Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site.
- Ensure vehicles entering and leaving the sites are covered to prevent escape of materials during transport.
- Inspection and cleaning of vehicles wheels before vehicles leave the site.
- Record all inspections of haul routes and any subsequent action in a site log book.

## 3.5 RESIDUAL IMPACT

The main objective of the IAQM methodology is to determine the risk of dust emissions from construction sites and then to define the mitigation measures required to ensure that impacts are 'not significant'. Therefore, with the adoption of the recommended mitigation measures provided in *Section 3.4*, it is concluded that the residual risk would be '*negligible*' and the impact on dust soiling and human health would be '*not significant*'. However, it is noted that even with a rigorous DMP in place there may be occasions when dust mitigation measures may not be effective (e.g. extreme weather, interruption of water supplies or accidental releases).

## 3.6 MONITORING OF DUST IMPACTS

The IAQM has published guidance relating to the monitoring of dust at demolition and construction sites [9]. The IAQM guidance states that as part of the Dust Management Plan for the site, monitoring of dust impacts should be carried out on a daily basis. This ensures that the mitigation measures employed on site are adequately controlling dust emissions, thereby reducing the risk of dust annoyance or exceedances of the air quality objectives for $PM_{10}$ and/or $PM_{2.5}$.

The level of dust monitoring that should be carried out is dependent on the phase of the development and the estimated risk of impacts occurring. For example, steelwork erection, cladding and fit-out would be very low risk.

As a negligible risk following the implementation of mitigation measures provided in *Section 3.4*, visual monitoring of dust is proposed. This would involve a daily visual inspection of dust deposition to surfaces both on and off-site. This is particularly important at times where meteorological conditions are likely to increase impacts off-site (e.g. dry and windy) or if the prevailing wind is in the direction of sensitive receptors. Observations should be recorded in a site log, providing a useful reference document in the event of complaints relating to dust annoyance. A log of complaints from the public, and the measures taken to address any complaints, where necessary, would also be maintained.

Visual assessment of on-site dust releases such as stockpiling and earthwork activities should also be carried out as a matter of course to ensure the mitigation measures employed are effective.

9 Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites, IAQM, 2012

# 4 ASSESSMENT METHODOLOGY FOR OPERATIONAL IMPACTS

## 4.1 INTRODUCTION

The potential impact on local air quality of particle emissions from the Padeswood Cement Works has been assessed using a dispersion model to predict airborne ground level concentrations of particles from the entire cement works with and without the operation of Mill 5.

Dispersion modelling of emissions from the cement works has been undertaken using the United US EPA AERMOD Prime dispersion model (US EPA Version 16216r). As preferred by the Environment Agency, this is a newer generation dispersion model that incorporates the latest understanding of the atmospheric boundary layer. It is used extensively in the UK for assessing the air quality impacts of industrial and other polluting processes.

The model used is a commercial version of AERMOD Prime produced by Trinity Consultants (Version 7.12.1).

This methodology has followed the guidance for dispersion modelling assessments set out by the Royal Meteorological Society [10] and Atmospheric Dispersion Modelling Liaison Committee (ADMLC) [11].

## 4.2 QUANTIFICATION OF POINT SOURCE EMISSIONS

### 4.2.1 Introduction

Point emission sources include the new cement mill, the main kiln stack, the other cement mills and other small bag filters etc. Due to the monitoring and maintenance required for these emission sources, these are relatively well characterised. The assessment has considered all low-level point source emissions where the greatest impact is likely to be at the site boundary. The main stack emission has been excluded since as a high-level emission this disperses further and maximum concentrations are some distance from the site.

10 Atmospheric Dispersion Modelling – Guidelines on the Choice and Use of Models and the Communication and Reporting of Results, Royal Meteorological Society (May 1995).

11 Guidelines for the Preparation of Dispersion Modelling Assessments for Compliance with Regulatory Requirements – an Update to the 1995 Royal Meteorological Society Guidance, ADMLC (2004.)

### 4.2.2 Detailed Inventory of Emissions

A detailed emissions inventory for the Padeswood Cement Works has been generated. This has included detailed information, which is required for modelling these point emissions as follows:

- grid reference for source;
- emission height above ground level;
- stack diameter or area of emission at source;
- orientation of source (i.e. vertical, horizontal);
- volume flow rate of air through source;
- temperature of emission;
- particle emission concentration; and
- operational hours.

Detailed emission parameters for all sources considered are summarised in *Table 4.1*. Information required for dispersion modelling of the emissions is provided in *Table 4.2*. Sources P42 to P48 are new emissions associated with Cement Mill 5. However, some of the existing sources will be decommissioned as a result of the new cement mill. Therefore, the sources are separated into 'existing only', 'both existing and future' and 'future only'. Mill 4 will be mothballed rather than decommissioned and it could be bought back into use in the future. However, this would not be able to operate at the same time as Mill 5. Therefore, it has not been included in the future emissions.

### 4.2.3 Worst-case Emissions

In order to represent a worst-case scenario, the works is assumed to operate for 100% of the year. In reality the works would not operate continuously to allow for necessary maintenance periods, therefore predicted annual average concentrations may be overestimated. For example, the new Mill 5 is expected to operate for 6,990 hours per year (80% of the year).

## TABLE 4.1: DETAILED PARTICLE EMISSIONS INVENTORY FOR POINT SOURCES

| Ref. | Source Description | Existing or Future Source | NGR Easting | NGR Northing | Emission Height (m) | Area of Emissions ($m^2$) | Volume Flow ($Am^3$ $h^{-1}$) (a) | Normalised Volume Flow ($Nm^3$ $s^{-1}$) (b) | Temp. (°C) | Emission Concentration (mg $Am^{-3}$) (a) |
|---|---|---|---|---|---|---|---|---|---|---|
| P1 | Clinker Cooler | Both | 329140 | 362040 | 35 | 2.81 | 86,859 | 18.00 | 93 | 20 |
| P2 | Cement Mill 1 | Both | 329200 | 362134 | 17.5 | 0.20 | 3,015 | 0.65 | 80 | 10 |
| P3 | Cement Mill 2 | Both | 329200 | 362134 | 12.7 | 0.20 | 3,015 | 0.65 | 80 | 10 |
| P4 | Cement Mill 3 | Both | 329200 | 362134 | 27 | 2.27 | 44,942 | 9.65 | 80 | 20 |
| P5 | Cement Mill 4 - Mill | Existing only | 329228 | 362138 | 16.7 | 0.40 | 11,260 | 2.49 | 70 | 10 |
| P6 | Cement Mill 4 - DCE | Existing only | 329228 | 362138 | 21.5 | 1.27 | 48,340 | 10.69 | 70 | 20 |
| P7 | Clinker Store BF41 | Both | 329241 | 362145 | 15 | 0.58 | 24,885 | 5.50 | 70 | 10 |
| P8 | Raw Meal Blending | Both | 329015 | 362138 | 26 | 0.20 | 8,906 | 2.27 | 25 | 10 |
| P9 | Raw Meal Storage | Both | 329086 | 362146 | 34 | 0.20 | 8,836 | 2.25 | 25 | 10 |
| P10 | Crumbeliser Silo 1 | Both | 329049 | 362106 | 20 | 0.09 | 2,026 | 0.48 | 50 | 10 |
| P11 | Silos 1 - 4 | Both | 329203 | 362274 | 24 | 0.17 | 9,181 | 2.16 | 50 | 10 |
| P12 | Silo 5 | Both | 329203 | 362274 | 27 | 0.17 | 1,124 | 0.26 | 50 | 10 |
| P13 | Silo 6 - Bottom | Both | 329167 | 362319 | 8 | 0.17 | 4,068 | 0.96 | 50 | 10 |
| P14 | Packing Bay - | Both | 329162 | 362308 | 27 | 0.20 | 5,883 | 1.38 | 50 | 10 |
| P15 | Packing Bay - | Both | 329162 | 362308 | 27 | 0.50 | 4,343 | 1.02 | 50 | 10 |
| P16 | Packing Bay - Packer | Both | 329162 | 362308 | 11 | 0.17 | 4,367 | 1.03 | 50 | 10 |
| P17 | Silos 11 | Existing only | 329224 | 362262 | 31 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P18 | Silos 12 | Existing only | 329224 | 362262 | 32 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P19 | Silo 16 | Both | 329224 | 362262 | 31 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P20 | Silo 7 Top | Existing only | 329240 | 362247 | 27 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P21 | Silo 8 Top | Existing only | 329240 | 362247 | 27 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P22 | Silo 9 Top | Existing only | 329240 | 362247 | 27 | 0.06 | 1,855 | 0.44 | 50 | 10 |

**TABLE 4.1: DETAILED PARTICLE EMISSIONS INVENTORY FOR POINT SOURCES**

| Ref. | Source Description | Existing or Future Source | NGR Easting | NGR Northing | Emission Height (m) | Area of Emissions ($m^2$) | Volume Flow ($Am^3 h^{-1}$) (a) | Normalised Volume Flow ($Nm^3 s^{-1}$) (b) | Temp. (°C) | Emission Concentration ($mg Am^{-3}$) (a) |
|---|---|---|---|---|---|---|---|---|---|---|
| P23 | Silo 10 Top | Existing only | 329240 | 362247 | 27 | 0.06 | 1,855 | 0.44 | 50 | 10 |
| P24 | Silo 7 Bottom | Existing only | 329240 | 362247 | 7 | 0.03 | 1,259 | 0.30 | 50 | 10 |
| P25 | Silo 8 Bottom | Existing only | 329240 | 362247 | 7 | 0.03 | 1,259 | 0.30 | 50 | 10 |
| P26 | Silo 9 Bottom | Existing only | 329240 | 362247 | 7 | 0.03 | 1,259 | 0.30 | 50 | 10 |
| P27 | Silo 10 Bottom | Existing only | 329240 | 362247 | 7 | 0.03 | 1,259 | 0.30 | 50 | 10 |
| P28 | Silo 13 | Both | 329216 | 362262 | 31 | 0.05 | 1,962 | 0.46 | 50 | 10 |
| P29 | Silo 14 | Both | 329216 | 362262 | 31 | 0.05 | 1,962 | 0.46 | 50 | 10 |
| P30 | Silo 15 | Both | 329216 | 362262 | 31 | 0.05 | 1,962 | 0.46 | 50 | 10 |
| P31 | Between Silos 11 and | Existing only | 329224 | 362262 | 5 | 0.02 | 1,323 | 0.31 | 50 | 10 |
| P32 | Bottom of Silos 2, 3, 5 | Both | 329203 | 362274 | 6 | 0.09 | 4,707 | 1.11 | 50 | 10 |
| P33 | Cement Mill 3 dedusting | Both | 329200 | 362134 | 20 | 0.10 | 4,617 | 1.08 | 50 | 10 |
| P34 | Limestone Receiving 1 | Both | 329194 | 362306 | 4 | 0.17 | 9,094 | 2.31 | 25 | 10 |
| P35 | Limestone Receiving 2 | Both | 329194 | 362307 | 10 | 0.17 | 9,094 | 2.31 | 25 | 10 |
| P36 | Limestone Receiving 3 | Both | 329194 | 362308 | 27 | 0.17 | 9,094 | 2.31 | 25 | 10 |
| P37 | Crumbeliser Silo 2 | Both | 329049 | 362106 | 20 | 0.09 | 1,961 | 0.46 | 50 | 10 |
| P38 | Pressure Relief Coal | Both | 329060 | 362070 | 30 | 0.25 | 1,773 | 0.45 | 25 | 10 |
| P39 | Dedusting Coal/Shale | Both | 329015 | 362120 | 15 | 0.44 | 3,181 | 0.81 | 25 | 10 |
| P40 | Arodo Packer filter | Both | 329155 | 362305 | 15 | 0.28 | 16,000 | 4.07 | 25 | 10 |
| P41 | Silo 6 top | Both | 329166 | 362334 | 34 | 0.07 | 1,080 | 0.25 | 50 | 10 |
| P42 | Rail silo 1 dedusting Filter | Future only | 329200 | 362251 | 34 | 0.07 | 1,080 | 0.25 | 50 | 10 |
| P43 | Rail silo 2 dedusting Filter | Future only | 329209 | 362248 | 34 | 0.07 | 1,080 | 0.25 | 50 | 10 |
| P44 | Rail silo 3 dedusting Filter | Future only | 329218 | 362244 | 34 | 0.07 | 1,080 | 0.25 | 50 | 10 |

**TABLE 4.1: DETAILED PARTICLE EMISSIONS INVENTORY FOR POINT SOURCES**

| Ref. | Source Description | Existing or Future Source | NGR Easting | NGR Northing | Emission Height (m) | Area of Emissions ($m^2$) | Volume Flow ($Am^3 h^{-1}$) (a) | Normalised Volume Flow ($Nm^3 s^{-1}$) (b) | Temp. (°C) | Emission Concentration (mg $Am^{-3}$) (a) |
|---|---|---|---|---|---|---|---|---|---|---|
| P45 | Rail silo loading head | Future only | 329210 | 362250 | 5 | 0.10 | 5,760 | 1.35 | 50 | 10 |
| P46 | Clinker transport at mill 4 | Future only | 329231 | 362200 | 5 | 0.07 | 1,080 | 0.25 | 50 | 10 |
| P47 | Clinker transport at mill 5 | Future only | 329248 | 362283 | 25 | 0.07 | 1,080 | 0.25 | 50 | 10 |
| P48 | Mill 5 Stack New | Future only | 329206 | 362293 | 47 | 4.34 | 67,788 | 13.99 | 94.5 | 10 |

(a) The volume flow rate is expressed at actual conditions but the emission concentration is expressed at normal conditions which vary depending on the source

(b) Normalised flow rate at 273K and 1 atmosphere

**TABLE 4.2: MODEL INPUT PARAMETERS REQUIRED FOR DISPERSION MODELLING OF POINT SOURCE EMISSIONS**

| Model Ref. | Source Description | NGR Easting | NGR Northing | Emission Height (m) | Diameter of Emission (m) | Velocity of Emission (m $s^{-1}$) | Volume Flow ($Am^3$ $s^{-1}$) | Temp. (K) | Emission Rate (g $s^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| P1 | Clinker Cooler | 329140 | 362040 | 35 | 1.89 | 8.6 | 24.1 | 366 | 0.360 |
| P2 | Cement Mill 1 | 329200 | 362134 | 17.5 | 0.51 | 4.1 | 0.8 | 353 | 0.0065 |
| P3 | Cement Mill 2 | 329200 | 362134 | 12.7 | 0.51 | 4.1 | 0.8 | 353 | 0.0065 |
| P4 | Cement Mill 3 | 329200 | 362134 | 27 | 1.7 | 5.5 | 12.5 | 353 | 0.193 |
| P5 | Cement Mill 4 - Mill | 329228 | 362138 | 16.7 | 0.71 | 7.9 | 3.1 | 343 | 0.025 |
| P6 | Cement Mill 4 - DCE | 329228 | 362138 | 21.5 | 1.27 | 10.6 | 13.4 | 343 | 0.214 |
| P7 | Clinker Store BF41 | 329241 | 362145 | 15 | 0.86 | 11.9 | 6.9 | 343 | 0.055 |
| P8 | Raw Meal Blending | 329015 | 362138 | 26 | 0.5 | 12.6 | 2.5 | 298 | 0.023 |
| P9 | Raw Meal Storage | 329086 | 362146 | 34 | 0.5 | 12.5 | 2.5 | 298 | 0.022 |
| P10 | Crumbeliser Silo 1 | 329049 | 362106 | 20 | 0.34 | 6.2 | 0.6 | 323 | 0.005 |
| P11 | Silos 1 - 4 | 329203 | 362274 | 24 | 0.47 | 14.7 | 2.6 | 323 | 0.022 |
| P12 | Silo 5 | 329203 | 362274 | 27 | 0.47 | 1.8 | 0.3 | 323 | 0.003 |
| P13 | Silo 6 - Bottom | 329167 | 362319 | 8 | 0.46 | 6.8 | 1.1 | 323 | 0.010 |
| P14 | Packing Bay - | 329162 | 362308 | 27 | 0.51 | 8 | 1.6 | 323 | 0.014 |
| P15 | Packing Bay - | 329162 | 362308 | 27 | 0.8 | 2.4 | 1.2 | 323 | 0.010 |
| P16 | Packing Bay - Packer | 329162 | 362308 | 11 | 0.46 | 7.3 | 1.2 | 323 | 0.010 |
| P17 | Silos 11 | 329224 | 362262 | 31 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P18 | Silos 12 | 329224 | 362262 | 32 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P19 | Silo 16 | 329224 | 362262 | 31 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P20 | Silo 7 Top | 329240 | 362247 | 27 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P21 | Silo 8 Top | 329240 | 362247 | 27 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P22 | Silo 9 Top | 329240 | 362247 | 27 | 0.27 | 9 | 0.5 | 323 | 0.0044 |

**TABLE 4.2: MODEL INPUT PARAMETERS REQUIRED FOR DISPERSION MODELLING OF POINT SOURCE EMISSIONS**

| Model Ref. | Source Description | NGR Easting | NGR Northing | Emission Height (m) | Diameter of Emission (m) | Velocity of Emission (m $s^{-1}$) | Volume Flow ($Am^3$ $s^{-1}$) | Temp. (K) | Emission Rate (g $s^{-1}$ ) |
|---|---|---|---|---|---|---|---|---|---|
| P23 | Silo 10 Top | 329240 | 362247 | 27 | 0.27 | 9 | 0.5 | 323 | 0.0044 |
| P24 | Silo 7 Bottom | 329240 | 362247 | 7 | 0.21 | 10.1 | 0.3 | 323 | 0.0030 |
| P25 | Silo 8 Bottom | 329240 | 362247 | 7 | 0.21 | 10.1 | 0.3 | 323 | 0.0030 |
| P26 | Silo 9 Bottom | 329240 | 362247 | 7 | 0.21 | 10.1 | 0.3 | 323 | 0.0030 |
| P27 | Silo 10 Bottom | 329240 | 362247 | 7 | 0.21 | 10.1 | 0.3 | 323 | 0.0030 |
| P28 | Silo 13 | 329216 | 362262 | 31 | 0.25 | 11.1 | 0.5 | 323 | 0.0046 |
| P29 | Silo 14 | 329216 | 362262 | 31 | 0.25 | 11.1 | 0.5 | 323 | 0.0046 |
| P30 | Silo 15 | 329216 | 362262 | 31 | 0.25 | 11.1 | 0.5 | 323 | 0.0046 |
| P31 | Between Silos 11 and | 329224 | 362262 | 5 | 0.15 | 20.8 | 0.4 | 323 | 0.0031 |
| P32 | Bottom of Silos 2, 3, 5 | 329203 | 362274 | 6 | 0.34 | 14.4 | 1.3 | 323 | 0.011 |
| P33 | Cement Mill 3 dedusting | 329200 | 362134 | 20 | 0.36 | 12.6 | 1.3 | 323 | 0.011 |
| P34 | Limestone Receiving 1 | 329194 | 362306 | 4 | 0.46 | 15.2 | 2.5 | 298 | 0.023 |
| P35 | Limestone Receiving 2 | 329194 | 362307 | 10 | 0.46 | 15.2 | 2.5 | 298 | 0.023 |
| P36 | Limestone Receiving 3 | 329194 | 362308 | 27 | 0.46 | 15.2 | 2.5 | 298 | 0.023 |
| P37 | Crumbeliser Silo 2 | 329049 | 362106 | 20 | 0.34 | 6 | 0.5 | 323 | 0.0046 |
| P38 | Pressure Relief Coal | 329060 | 362070 | 30 | 0.56 | 2 | 0.5 | 298 | 0.0045 |
| P39 | Dedusting Coal/Shale | 329015 | 362120 | 15 | 0.75 | 2 | 0.9 | 298 | 0.0081 |
| P40 | Arodo Packer filter | 329155 | 362305 | 15 | 0.6 | 15.7 | 4.44 | 298 | 0.041 |
| P41 | Silo 6 top | 329166 | 362334 | 34 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |
| P42 | Rail silo 1 dedusting Filter | 329200 | 362251 | 34 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |
| P43 | Rail silo 2 dedusting Filter | 329209 | 362248 | 34 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |
| P44 | Rail silo 3 dedusting Filter | 329218 | 362244 | 34 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |

**TABLE 4.2: MODEL INPUT PARAMETERS REQUIRED FOR DISPERSION MODELLING OF POINT SOURCE EMISSIONS**

| Model Ref. | Source Description | NGR Easting | NGR Northing | Emission Height (m) | Diameter of Emission (m) | Velocity of Emission ($m\ s^{-1}$) | Volume Flow ($Am^3\ s^{-1}$) | Temp. (K) | Emission Rate ($g\ s^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| P45 | Rail silo loading head | 329210 | 362250 | 5 | 0.35 | 16.6 | 1.6 | 323 | 0.014 |
| P46 | Clinker transport at mill 4 | 329231 | 362200 | 5 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |
| P47 | Clinker transport at mill 5 | 329248 | 362283 | 25 | 0.3 | 4.2 | 0.3 | 323 | 0.003 |
| P48 | Mill 5 Stack New | 329206 | 362293 | 47 | 2.35 | 8.3 | 18.83 | 368 | 0.14 |

## 4.3 MODEL DESCRIPTION

AERMOD is a PC-based model for simulating dispersion in the atmosphere of pollutants released from industrial sources. AERMOD has been comprehensively validated and independently reviewed. The model incorporates the following key features:

- Characterisation of the boundary layer in terms of two parameters: the boundary layer depth and the Monin-Obhukov length, rather than using the "old-generation" stability categories.
- AERMAP; a terrain pre-processor, which provides information for streamline height algorithms and uses digital data to obtain receptor elevations.
- AERMET; a meteorological pre-processor, which estimates vertical profiles of wind, turbulence and temperature based on meteorological parameters (surface roughness, bowen ratio and albedo) representative of the modelling domain.
- Multiple source definition including point, area and volume source types. Source groups may also be defined.
- Discrete and boundary receptors, allowing maximum off-site concentrations to be calculated. On-site receptors may be removed from the project.
- Wet and dry deposition.
- PRIME building downwash module.
- Base map and terrain (3D) visualisation and layering with source and receptor information.

## 4.4 SENSITIVE RECEPTORS

### 4.4.1 Human Receptors

The nearest residential properties to the Works are located at a number of isolated farms and along Padeswood Drive to the north of the cement works. Penyffordd is the nearest area of relatively high-density residential properties. A number of discrete receptors have been included in the modelling. The locations of the receptors considered are presented in *Figure 4.1* and *Table 4.3*.

**FIGURE 4.1 LOCATIONS OF SENSITIVE RECEPTORS CONSIDERED FOR THE ASSESSMENT**

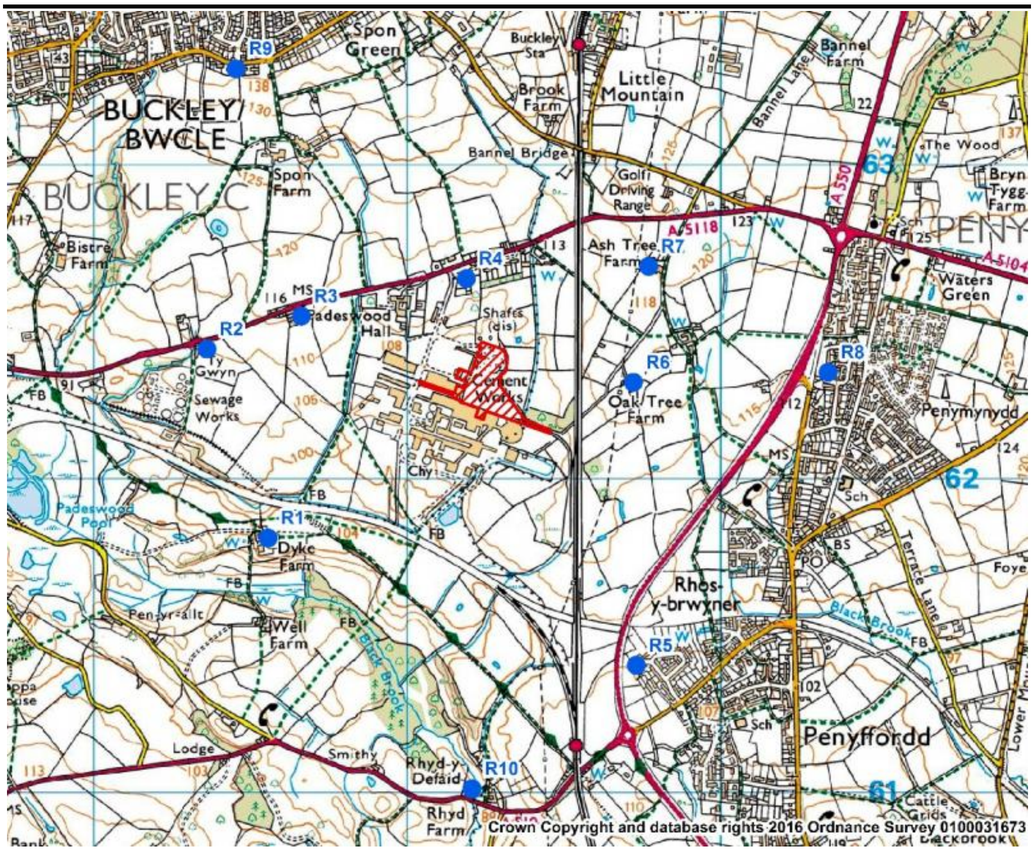



**TABLE 4.3 LOCATIONS OF SENSITIVE RECEPTORS CONSIDERED FOR THE ASSESSMENT**

| Receptor | Receptor Type | Easting | Northing |
|---|---|---|---|
| R1 Dyke Farm | Farm/Residential | 328556 | 361812 |
| R2 Ty Gwyn | Residential | 328361 | 362414 |
| R3 Oak Tree Farm (west) | Farm/Residential | 328662 | 362519 |
| R4 Padeswood Drive | Residential | 329188 | 362639 |
| R5 Penyffordd West | Residential | 329730 | 361406 |
| R6 Oak Tree Farm | Farm/Residential | 329721 | 362308 |
| R7 Ash Tree Farm | Farm/Residential | 329769 | 362678 |
| R8 Penymynydd | Residential | 330342 | 362340 |
| R9 Buckley | Residential | 328454 | 363308 |
| R10 Rhyd Farm | Farm/Residential | 329206 | 361013 |

### 4.4.2 Habitat Receptors

The nearest habitat receptor to the site is Black Brook Plantation, a local wildlife site located around 700 m to the south of the new cement mill. The nearest European habitat site is the Deeside and Buckley Newt site which is a Special

Area of Conservation (SAC) and is located approximately 1.5 km to the north of the site. Emission sources associated with the new cement mill are all low level and the greatest impact will be experienced close to the site boundary. Therefore, it is concluded that the impact of emissions from the new cement mill be negligible at these habitat sites particularly when emissions from the cement works as a whole are taken into consideration. Therefore, the impact of operational emissions on habitat sites is not considered further.

## 4.5 OPERATIONAL SCENARIOS

The dispersion modelling assessment will consider the impact of emissions of particulates from low-level sources (i.e. excludes the main kiln stack which has an emission height of 110 m) at the site with and without Mill 5. Modelling has been undertaken based on worst-case emissions from all sources (e.g. emissions at the emission limits, continuous operation of all emission sources).

## 4.6 OTHER MODELLING PARAMETERS

### 4.6.1 Building Downwash

In AERMOD, downwash effects are only significant where building heights are greater than 40% of the emission release height. The downwash structures also have to be sufficiently close for their influence to be significant. The height, dimensions and location of buildings regarded as potential downwash structures and included in the modelling are summarised in *Table 4.4*.

**TABLE 4.4 BUILDINGS INCLUDED IN THE DISPERSION MODEL (a)**

| Building | Height (m) | Location of Northwest Corner | | X Length (m) | Y Length (m) | Angle (°) |
|---|---|---|---|---|---|---|
| Raw Mill | 31.0 | 329025 | 362137 | 17.2 | 19.7 | 19 |
| Raw Meal Silos (west) | 31.0 | 329016 | 362175 | 9.1 | 7.0 | 19 |
| Raw Meal Silos (east) | 34.0 | 329042 | 362134 | 31.8 | 14.2 | 19 |
| Cranestore | 29.0 | 329074 | 362250 | 211 | 25.7 | 19 |
| Packing Plant | 26.0 | 329080 | 362304 | 20.0 | 21.0 | 19 |
| Pre-heater | 95.5 | 329054 | 362064 | 20.0 | 20.0 | 19 |
| Clinker Store | 40.0 | 329333 | 362145 | Radius = 36 | | - |
| Kiln 4 | 107.8 | 329062 | 362069 | Radius = 3.5 | | - |
| Mill 5 Building (a) | 26 | 329200 | 362311 | 60.0 | 16.0 | 19 |
| Rail silos (a) | 37 | 329197 | 362257 | 28.0 | 10.0 | 19 |
| (a) The height and building dimensions are the values assumed for the purposes of the modelling and may differ from the actual dimensions where the buildings have variable heights, widths and lengths | | | | | | |

### 4.6.2 Grid Size

A grid size of 3 km by 3 km and grid spacing of 50 m has been used for the dispersion modelling assessment.

## 5 PREDICTED IMPACT OF PARTICLE EMISSIONS

### 5.1 ANNUAL VARIABILITY

For assessing annual variability, worst-case ground level concentrations have been predicted for all five meteorological data sets (2012 to 2016). Modelling has been carried out for all low-level sources at operational emission limits. Predicted concentrations are presented for the maximum off-site concentration (i.e. at or beyond the installation boundary) and for the discrete receptors identified in *Section 4.4*.

### 5.2 CEMENT MILL 5 ALONE

#### 5.2.1 Predicted $PM_{10}$

Predicted worst-case annual mean and 24-hour ground level concentrations of $PM_{10}$ as a result of emissions from the new Mill 5 are presented *Table 5.1*. The predicted concentrations are for the seven new sources associated with the proposed new cement mill.

The results presented in this section assume 100% of particles are $PM_{10}$, which represents a worst-case assessment.

**TABLE 5.1 PREDICTED ANNUAL MEAN AND 24-HOUR MEAN $PM_{10}$ CONCENTRATIONS – CEMENT MILL 5 SOURCES ALONE**

| Receptor | Annual Mean (µg m$^{-3}$) | Annual Mean Percentage of AQO | 24-hour Mean as 90.4$^{th}$ %ile (µg m$^{-3}$) | 24-hour Mean Percentage of AQO |
|---|---|---|---|---|
| Maximum Off-site | 0.44 | 1% | 1.3 | 3% |
| R1 Dyke Farm | 0.03 | 0% | 0.10 | 0% |
| R2 Ty Gwyn | 0.03 | 0% | 0.09 | 0% |
| R3 Oak Tree Farm (west) | 0.07 | 0% | 0.23 | 0% |
| R4 Padeswood Drive | 0.16 | 0% | 0.41 | 1% |
| R5 Penyffordd West | 0.08 | 0% | 0.27 | 1% |
| R6 Oak Tree Farm | 0.10 | 0% | 0.29 | 1% |
| R7 Ash Tree Farm | 0.09 | 0% | 0.27 | 1% |
| R8 Penymynydd | 0.04 | 0% | 0.12 | 0% |
| R9 Buckley | 0.07 | 0% | 0.20 | 0% |
| R10 Rhyd Farm | 0.01 | 0% | 0.03 | 0% |
| *Air Quality Objective* | *40* | | *50* | |

Predicted concentrations would all be described as 'negligible' in accordance with the IAQM planning guidance. Maximum predicted annual mean concentrations represent 1% of the annual mean AQO and the maximum 24-hour mean as the 90.4$^{th}$ percentile is 3% of the AQO. At sensitive receptors locations predicted concentrations are substantially lower. Therefore, it is concluded that emissions of $PM_{10}$ from the new cement mill alone would be 'not significant'.

### 5.2.2 Predicted $PM_{2.5}$

Predicted worst-case annual mean ground level concentrations of $PM_{2.5}$ as a result of emissions from the new Mill 5 are presented *Table 5.2*. The predicted concentrations are for the seven new sources associated with the proposed new cement mill.

The results presented in this section assume 100% of particles are $PM_{2.5}$, which represents a worst-case assessment.

**TABLE 5.2 PREDICTED ANNUAL MEAN $PM_{2.5}$ CONCENTRATIONS – CEMENT MILL 5 SOURCES ALONE**

| Receptor | Annual Mean (µg m$^{-3}$) | Annual Mean Percentage of AQO |
|---|---|---|
| Maximum Off-site | 0.44 | 2% |
| R1 Dyke Farm | 0.03 | 0% |
| R2 Ty Gwyn | 0.03 | 0% |
| R3 Oak Tree Farm (west) | 0.07 | 0% |
| R4 Padeswood Drive | 0.16 | 1% |
| R5 Penyffordd West | 0.08 | 0% |
| R6 Oak Tree Farm | 0.10 | 0% |
| R7 Ash Tree Farm | 0.09 | 0% |
| R8 Penymynydd | 0.04 | 0% |
| R9 Buckley | 0.07 | 0% |
| R10 Rhyd Farm | 0.01 | 0% |
| *Air Quality Objective* | 25 | |

Predicted concentrations would all be described as 'negligible' in accordance with the IAQM planning guidance. Maximum predicted annual mean concentrations represent 2% of the annual mean AQO. At sensitive receptors locations predicted concentrations are substantially lower. Therefore, it is concluded that emissions of $PM_{2.5}$ from the new cement mill alone would be 'not significant'.

## 5.3 CHANGE IN PREDICTED CONCENTRATIONS

### 5.3.1 Predicted $PM_{10}$

Predicted concentrations provided in *Section 5.2* are for emissions from the new cement mill stack and other associated emissions. However, it is the change in predicted concentrations which is the important consideration as well as the cumulative impact of total emissions from the cement works on local air quality. The proposed development introduces seven new emission points including the Mill 5 stack. However, there are a number of existing emission sources which will be decommissioned as a result of the new cement mill development.

The impact of existing and future emissions on annual mean and 24-hour mean $PM_{10}$ concentrations is presented in *Table 5.3* and *Table 5.4*, respectively.

**TABLE 5.3 PREDICTED ANNUAL MEAN $PM_{10}$ CONCENTRATIONS – EXISTING AND FUTURE EMISSIONS**

| Receptor | Existing Annual Mean (μg m$^{-3}$) | Future Annual Mean (μg m$^{-3}$) | Difference (μg m$^{-3}$) | Difference as Percentage of AQO |
|---|---|---|---|---|
| Maximum Off-site | 5.6 | 5.1 | -0.5 | -1% |
| R1 Dyke Farm | 0.32 | 0.27 | -0.1 | 0% |
| R2 Ty Gwyn | 0.39 | 0.33 | -0.1 | 0% |
| R3 Oak Tree Farm (west) | 0.80 | 0.74 | -0.1 | 0% |
| R4 Padeswood Drive | 2.5 | 2.2 | -0.4 | -1% |
| R5 Penyffordd West | 0.82 | 0.68 | -0.1 | 0% |
| R6 Oak Tree Farm | 1.4 | 0.97 | -0.4 | -1% |
| R7 Ash Tree Farm | 0.77 | 0.63 | -0.1 | 0% |
| R8 Penymynydd | 0.49 | 0.35 | -0.1 | 0% |
| R9 Buckley | 0.79 | 0.65 | -0.1 | 0% |
| R10 Rhyd Farm | 0.19 | 0.13 | -0.1 | 0% |
| *Air Quality Objective* | *40* | | | - |

For all receptors, predicted concentrations decrease as a result of the new Mill 5 due to the decommissioning of some of the existing emission sources. The maximum predicted total concentration (background plus cement works contribution) for the future is 18.1 μg m$^{-3}$ for a background concentration of 13 μg m$^{-3}$. This is 45% of the annual mean AQO of 40 μg m$^{-3}$. Therefore, although there is a reduction in $PM_{10}$ concentrations the benefit is not considered to be significant in accordance with the IAQM planning guidance.

As for the annual mean, predicted 90.4$^{th}$ percentile of 24-hour mean concentrations for the future scenario are lower than the existing scenario demonstrating that the new cement mill has a beneficial impact on local air quality. For the maximum predicted concentration, the difference between the existing and future emissions is 2% of the AQO. Therefore, the beneficial impact is considered 'not significant'.

**TABLE 5.3 PREDICTED 90.4TH PERCENTILE OF 24-HOUR MEAN $PM_{10}$ CONCENTRATIONS – EXISTING AND FUTURE EMISSIONS**

| Receptor | Existing 24-hour Mean (μg $m^{-3}$) | Future 24-hour Mean (μg $m^{-3}$) | Difference (μg $m^{-3}$) | Difference as Percentage of AQO |
|---|---|---|---|---|
| Maximum Off-site | 13.3 | 12.4 | -0.9 | -2% |
| R1 Dyke Farm | 1.0 | 0.83 | -0.2 | 0% |
| R2 Ty Gwyn | 1.2 | 1.1 | -0.1 | 0% |
| R3 Oak Tree Farm (west) | 2.1 | 2.0 | -0.1 | 0% |
| R4 Padeswood Drive | 5.9 | 5.7 | -0.3 | -1% |
| R5 Penyffordd West | 2.4 | 2.0 | -0.4 | -1% |
| R6 Oak Tree Farm | 3.8 | 2.6 | -1.2 | -2% |
| R7 Ash Tree Farm | 2.0 | 1.8 | -0.3 | -1% |
| R8 Penymynydd | 1.4 | 1.0 | -0.4 | -1% |
| R9 Buckley | 2.2 | 1.8 | -0.4 | -1% |
| R10 Rhyd Farm | 0.59 | 0.39 | -0.2 | 0% |
| *Air Quality Objective* | *50* | | | - |

### 5.3.2 Predicted $PM_{2.5}$

The impact of existing and future emissions on annual mean $PM_{2.5}$ concentrations is presented in *Table 5.5*. This assumes as a worst-case that all emissions are $PM_{2.5}$.

**TABLE 5.5 PREDICTED ANNUAL MEAN $PM_{2.5}$ CONCENTRATIONS – EXISTING AND FUTURE EMISSIONS**

| Receptor | Existing Annual Mean (μg $m^{-3}$) | Future Annual Mean (μg $m^{-3}$) | Difference (μg $m^{-3}$) | Difference as Percentage of AQO |
|---|---|---|---|---|
| Maximum Off-site | 5.6 | 5.1 | -0.5 | -2% |
| R1 Dyke Farm | 0.32 | 0.27 | -0.1 | 0% |
| R2 Ty Gwyn | 0.39 | 0.33 | -0.1 | 0% |
| R3 Oak Tree Farm (west) | 0.80 | 0.74 | -0.1 | 0% |
| R4 Padeswood Drive | 2.5 | 2.2 | -0.4 | -2% |
| R5 Penyffordd West | 0.82 | 0.68 | -0.1 | -1% |
| R6 Oak Tree Farm | 1.4 | 0.97 | -0.4 | -2% |
| R7 Ash Tree Farm | 0.77 | 0.63 | -0.1 | -1% |
| R8 Penymynydd | 0.49 | 0.35 | -0.1 | -1% |
| R9 Buckley | 0.79 | 0.65 | -0.1 | -1% |
| R10 Rhyd Farm | 0.19 | 0.13 | -0.1 | 0% |
| *Air Quality Objective* | *25* | | | - |

For all receptors, predicted $PM_{2.5}$ concentrations decrease as a result of the new Mill 5 due to the decommissioning of some of the existing emission sources. The maximum predicted total concentration (background plus cement works contribution) for the future is 14.1 µg m$^{-3}$ for a background concentration of 9 µg m$^{-3}$. This is 56% of the annual mean AQO of 25 µg m$^{-3}$. Therefore, although there is a reduction in $PM_{2.5}$ concentrations the benefit is not considered to be significant in accordance with the IAQM planning guidance.

## 5.4 DISTRIBUTION OF PREDICTED CONCENTRATIONS

For the future scenario (with Cement Mill 5 operating), predicted annual mean $PM_{10}$/$PM_{2.5}$ and 90.4$^{th}$ percentile of 24-hour mean $PM_{10}$ concentrations are presented as contour plots in *Figure 5.1* and *Figure 5.2*, respectively. These are provided for the most recent meteorological year

**FIGURE 5.1 PREDICTED ANNUAL MEAN CONCENTRATIONS OF $PM_{10}$ AND $PM_{2.5}$ – ALL FUTURE SOURCES FOR 2016 (µg m$^{-3}$)**

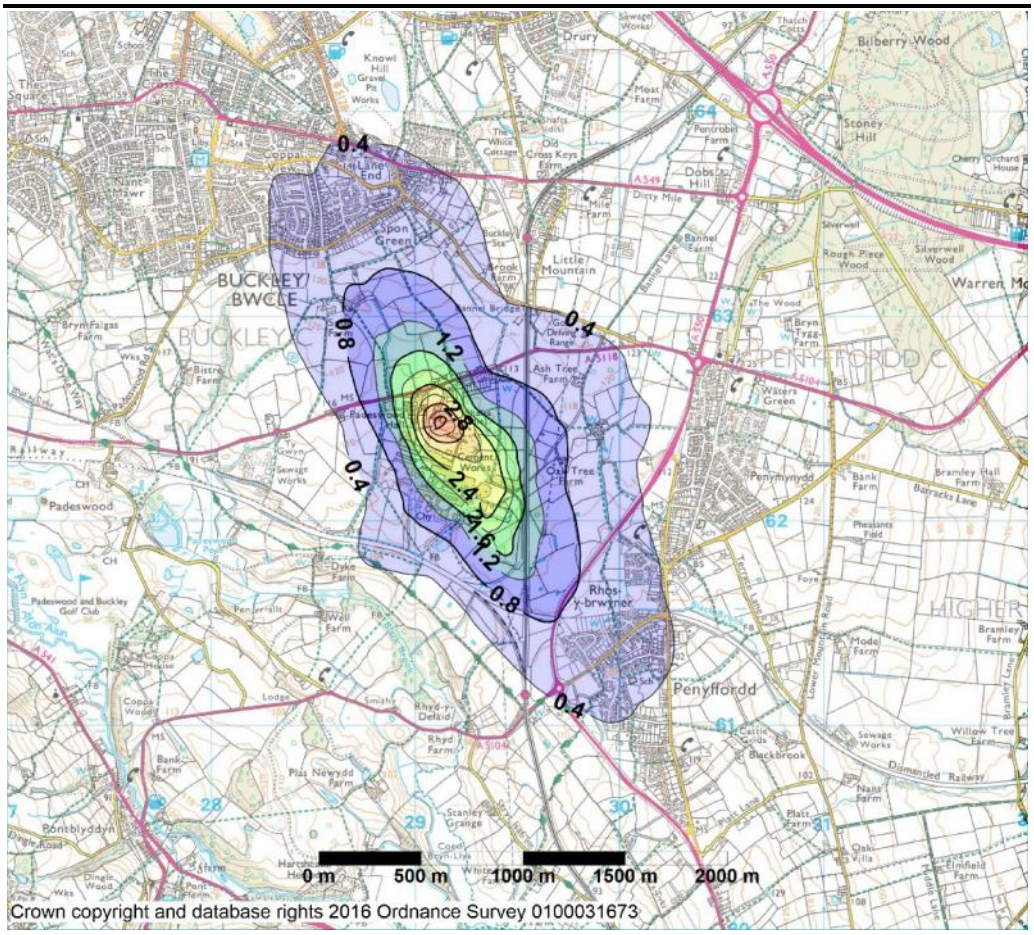
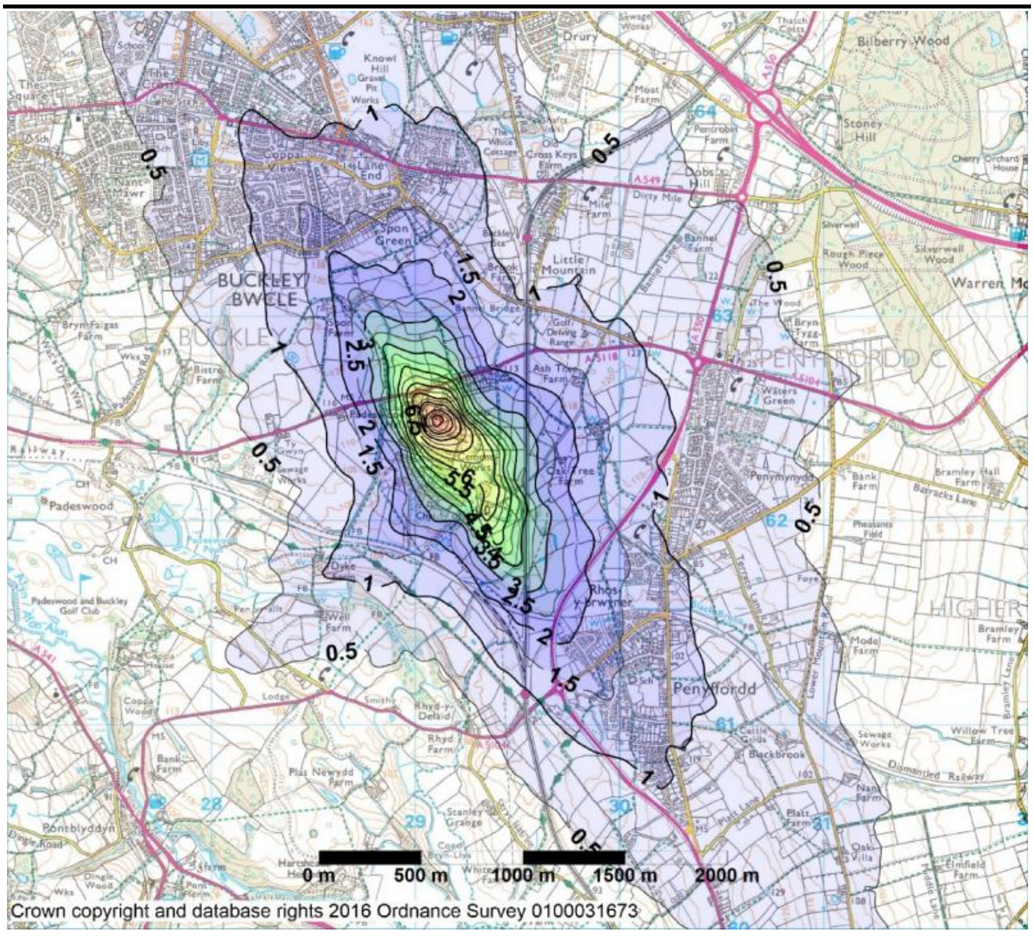


**FIGURE 5.2 PREDICTED 90.4TH PERCENTILE OF 24-HOUR MEAN CONCENTRATIONS OF $PM_{10}$ – ALL FUTURE SOURCES FOR 2016 (µg $m^{-3}$)**



# 6 CONCLUSIONS

## 6.1 SUMMARY

An assessment of air quality impacts associated with the installation of a new cement mill at the Padeswood cement works has been carried out. This has considered potential air quality impacts during construction and operation and the impact on human and habitat receptors.

The assessment has considered traffic-related air quality impacts during construction and operation, construction dust impacts and the operational impacts of the new cement mill.

The main emission from the cement mill is total suspended particles (TSP) which will comprise a range of particle sizes. For human health effects, fine particles (i.e. particles of less than 10 µm in diameter, termed $PM_{10}$ or less than 2.5 µm termed $PM_{2.5}$) are of most concern. Therefore, as a worst-case it is assumed that particle emissions from the cement works comprise entirely of these finer fractions. The larger particles will settle quicker and be less likely to remain airborne as well as being of less concern for human health effects.

It is considered that fugitive emissions from the new cement mill and associated facilities will be minimal as all transport and storage of product will be covered or enclosed. Therefore, it is concluded that the impact of fugitive emissions on human and habitat receptors would be minimal and has been screened out of the assessment.

In addition to operational impacts of the cement mill, it was necessary to assess the potential impact on air quality of the construction phase and associated activities. These include the following:

- Construction activities associated with the cement mill, associated silos and upgrading of the railway sidings; and
- Increases in vehicle movements (e.g. road and rail) associated with the commissioning of the new cement mill.

As a result of the introduction of the new cement mill, it is anticipated that there will be a reduction in road traffic vehicle movements but an increase in rail movements. The reduction in road traffic is estimated as 31 vehicles per day (62 vehicle movements into and out of the site).

The number of heavy duty vehicles (HDV's) accessing the site during construction is estimated at an average of 35 movement per week (approximately 6 movements per day for a 6 day working week) over the duration of the construction period. At worst, there would be around 28 HDV movements per day due to the movement of materials off site (estimated as 675 HDV vehicles, 1,350 movements, over an eight-week period). Construction personnel will result in an additional 85 vehicles (170 movements) per day assuming each worker travels in their own vehicle. The number of additional rail movements is estimated to be 175 trains (350 rail movements) per year. Therefore, there would be approximately one movement per day on average. Therefore, it was concluded that the impact of rail traffic and road traffic on local air quality can be screened out of the assessment.

Therefore, the focus of the assessment was on construction dust impacts and operational impacts from the operation of the kiln and emissions via the stack.

The construction dust assessment considered the impact of demolition, earthworks, construction and trackout on dust soiling and human health. The impact on habitat sites was screened out of the assessment given the distance from construction activities and construction routes. Prior to mitigation, the impact of demolition and earthworks was assessed as 'low risk' whereas the impact of construction and trackout was assessed as 'negligible risk'. Mitigation measures for minimising impacts have been recommended.

The quantitative assessment of particle emissions from the cement works with and without the new cement mill was undertaken to assess the impact of the new cement mill at the site. Dispersion modelling was undertaken using the US EPA AERMOD Prime dispersion model and five years of meteorological data from Hawarden (2012 to 2016).

Predicted ground level concentrations for emissions of $PM_{10}$ and $PM_{2.5}$ from low-level sources at the site are compared with air quality objectives and existing air quality.

The results of this assessment indicate that maximum predicted annual mean and 24-hour mean ground level concentrations are substantially less than the relevant air quality objective set for the protection of human health. Furthermore, predicted concentrations with the new cement mill were less than existing emission sources. However, it was concluded that this reduction in concentrations was not significant.

## 6.2 CONCLUSIONS

The results of this assessment indicate that the additional releases from the proposed Cement Mill 5 will not have a significant impact on local air quality.

Gair Consulting Limited
3 Ware Leys Close
Marsh Gibbon
Bicester
OX27 0EN

Tel: 01869 278889