Proposed Burnham Quarry – Air Quality

Prepared for

Burnham 2020 Limited

August 2023

PATTLE DELAMORE PARTNERS LTD
Level 5, PDP House
235 Broadway, Newmarket, Auckland 1023
PO Box 9528, Auckland 1149, New Zealand

Office +64 9 **523 6900**
Website **http://www.pdp.co.nz**

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Quality Control Sheet

TITLE	Proposed Burnham Quarry – Air Quality
CLIENT	Burnham 2020 Limited
ISSUE DATE	24 August 2023
JOB REFERENCE	C04096800R001_revised.docx

Revision History

REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
1.0	8 August 2023	Final report	Jonathan Harland	Jonathan Harland	Andrew Curtis
2.0	24 August 2023	Revised final report	Jonathan Harland	Jonathan Harland	Andrew Curtis

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE 

Jonathan Harland

Reviewed and Approved by

SIGNATURE 

Andrew Curtis

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1.0 Introduction

Burnham 2020 Limited (operated by Winstone Aggregates) (Winstones) is proposing to establish a gravel quarry located approximately 500 metres to the north of the Burnham Military Camp (Burnham Camp). The proposed quarry is to be known as 'Burnham Quarry' and will produce a wide variety of aggregates, including basecourse, concrete aggregates and sealing chip that will be used in civil infrastructure projects in the Canterbury region.

The site is approximately 360 hectares in size, and it is anticipated that approximately 26 to 36 million bank cubic metres (BCM) of gravel will be available to be quarried from the site. The extraction rate will be influenced by the demand for aggregate, but the rate of extraction is expected to be on average 500,000 BCM per year which would give an expected life of the quarry of more than 60 years.

The proposal will require the removal of topsoil and overburden to access the resource, extraction of the resource and transportation of the material to the processing plant, and the processing of material which will involve washing, crushing, screening and stockpiling.

Pattle Delamore Partners Limited (PDP) has been engaged to assess the air quality aspects, and in particular dust effects, of this proposal. PDP has prepared a FIDOL assessment for the proposed Burnham Quarry, which is based on observations and experiences at other similar sites. The findings of this assessment are presented in the following sections of this report and will be used as supporting documentation for the consent applications to the Canterbury Regional Council (ECan) and the Selwyn District Council (SDC).

2.0 Background Information

When selecting the proposed site Winstones has tried to strike a balance between being in close proximity to the market and a location where there are as few as possible receptors that might be sensitive to quarry effects. The proposed Burnham Quarry is within a triangular block of land bounded by Grange Road to the south, Aylesbury Road to the east and pastoral land to the west. The site is currently used for dairy farming and the farming activities will continue to co-exist with the quarrying activities. The surrounding area is also used for farming activities, residential dwellings, lifestyle blocks, horse training facilities and further afield is the Burnham Military Camp. The closest dwelling to the proposed quarrying activities will be 100 metres to the east of the southeastern corner of the site. The site is shown as the white triangle in Figure 1.

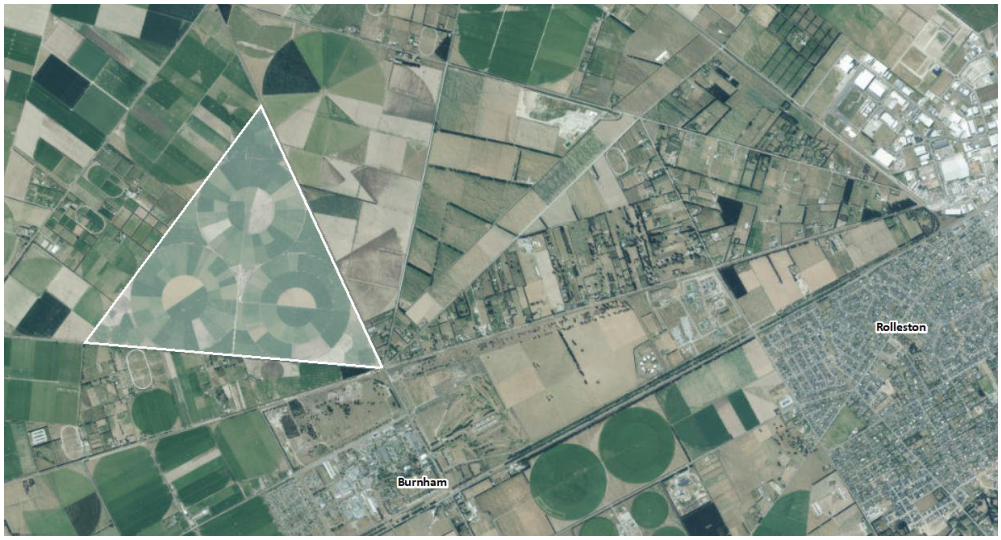

Figure 1: Site Location

2.1 Topography

The topography of an area will largely influence wind speed and wind direction, and therefore is an important consideration in the potential for dust to be transported off-site. The proposed site and the surrounding area are relatively flat and therefore there are unlikely to be any localised wind effects based on the topography. The wider Canterbury area is influenced by the Southern Alps which results in prevailing winds from the northeast and southwest.

2.2 Existing Air Quality

PDP is unaware of any publicly available ambient air quality monitoring undertaken in the vicinity of the proposed site, therefore a monitoring programme has been undertaken to better understand the current background particulate concentrations. While the predominant pollutant generated from the proposed site is most likely to be nuisance dust (coarser particulate 30 – 100 micrometres (µm) in diameter) monitoring of finer particulate concentrations (PM_{10}) has been undertaken as this will help identify any potential dust concentrations that might result in health effects. Elevated concentrations of finer particulate can also help to indicate existing nuisance dust effects.

Monitoring commenced on 21 July 2022[1] and has been undertaken using a combination of nephelometers and a near reference Beta Attenuation Monitor (BAM) with the location of these monitors indicated in Figure 2. While neither of these types of monitors are considered reference standards under the National Environmental Standard for Air Quality (NES), the BAM uses the same measurement technique as other instruments that meet the USEPA

[1] The Western Dust Monitor wasn't installed until 16 August 2022

Federal Equivalent Method (FEM) and nephelometers are commonly used throughout New Zealand on projects of this nature. Therefore, PDP considers that these instruments are appropriate to provide indicative information on the existing concentrations of PM_{10} in the local area.

Figure 2: Dust monitoring locations

The daily average PM_{10} concentration measured between 21 July 2022 and 25 May 2023 is presented in Figure 4. Both the Western and Southern dust monitors recorded similar daily average concentration of 3.5 and 3.6 µg/m³ respectively, whereas the Eastern monitor had a higher daily average concentration of 5.8 µg/m³. The Eastern dust monitor recorded a number of days in mid-October where daily average concentrations were elevated and approaching the NES for PM_{10} (50 µg/m³). However, as a whole, the concentrations measured at these dust monitors are comparable to other rural background air quality monitoring sites, such as the Pongakawa Bush Road site[2] in the Bay of Plenty.

[2] Environment Bay of Plenty, NERMN Air Monitoring 2012, Environmental Publication 2012/02

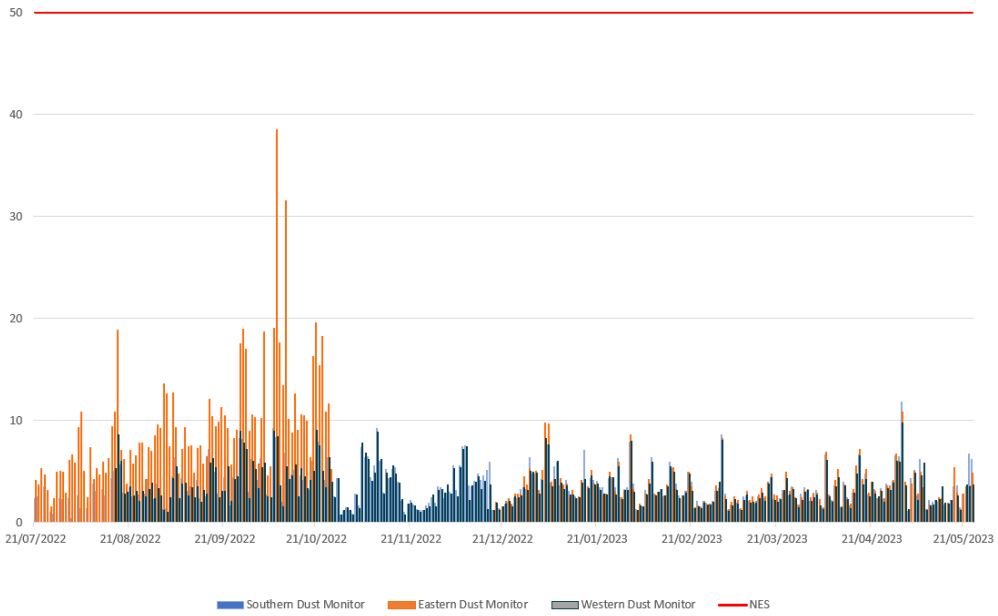

Figure 3: Background 24-hour average PM_{10} concentrations

To help understand the potential sources of dust currently experienced on site Figure 4 presents a polar plot of the data for the Eastern dust monitor. A polar plot shows three variables in one representation, wind speed, wind direction and 1-hour average PM_{10} concentration (µg/m³). A coloured dot is placed over the grid for each possible wind direction and speed. The colour of the dot represents the "maximum" concentration (in µg/m³) of PM_{10} measured at the monitoring site during the wind conditions at the spot i.e. for the plots below, the higher PM_{10} concentrations are indicated by red and the lower concentrations by purple. By presenting the three variables (concentration, windspeed and wind direction) on one figure, it makes it easier to understand the potential source of the dust.

Based on Figure 4, for the Eastern dust monitor, the main source of PM_{10} appears to be to the northwest of the dust monitor and occurs during very strong windspeeds (>10 m/s). While it is not clear what the source of the dust might be, given the rural nature of the surrounding land, it may have been from activities such as field cultivation. Regardless of the source of the dust, given that the higher concentrations coincide with very strong wind speeds the source could be some distance (potentially kilometres) away.

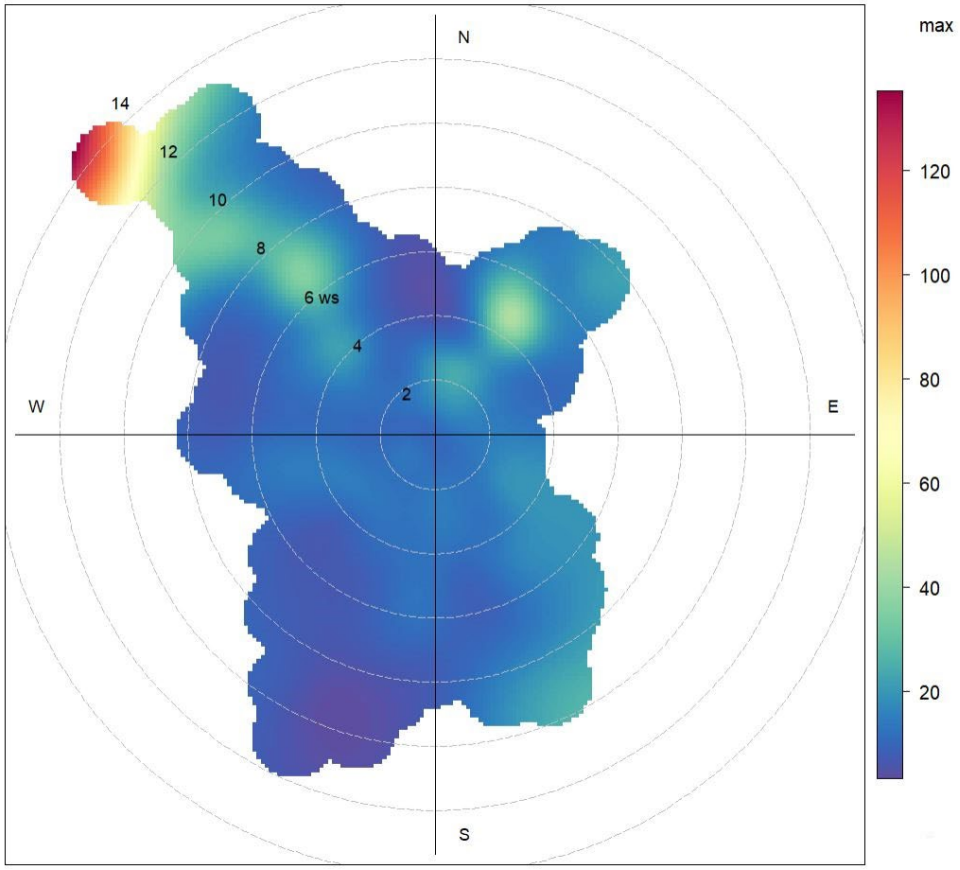

Figure 4: PM_{10} Polar Plot for Eastern Dust Monitor

The 1-hour average PM_{10} recorded at the three dust monitoring locations is presented in Figure 5. While concentrations are typically well below the MfE dust nuisance trigger value of 150 µg/m³, there have been a few occasions when background concentrations at the Eastern dust monitor were elevated and above the guideline value. These coincide with the highest daily averages and are a result of an unknown discrete event.

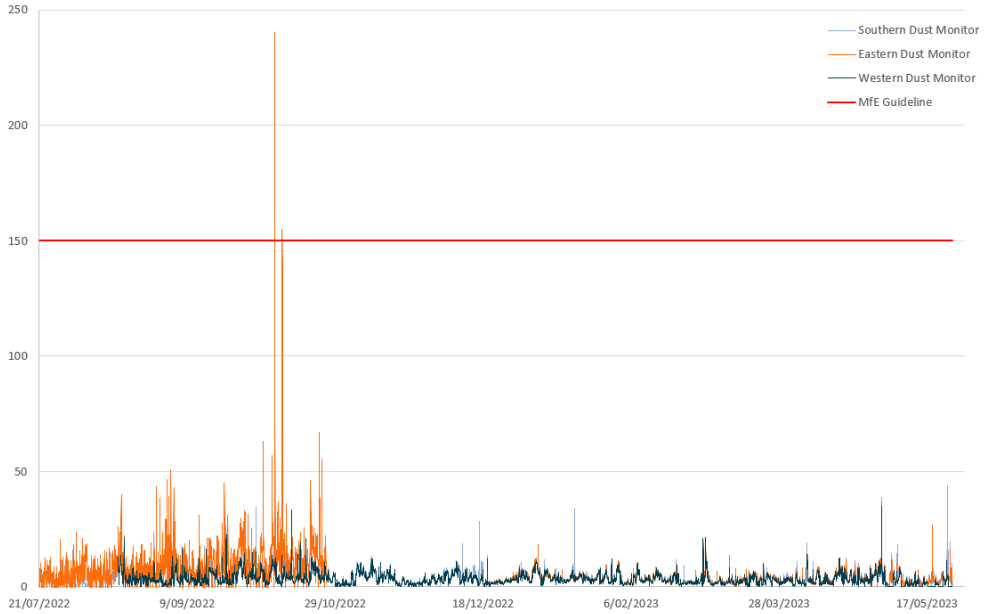

Figure 5: Background 1-hour average PM_{10} concentrations

2.2.1 Respirable Crystalline Silica

In addition to monitoring ambient PM_{10} concentrations, ambient monitoring for respirable crystalline silica (RCS) monitoring has also been undertaken using a Partisol 2000i with a PM_4 cyclone inlet. The RCS monitoring was co-located with the Eastern Dust monitor adjacent to Aylesbury Road. The monitoring was undertaken between 15 July 2022 and 3 January 2023.

PDP considers that the July to January RCS monitoring covers a wide range of surface moisture conditions (wet and dry periods) and doesn't expect the values to vary considerably during other parts of the year (January to June). This is mainly due to RCS concentrations being proportional to PM_{10} and dust concentrations. The monitoring data in Figure 5 suggests there will be no strong seasonal impact in the dust concentrations, with peaks representing individual discrete events, rather than more frequent peaks occurring in a dry season. PM_{10} concentrations on a monthly basis remain fairly constant, even over the typically drier months of January to March.

Each RSC sample was collected over a period of between two to four weeks. This period of sampling is a compromise. It is long enough to ensure that sufficient RSC is captured on the filter to be above the limit of detection and short enough period to identify monthly variations in concentrations. However, the sampling period is not directly comparable to the relevant 24-hour and annual RCS health guidelines. To enable the monitored RCS data comparable to the relevant health guidelines an assumption about the data needs to be made. The comparison of monitored RCS concentrations to health impact guidelines is provided below along the assumptions made. Table 1 presents a summary of the RSC monitoring.

Table 1: RCS Monitoring Results		
Start	**End**	**RCS (µg/m³)**
15/7/2022	11/8/2022	0.14
16/8/2022	15/9/2022	0.19
16/9/2022	13/10/2022	0.29
14/10/2022	28/10/2022	0.40
29/10/2022	12/11/2022	0.44
16/11/2022	30/11/2022	0.26
5/12/2022	19/12/2022	0.34
20/12/2022	3/1/2023	0.32
Average		0.30
Maximum		0.44

The RCS monitoring over this period indicates an average RCS concentration of 0.3 µg/m³ and a maximum concentration of 0.44 µg/m³.

In New Zealand, the Californian[3] (USA) and Victorian[4] (Australia) annual average health guideline of 3 µg/m³ is commonly adopted. As the monitoring was only undertaken over a period of approximately six months and therefore cannot be compared directly to the RCS annual average health guideline. For the reasons noted above PDP assumes that the six months of data collected is representative of concentrations that would be experienced throughout a full year and therefore can be compared to the annual guideline value.

Comparing the six-month average monitored concentration (0.3 µg/m³) to the RCS guideline (3 µg/m³) shows that on average over a year, concentrations are likely to be 10% of the guideline value. Even if the maximum monitored RSC concentration value of 0.44 µg/m³ was assumed to occur every month of the year then this would equate to an annual concentration of 0.44 µg/m³ which is well below (15%) the guideline value of 3 µg/m³.

PDP also reviewed the literature aiming to identify an appropriate short-term health assessment criteria of RCS. This review disclosed a Texas[5] (USA) 24-hour average health assessment criteria of 24 µg/m³. While there is no 24-hour average RCS monitoring data for the site, assumption can be made based on the 24-hour average PM_{10} concentrations. However, this is conservative as RSC is measured as PM_4 and therefore would be a small portion of the monitored PM_{10} concentrations (presented in section 2.2).

[3] (California) Office of Environmental Health Hazard Assessment, (2005). *Adopted Chronic Reference Exposure Levels for Silica (Crystalline Respirable)*.
[4] EPA Victoria, (December 2007). *Mining and Extractive Industries*.
[5] Texas Commission on Environmental Quality, (December 2020). *24-hour ReV for Silica, Crystalline Forms*.

The 24-hour average PM_{10} concentrations at each of the monitoring sites are between 3.5 and 5.8 µg/m³. Because RSC is measured as PM_4 and not all PM_4 will be RSC the 24-hour average RCS concentrations must be well below monitored PM_{10} concentrations. Making a highly (even unrealistically) conservative assumption that all PM_{10} is RSC, the maximum RSC concentration (5.8 µg/m³) would be well below (12%) the Texas 24-hour health assessment criteria (24 µg/m³).

This conclusion can be tested by considering RCS the monitoring data. To compare the RCS monitoring data against the Texas 24-hour health assessment criteria, two assumptions must be made:

- All the RCS was captured in a single continuous 24-hour period during the 2 to 4 week sampling periods; and,
- All other days during this period had an RSC concentration of zero,

Using these assumptions, the monitored 24-hour average RSC concentrations would range between 4.2 µg/m³ and 7.8 µg/m³ with an average value of 5.3 µg/m³. For example, in the 27 day period between 16 September and 13 October where the average RCS concentration was 0.29 µg/m³, therefore worst case 24 hour average concentration would be 7.8 µg/m³ assuming every other day in the period had zero RCS.

Based on the above, PDP considers that background RCS concentrations will be well below the 24-hour guideline values.

The information presented in this section demonstrates that there will be no adverse short or long term health impacts from the background concentrations of RCS experienced at the site. The cumulative impact of RCS from background concentrations combined with source contributions of RSC is assessed in Section 6.3.

2.3 Rainfall

Rainfall acts as a natural dust suppressant and therefore reduces the potential for dust generation. Therefore, a key consideration in assessing the potential for dust emissions is identifying when the ground surface is likely to be wet or dry, i.e. when the evaporation rate exceeds the rainfall rate or soil moisture levels.

The percentage of dry days by month has been calculated based on the nearby Lincoln monitoring site for the years 2020 to 2022 and is presented in Figure 6. The driest months of the year are generally January and April, therefore greater consideration for and management of dust should be given during these drier months. Over the three-year period, the number of days where evaporation rates exceed rainfall in a 24-hour period (or 'dry days') was 888 days, which corresponds to 81 percent of the time.

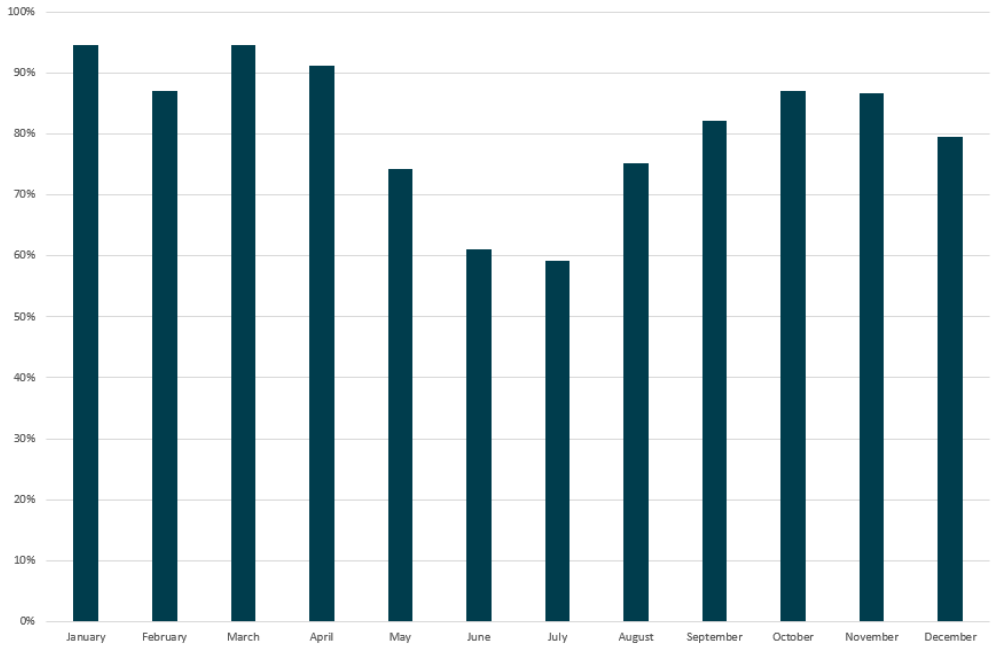

Figure 6: Percentage of dry days by month

2.4 Meteorology

Wind can have a significant effect on dust generation and transportation. The site has its own Automatic Weather Station (AWS), however this has only been in operation since 16 August 2022 and therefore does not cover a full year of meteorological conditions. The nearest publicly available meteorological weather stations relative to the site are at Christchurch Airport approximately 21 km to the northeast, Darfield approximately 15 km to the northwest and at Lincoln approximately 13 km to the east. As shown in Figure 7 there is a distinct difference in the wind patterns for the nearby meteorological sites, and therefore these sites would not represent the likely wind conditions at the proposed Burnham Quarry.

Figure 7: Windrose from Darfield, Lincoln and Christchurch Airport

Given the lack of suitable meteorological data, PDP has used a three-dimensional meteorological dataset developed using the Weather Research and Forecasting model (WRF[6]). The WRF dataset covered the area of the site at 1 km resolution for the years 2019-2020. Figure 8 compares the wind roses for the limited data collected to date at the proposed site and the WRF meteorological dataset for the same months (September to July). As can be seen, both datasets are showing dominant winds from both the northeast and northwest, however the WRF dataset appears to be overpredicting northwesterly winds and overall predicts stronger winds. Given that a significant number of receptors would be downwind of the proposed quarry during northwesterlies and that stronger winds are required to transport nuisance dust, PDP considers using the WRF dataset would most likely add conservatism to this assessment.

[6] https://www.mmm.ucar.edu/weather-research-and-forecasting-model

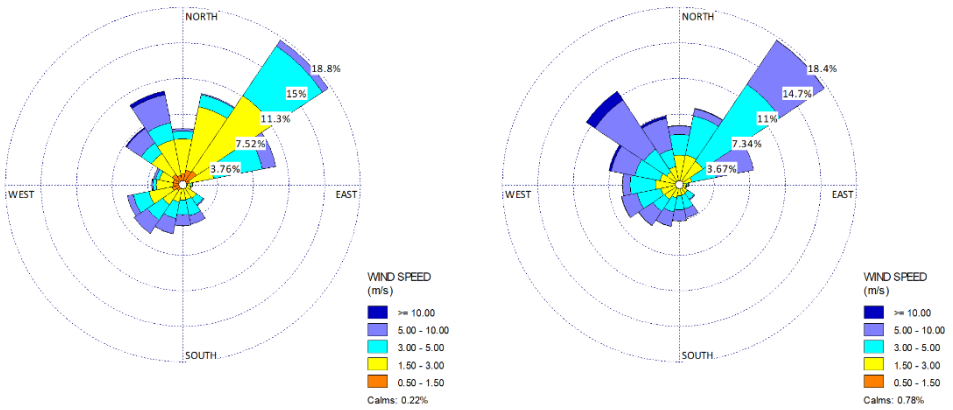

Figure 8: Wind rose from Site AWS (left) and WRF (right)

Figure 9 presents a wind rose for the site that was extracted for the entire WRF meteorological dataset period. The wind rose depicts wind speed and direction and the frequency at which they occur. From Figure 9 it is evident that the dominant wind directions are from the northeast and the northwest. Table 2 presents the predicted distribution frequency of wind speed. The predominant higher speed winds (greater than 5 metres per second (m/s)) originate from the northwest. Based on PDP's experience, it is these stronger wind conditions that have the greatest potential to cause off-site dust nuisance effects.

When wind speeds at the ground level reach 5 m/s they have the highest potential to transport dust off-site. In the case of the site and as discussed later, winds from the north northwest to the south have the potential to transport dust to the closest receptors along the southern boundary and southeast corner of the site, and these winds have speeds in excess of 5 m/s between 0 and 5.2 percent of the time. These predicted wind speeds are based on winds at 10 metres high and therefore will overpredict strong winds at ground level.

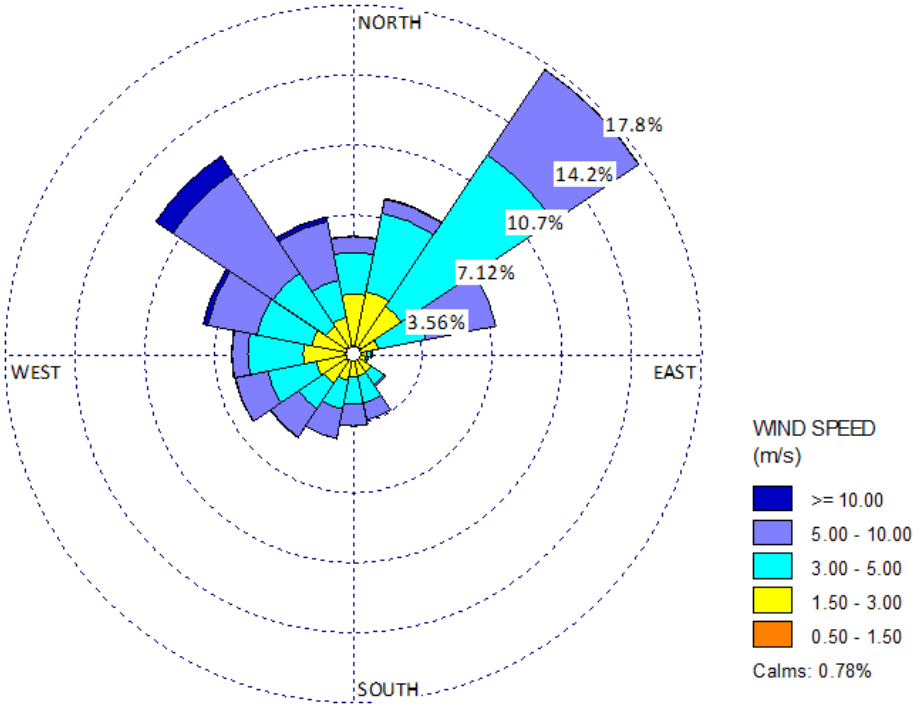

Figure 9: Predicted windrose for the proposed Burnham Quarry

Table 2: Wind Speed Frequency Distribution for Burnham Quarry			
Direction	Wind Speed (m/s)		Total (%)
	0-5	>5	
North	5.2	0.8	6.0
North Northeast	7.4	0.8	8.1
Northeast	12.2	5.2	17.5
East Northeast	3.8	3.6	7.4
East	1.0	0.0	1.0
East Southeast	0.8	0.0	0.8
Southeast	1.9	0.1	2.0
South Southeast	2.6	0.9	3.5
South	2.6	1.1	3.7
South Southwest	2.9	1.5	4.4
Southwest	3.4	1.8	5.2
West Southwest	4.5	1.7	6.2
West	5.4	0.8	6.2
West Northwest	5.1	2.8	7.8
Northwest	5.0	7.1	12.1
North Northwest	3.9	3.3	7.1
Calms			0.8

2.5 Sensitivity of the Receiving Environment

A site investigation has been undertaken to identify discrete receptors considered sensitive to changes in air quality as a result of potential discharges to air from the proposed quarry.

In the context of this assessment, the term 'sensitive receptors' is defined as a location where people or surroundings may be particularly sensitive to the effects of air pollution. This type of receptor includes:

- Residential properties;
- Hospitals;
- Schools;

- Libraries; and
- Public outdoor locations (e.g. parks, reserves, beaches, sport fields).

The nearest sensitive receptors are summarised in Table 3 and Figure 10 shows these graphically. PDP has not included all of the dwellings as discrete receptors for practical purposes but has instead selected a number of locations that are representative of them. The representative locations were chosen based on wind direction, i.e. they would be representative of other dwellings along the same wind direction, and also the distance from the proposed quarry as it would be more likely to be impacted by dust when compared to another dwelling that is further way.

The closest dwelling relative to the site is approximately 25 metres to the east northeast of the site boundary, however as already discussed, Winstones will not undertake gravel extraction within 100 metres of a dwelling. Other than residential dwellings, the only other locations that might be sensitive to air quality impacts in the vicinity of the proposed quarry are Coronation Park and the Golf Club which are 250 metres and 700 metres respectively to the southwest.

Table 3: Location of receptors close to the proposed quarry

Receptor Name	Address	Closest Distance to Quarry Activity (m)	Direction Relative to the Quarry
R1	168 Aylesbury Road	100	East northeast
R2	159 Grange Road	150	South
R3	273 Grange Road	350	South
R4	176 Kivers Road	330	Northwest
R5	716 Wards Road	1,100	North northwest
R6	716 Wards Road	1,450	East northeast

Notes: Distance is measured from the closest proposed quarrying activity.

Figure 10: Location of Sensitive Receptors

3.0 Assessment Methodology

This assessment has been undertaken in accordance with the Ministry for the Environment (MfE) guidance for assessing and managing the environmental effects of dust emissions[7] (MfE GPG Dust).

It is common practise in New Zealand to undertake a qualitative assessment of the potential effects associated with large earth moving projects and the bulk handling of materials. This assessment has involved a review of the proposed activities that will be undertaken, and then determining the likely potential for these activities to cause nuisance dust which could affect the surrounding environment. In determining whether there is the potential for nuisance to occur, the following considerations have been made:

- The nature of the activity undertaken;
- How long the activities are likely to occur;
- The nature of the material being handled, placed and stored;
- Whether mitigation measures can be implemented to control the potential for effects (e.g. covering or storage of materials, use of water suppression, etc.);

[7] MfE Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions, November 2016

- How close the local community is to the activities;
- The nature of the receptors in these communities and their sensitivity to dust; and,
- The prevailing meteorological conditions.

3.1 Comparison with Assessment Criteria

The assessment criteria used in the Canterbury Air Regional Plan (CARP) is based on the FIDOL assessment tool when determining whether or not a dust discharge has caused an objectionable or offensive effect.

PDP has undertaken a qualitative assessment to predict the effects from the proposed quarrying operations using the FIDOL assessment tool (Frequency, Intensity, Duration, Offensiveness and Location).

The FIDOL factors are explained in detail below:

- Frequency: relates to how often an individual is exposed to dust. Factors determining this include the frequency that the source releases dust (including its source type, characteristics and the rate of emission of the compound or compounds); prevailing meteorological conditions; and topography.
- Intensity: is the concentration of dust at the receptor location.
- Duration: is the amount of time that a receptor is exposed to dust. Combined with frequency, this indicates the exposure to dust. The duration of dust emissions, like its frequency, is related to the source type and discharge characteristics, meteorology and location. The longer the dust detection persists in an individual location, the greater the level of complaints that may be expected.
- Offensiveness: is a subjective rating of the unpleasantness of the effects of nuisance dust. Offensiveness is related to the sensitivity of the 'receptors' to the dust emission i.e., industrial premise may be more tolerant to dust concentrations than residential properties. Offensiveness can also be related to the colour of the dust, with natural tones being more acceptable than more distinct colours such as black from coal dust or yellow from sulphur.
- Location: is the type of land use and the nature of human activities in the vicinity of a dust source. The same process in a different location may produce more or less dust depending on local topography and meteorological conditions. It is also important to note that in some locations certain higher dust concentrations may be more acceptable than in others.

4.0 Proposed Activities

4.1 Project Overview

The proposed site is approximately 360 hectares in size and is currently a dairy farm and it is intended that farming activities will co-exist with the quarrying activities. Given that the site will also be used as a working farm, it is important to Winstones that the smallest possible area is used for quarrying activities and once an area has been quarried then it is rehabilitated to a standard which allows farming to be reestablished.

Winstones proposes to utilise as much of the site as possible, with extraction being undertaken up to 17.5 metres from the site boundary, except where there is permanent bunding and the setback will be 24.5 metres. Where there are dwellings close to the site boundary, the setback in these locations will be extended to provide for at 100 metres of separation between the dwelling and the extraction area. Therefore, based on this proposed footprint and an average quarry depth of 10 metres (depending on ground water level), it is anticipated that approximately 26 to 36 million BCM of gravel will be available to be quarried from the site. The extraction rate will be influenced by the demand for aggregate, but the rate of extraction is expected to be 500,000 BCM per year which would give an expected life of the quarry of more than 60 years.

The location of the site along with the proposed setbacks, processing and stockpiling areas, site access and each phase[8] of extraction is shown in Figure 11. Once the enabling works have been undertaken to establish the production and stockpile areas, along with the site facilities, extraction will move towards the southeast corner of the site and then move in a clockwise direction around the site. A more detailed staging plan showing the stages is provided in the Assessment of Environmental Effects.

[8] Each phase represents is approximately 5 years of production.

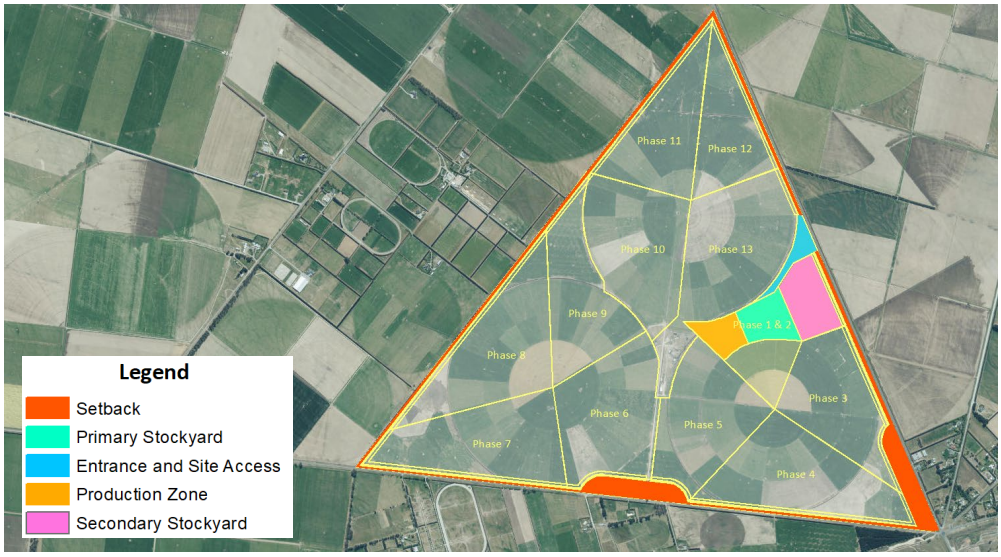

Figure 11: Proposed Quarry

4.2 Description of the Proposed Quarrying Activities

4.2.1 Site Establishment and Enabling Works

During the site establishment and enabling works the topsoil and overburden will be removed for the establishment of the quarry entrance, site office, amenities, parking and weigh bridge, production zone and stockyards. Material from these areas will be used to form the permanent bunding which will be in place for the life of the quarry. This bunding will be approximately three metres high and will run southward to the start of the 100 metre setback area in the southeast corner. In addition, 3 metre high topsoil stockpiles will be placed within the setback of each stage prior to the start of works in that area. These stockpiles will be removed as the stage is completed with the topsoil being used for rehabilitation.

4.2.2 Creation of Pit

The first extraction of material will create the production zone and stockpiling areas. Extraction will use the top-down method utilising excavators, wheel loaders and trucks. Material from this extraction will either be processed immediately using mobile processing equipment or stockpiled on top of future extraction areas.

4.2.3 Entrance and Site Access

The entrance and exit of the site will be located on Aylesbury Road. The entrance to the site will include offices, meeting rooms, amenities, light vehicle parking and the weigh bridge. From the entrance platform there will be a ramp leading down to the quarry floor which will include a wheel wash and a flood wash. The site entrance and the ramp down to the quarry floor will be sealed.

In terms of heavy vehicle movement, it is expected that the site will generate a maximum of 750 truck movements per day and up to 112 truck movements per hour. However, these maximum truck numbers are only expected during the latter stages of the quarry.

4.2.4 Production Zone

The production zone will house the processing plant which will include fixed plant as well as mobile plant as required. It is expected that there could be up to eight crushers operating in this area, with the material either being processed wet or dry.

Some stockpiling and loadout might occur in the production zone, but this will be generally limited to material that has a higher risk for dust emissions.

4.2.5 Primary and Secondary Stockyards

The primary stockyard is intended to contain those products which have a higher risk of dust emissions. Whereas the secondary stockyard is intended to contain products with a lower risk of dust emissions, bulk volume base coarse products, or slow-moving products with a low risk of dust emissions. Stockpiling bulk volume products in the secondary stockyard which is closer to the site access reduces the potential for wheel-based dust generation.

4.2.6 Extraction Zone

To access the resource below, overburden will be removed during a stripping campaign which will typically avoid the height of summer and the middle of winter. The amount of overburden material removed will be determined by the volume of aggregate required between stripping campaigns. Overburden from these stripping campaigns will be used to immediately rehabilitate areas where extraction is complete or be stored in temporary perimeter stockpiles before being used in the rehabilitation of the quarry.

Extraction of the resource will be undertaken using an excavator or front-end loaders by removing material from the toe of the quarry face. The extraction will advance from the inside to the outside of the site, meaning there is always a quarry face between the works and receptors.

Once the aggregate resource has been extracted it is Winstones intention to transport the majority of material to the production zone via conveyors however for conservatism this assessment is based on trucks moving this material. If used, conveyors will minimise dust generation and combustion emissions, especially when compared to typical load and cart operations with dump trucks and haul roads.

A temporary access road will be required to maintain the overland conveyors and provide access to the extraction and rehabilitation zone.

4.2.7 Silt Management

The approach to silt management will be finalised upon confirming the plant configuration. However, the following silt management methodology is envisaged:

- Silt will receive primary treatment in the production zone, most likely in the form of mechanical settling which will allow clarified water to be returned to the plant wash cycle. This clarified water is expected to make up a significant percentage of the overall water utilized by the production system. The residual silt slurry will be pumped to the silt management zone.
- The residual silt slurry will be retained within the silt management zone in ponds either holding it in a buffer capacity before pumping it on to rehabilitation or, reducing the moisture content so the silt can be stockpiled for future use in site rehabilitation.

4.3 Emissions to Air

The potential for air quality effects associated with the quarrying activities at the proposed Burnham Quarry relates almost exclusively to the potential for there to be dust emissions. While there is the potential for a number of vehicles operating on the site, the combustion emissions from the vehicles are considered to be insignificant and they are unlikely to result in any noticeable changes in air quality. Given that Winstones is investigating using conveyors and extracting equipment powered by electricity in the future and that the processing plant will be powered by electricity any combustion emissions from the site will be minimal.

Particulate matter in the environment generally falls into two categories: suspended and deposited particulate.

Suspended particulate matter is dust or aerosol which stays suspended in the atmosphere for significant periods of time. Its exact definition is dependent on the monitoring procedure adopted. The term Total Suspended Particulate (TSP) is commonly used to describe the total amount of suspended particulate in the atmosphere at any one time.

Deposited particulate matter is dust or aerosol which because of its aerodynamic diameter and density, falls from the air. In general terms, deposited particulate has a diameter of greater than about 30 µm. It is generally associated with nuisance effects such as soiling.

Suspended and deposited particulate arise from many natural and man-made sources. The most important sources globally are volcanoes and wind-blown dust, whilst on a local level, farms and fields, stationary and mobile combustion sources, road dust, wind-blown soil, pollen, and emissions from industrial processes are contributors.

The proposed quarry has the potential to generate dust from a number of potential operations. These include:

- Initial enabling works, including the construction of the haul roads and work platforms, removal of overburden, construction of erosion and sediment controls, and the formation of bunds.
- Extraction of aggregate.
- Operation of vehicles on the haul roads.
- Wind erosion of working areas.
- Rehabilitation of the completed areas.

A subfraction of the dust generated by quarry activities will fall into the category of PM_{10} which is regulated by a National Environmental Standard for Air Quality. PDP's experience at other sites is that PM_{10} from quarry activities is generally not measurable above background levels within a few hundred metres of the crusher. The Yaldhurst monitoring study which is discussed further in Section 6.3 also showed similar reductions in PM_{10} concentrations with distance.

Respirable crystalline silica (RCS) can also be present in the dust generated by quarry operations, and it is noted that any mitigation measures that control dust will also control RCS emissions. The activities which will generate dust and their mitigation measures are outlined in the following sub-sections.

5.0 Proposed Mitigation

This section of the report presents the mitigation measures that are used to control the effects of discharges to air during the proposed quarrying activities.

5.1 Overburden Placement

5.1.1 Process

The removal and placement of overburden occurs progressively as the quarrying activity progresses around the site, however these activities will only occur during earthmoving seasons (typically October to April). The overburden is stripped from the desirable material using excavators, with overburden loaded directly into trucks and transported to the site boundary and formed into bunds or immediately used to rehabilitate already quarried areas. As with overburden removal, as the active quarrying area progresses, the overburden bunds will be pushed back into the quarry pit for rehabilitation.

5.1.2 Potential Emission Sources

As overburden generally consists of soils, clays and weathered rock there is the potential for dust generation from this material. Dust emissions can occur from several sources which are:

- wind driven dust off exposed surfaces during overburden removal and the formation of bunds and topsoil stockpiles;
- dust being disturbed on haul roads between and within the excavation point and the bund construction areas;
- dust emissions from loading of trucks for transporting off-site; and,
- dust being disturbed as the bulldozer repositions overburden material in the creation of the bund to the desired contour.

5.1.3 Mitigation Measures

During overburden removal and placement the following mitigation measures will be implemented to mitigate the potential dust effects:

- watering the surface prior to disturbing it during dry weather conditions, if required;
- minimising the amount of vegetation, overburden and soil removal to a practicable level;
- controlling vehicle speeds to 20 km/h on unconsolidated surfaces;
- dampening of haul roads; and,
- mulching, grassing and / or planting of bare areas and bunds shall be undertaken as soon as reasonably practicable.

When it is impossible to avoid overburden disposal during particularly dry weather, watercarts or fixed sprinklers will be used to ensure that adequate dust suppression occurs to avoid generating off-site dust effects.

Water will be the primary mitigation tool that Winstones will implement to control dust. The use of water prevents (or suppresses) fine particulate from leaving the surface and becoming airborne through the action of mechanical disturbance or wind. In effect, the water acts to bind the small particles to the larger material, thus reducing the emission potential.

5.2 Aggregate Extraction Operations

5.2.1 Aggregate Extraction and Truck Loading

Once the desired quarried material is exposed, the material will be extracted and transported to the processing plant. While it is expected that extraction of the aggregate resource will start with standard quarrying machinery such as excavators and front-end loaders, Winstones is exploring options to utilise bucket wheel excavators in the future. For the purposes of a conservative assessment, PDP has assumed that the extracted material will be loaded into dump trucks and carted to the processing plant, although as mentioned earlier Winstone is investigating using conveyors to transport quarried material.

5.2.2 Potential Emission Sources

There are two primary sources of airborne emissions from this activity:

- Dust emissions from the excavation; and,
- Dust emissions from the placement of aggregate into the truck.

5.2.2.1 Mitigation Measures

For the majority of the time the rock extraction and truck loading will take place below ground level which will greatly reduce dust emissions. In addition, or when extraction and works are undertaken around or at current ground level such as enabling works, there are three possible techniques that are commonly to control dust from excavation and truck loading activities. These include wetting the material on the ground prior to the commencement of loading, the use of a fine water spray whilst loading is occurring, and / or the use of windbreaks to reduce wind velocities in the vicinity of the quarry.

5.3 Aggregate Processing

While the exact processing equipment is currently unknown, there will be potentially three stages of processing, these are: crushing (primary, secondary, tertiary and potentially quaternary), screening, and washing. The quarry will use a combination of fixed and mobile processing plant, with all processing undertaken in the production zone situated in the centre of the site. The fixed plant will be used to process the majority of the material, however mobile processing may be required to supplement the fixed plant production capacity in meeting peak demand. Mobile processing will also be used in the early establishment of the production and stockyard areas.

Described below are the potential emission sources from these activities.

5.3.1 Potential Emission Sources

The processing plants will be used for the manufacture of a wide range of materials for use in the roading, construction, concrete and asphalt industries. The material will most likely be fed into a jaw crusher and the crushed material will be passed over scalping screens. From the scalping screens the material will be further processed and depending on the end product, further crushing using jaws, cones or barmac crushers might be required. Material from the crushers will be either dry or wet screened and the final material will be stockpiled.

5.3.2 Mitigation Measures

The majority of the aggregates at Burnham Quarry will be processed wet, which will result in little potential for dust emissions from the processing plant. Additionally, Winstone is proposing to undertake the following mitigation:

- All dry screens will have either fixed line fogging installed or will be enclosed.
- All crushers will have fixed line fogging installed around the infeed and outfeed, with additional fogging on the first few metres on the discharge conveyor.
- All transfer points for unwashed or dry material will have fixed line foggers installed.
- Conveyors transferring unwashed dry products less than 5 mm will be covered.
- Fogging canons will be available to control residual emissions as required.
- Also, Winstones is proposing to locate the processing plant near the centre of the site (over 1,000 metres from the closest dwelling) and approximately 10 metres below existing ground level.

5.4 Stockpiles and Exposed Areas

5.4.1 Potential Emission Sources

Winstones intends to operate two stockpile areas. The primary stockpile area will be directly to the east of the processing plant, and this area will be used to store products that have a higher risk for dust generation (finer materials), whereas the secondary stockpile area will be further to the east and will be used to store lower risk material (coarser and/or washed materials).

The sources of dust from wind erosion are from exposed soil around the quarry, together with dust from the stockpiles and overburden piles generated during normal operation of the quarry.

5.4.2 Mitigation Measures

The following mitigation measures will be the main techniques to control dust emissions from stockpiles and exposed areas.

5.4.2.1 Height of Stockpiles and Bunds

Windspeed increases with height above ground and therefore minimising the height of stockpiles and bunds will reduce the potential for dust generation from these sources. Where practical Winstones will keep aggregate stockpiles to a maximum height of 5 metres above the existing ground-level and bunds to a maximum height of 3 metres.

5.4.2.2 Minimise Exposed Area

Dust emissions due to wind erosion are directly proportional to the surface area exposed. Accordingly, the most appropriate means of controlling wind erosion is to minimise, at all times, the area from which dust particles can be eroded.

5.4.2.3 Vegetate the Surface

This is generally the most effective means of control and usually the most economical way to control wind erosion. However, ground cover can take some time to establish, particularly if required during a slow growing period. Therefore, other measures, such as chemical stabilisation, are often required while vegetation is becoming established.

5.4.2.4 Irrigation with Water

The periodic irrigation of exposed land by water carts can control dust emission through the addition of moisture, which in turn consolidates the surface particles and creates a crust on the soil surface when drying occurs. The amount of water and frequency of irrigation to maintain a desired level of dust control will be a function of the season and of the crusting ability of the soil.

5.5 Truck Loading and Transportation

5.5.1 Potential Emission Sources

The load out of trucks and the transport of material around the site without mitigation measures has the potential to generate dust emissions. It is virtually impossible to prevent dust occurring from road sources, but it is possible to ensure that as far as practicable dust emissions from this source are minimised.

5.5.2 Mitigation Measures

During truck load out the most practical dust mitigation is to limit the drop height of the material. Additional measures can be adopted such as during truck load out applying water if the material is particularly dry and installing wind break screens if load-out activities are undertaken in exposed areas.

In terms of transportation, while Winstones is exploring the use of conveyors as much as practicable to transfer material from the processing area to the stockpile areas there will be times when trucks are required to move material between the two areas. The main transport related mitigation methods that will be used at the Burnham Quarry are roadway watering, speed reduction and road surface management.

5.5.2.1 Watering

In general, the use of water on unpaved roads is the most economic and effective means of controlling dust emissions. Water will be applied by a water cart, through a series of spray nozzles attached to a water storage unit which are mounted to the body of a vehicle, which enables even distribution of water to the road surface. In more permanent unsealed sections of road that are regularly used, Winstones will consider using fixed sprinklers to apply water.

Winstones will use water as the principal means of dust suppression on roads as there is sufficient water supply from the groundwater bores on-site.

5.5.2.2 Speed Reduction

In general terms, the emission of dust from road traffic is proportional to vehicle speed. Hence, any reduction in vehicle speed will also mean a reduction in dust emission. To some extent, the recommended speed of vehicles is dictated by the load they are carrying. However, the most important factor is the dryness of the road surface, such that adequate watering can reduce the need for tight speed restrictions.

At the proposed Burnham Quarry a speed restriction of 30 km/h will be enforced on all internal roads to reduce the potential for dust emissions and for safety reasons.

5.5.2.3 Haul Road Maintenance

After aggregate has been spread on an unsealed road surface, the movement of vehicles over time breaks it down into smaller pieces. At some stage, those small pieces will reach a size where they can become easily airborne. Winstones can avoid this matter occurring by ensuring that the road metal is replaced prior to this becoming a potential dust source on internal roads.

5.5.2.4 Sealed Entrance Road and Wheel Wash

Sealed road surfaces are generally installed in high risks areas as the potential for dust generation from this source is much lower than unsealed roads. However, dust can still become a problem on sealed surfaces when dust is deposited usually from vehicles tracking dust from unsealed areas. As with unsealed roads, applying water will control dust from these surfaces, however other measures such as sweeping are often undertaken. Additionally, the site will also use a wheel wash and a flood wash to remove dirt from trucks leaving the site. This will minimise the risk of dust tracking at the site entrance and onto public roads.

5.6 Silt Management

Based on the potential methodology discussed in Section 4.2.7, the following dust management is proposed:

- If silt ponds remain slurried or have a top surface with a high moisture content such that fugitive dust does not arise, then no specific dust controls are required on the ponds themselves.
- If the top surface of ponds dries out completely, it is expected to form a protective 'crust', which provided it is not subject to vehicle tracking, is unlikely to produce fugitive dust emissions. Given that flocculants are expected to be used in the primary silt treatment process, these will aid the development of a surface crust. If the protective crust does produce emissions, then controls will be put in place – wetting the surface or applying polymer or other approved suppressants will be used.
- Silt stockpiles will be treated with a polymer or other approved suppressant or vegetated.

5.7 Dust Monitoring

5.7.1 General Monitoring

There are a range of simple monitoring activities that can be regularly used to ensure that dust is being appropriately controlled at Burnham Quarry. These monitoring measures are regularly used at most quarry sites and are incorporated into the draft dust management plan (Appendix A). Table 4 sets out these measures.

Table 4: Visual Dust Monitoring Programme	
Monitoring Activity	**Frequency**
Check weather forecasts for strong winds and rainfall to plan appropriate work schedule and dust management response.	Daily
Inspect land adjacent to the site where possible, site exits and adjoining roads for the presence of dust deposition.	Twice daily
Observe weather conditions including wind and rain via observations and data outputs from weather stations.	Daily and as conditions change
Inspect all exposed surfaces for dampness and to ensure that the exposed un-stabilised area is minimised.	Daily and as conditions change
Inspect any stockpiles to ensure that they are not subject to wind erosions. Minimise as far as practical the height of stockpiles containing unprocessed or unwashed material.	Daily and as conditions change
Inspect dust generating activities to ensure dust emissions are effectively controlled.	Daily and as new activities are commenced
Inspect watering systems (sprays and water carts) to ensure equipment is maintained and functioning to effectively dampen exposed areas	Weekly

5.7.2 Dust Monitoring

Winstones is looking to continue undertaking continuous dust monitoring with telemetry at three locations around the Burnham Quarry. These will be on each boundary of the site and at a location nearest to receptors close to the extraction area. Figure 12 provides indicative locations for the monitors during the first stage of work. Given that the monitors will be able to measure PM_{10} concentrations and send data in 'real time', PDP recommends that dust is controlled using the following triggers and these triggers have been incorporated into the draft dust management plan.

Trigger Level 1 - (120 µg/m³ as a 1-hour average) - To identify that dust concentrations have reached a point where dust nuisance is likely to occur if action is not taken to implement mitigation measures. It would not be expected that dust concentrations would reach this level unless there are adverse weather conditions in conjunction with a failure of mitigation.

Trigger Level 2 – (150 µg/m³ as a 1-hour average) - If this trigger is exceeded it indicates that dust concentrations have reached a level which is unacceptable, and dust nuisance will occur. All activities that have the potential to generate dust on site, apart from dust mitigation, must cease until such time as dust concentrations drop below Trigger Level 1.

If an investigation identifies that site activities are not responsible for the high dust concentrations, site activities may resume prior to concentrations dropping to below Trigger Level 1.

Figure 12: Location of Proposed Dust Monitors

5.7.3 Wind Monitoring

As part of the monitoring programme, real-time meteorological data will be provided to the quarry staff, which will be used to alert staff of potential dust generating winds. PDP recommends that alerts are sent out when wind speeds exceed 5 m/s and 10 m/s (during two consecutive 10-minute periods) so quarry staff can review that the appropriate dust management and mitigation measures are in place.

As far as is practicable the monitor will be located in accordance with AS 3580.14 - 2011 Ambient Air – Guide for the Measurement of Horizontal Wind for Air Quality Applications.

6.0 Assessment of Environmental Effects

This section provides an assessment of the potential emissions resulting from the proposed activities set out in Section 4 with the mitigation measures described in Section 5.

6.1 Dust Emissions

The most significant potential effect from the mining activities is nuisance associated with dust deposition. The activities that could cause this are discussed in Section 4.3.

There are number of factors that are important to consider when determining whether any dust nuisance is caused by the disturbance and placement of materials. These include; size and density of the particles, wind speed and direction, height of release and the distance between the discharge point and the receptors.

These factors are all interconnected, and it is how they combine that determines the potential for an effect to occur.

However, typically the following applies:

- Heavier and larger particles require higher wind speeds to become airborne;
- Large particles will deposit faster than small particles of a similar density;
- More dense particles will deposit more rapidly than less dense particles of a similar size; and,
- Particles will travel further before depositing with a strong wind blowing than with a light wind blowing.

Despite this range of variables, the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Mineral Dust Impacts for Planning[9] states that dust nuisance effects are generally only experienced within 400 metres of operations and that impacts from gravel extraction (which encompasses the proposed Burnham Quarry are uncommon beyond 250 metres. PDP considers that these distances are based on unmitigated sources and as Winstones will apply the various forms of mitigation described in Section 5.0 to reduce and control the potential for dust emissions the distance in which effects could occur will reduce significantly. Based on the types of activities that will be undertaken and guidance provided in US EPA technical documents[10], with mitigation in place it is likely that effects will only occur within 50 metres of sources that are located at ground level.

[9] IAQM (2016) Guidance on the Assessment of Mineral Dust Impacts for Planning. Institute of Air Quality Management, London.
[10] AP 42, Fifth Edition, Volume I Chapter 13 Miscellaneous Sources, Section 13.2.4 – Aggregate Handling and Storage Piles

Nuisance dust is typically between 30 and 100 µm in diameter. In practice, the large particles (i.e. greater than 30 µm) do not stay suspended in the atmosphere, as they tend to fall out rapidly and settle. The Ministry for the Environment (MfE) Good Practice Guide for Assessing and Managing Dust (GPG AMD) describes that in a 5 m/s wind, 100 µm particles would only be blown about 10 metres away from a source. Figure 13 depicts the distance potentially travelled by nuisance dust for a range of wind speeds based on a particle diameter of 50 µm (typical size of a visible particle). This is a reasonable assumption based on PDP's experience with dust nuisance. The release height in the figure is also typical of the height that dust is released from for a range of quarrying activities i.e. material being loaded into a truck. However, these distances are based on flat terrain and do not account for changes in terrain elevation. For the most part the surrounding receptors and the proposed quarry are on the same plain, but as work commences and the pit forms the distance that dust could travel based on a 3 metre drop height will be more conservative.

Based on the above discussion, 400 metres has been used in this assessment to conservatively indicate the distance within which some level of dust effects could be experienced if no form of mitigation were to be applied. Based on this guidance properties located further than 400 metres from the site are unlikely to be affected by dust during any wind speed conditions. Properties to the north (receptors R5 and R6) are greater than 400 metres away from the site therefore effects to these receptors are expected to be minimal with respect to dust nuisance. Therefore, these sites have not been considered any further in this assessment.

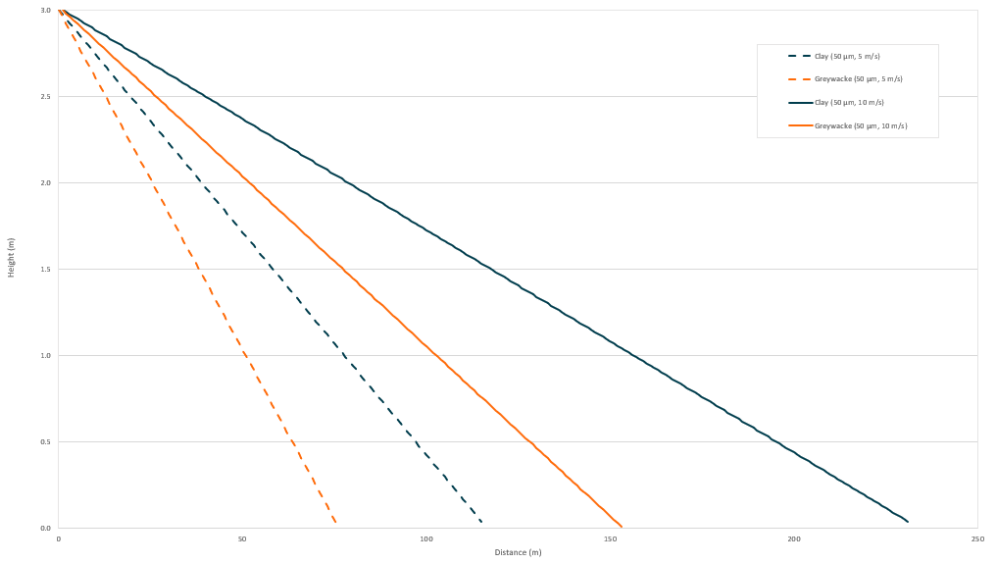

Figure 13: Difference in Particle Travel with Wind Speed

6.2 Assessment of Nuisance Dust Effects

6.2.1 Frequency

The frequency of dust discharges is influenced by the regular occurrence of suitable meteorological conditions to carry dust beyond the boundary to a sensitive receptor. Typically, nuisance dust would need winds greater than 5 m/s to travel beyond the site boundary. Given the information provided in Table 2, the predicted frequency of wind greater than 5 m/s occurs 31.6 percent of the time from all directions. Table 5 presents the frequency of high wind speeds in the direction of the nearby receptors which indicates that high wind speeds in the direction of receptors R1 and R2 are frequent, receptor R3 is moderately frequent and receptor R4 is infrequent. Frequency categories have been adopted from Table A3-2 of the Institute of Air Quality Management's (IAQM) Guidance on the Assessment of Mineral Dust Impacts for Planning[11]

For dust nuisance to occur, dust producing activities would need to coincide with the receptor affecting winds and during dry conditions. As these events must occur at the same time, the chances of dust nuisance occurring are smaller than the predicted wind frequencies in Table 5 and therefore less likely to occur. This, in combination with the proposed mitigation and monitoring, means that the frequency of any effects associated with the quarrying activities will be lower.

Table 5: Frequency of high wind speeds in the direction of nearby receptors

Receptor Name	Downwind direction	Percentage of high windspeeds	Frequency of wind
R1	North Northwest to South	15.9	Frequent
R2	North Northwest to East	13.7	Frequent
R3	North Northwest to Northeast	10.1	Moderately frequent
R4	East to South Southeast	1.0	Infrequent

Notes:

1. *The angle of wind direction is based on a distance of 400 metres, therefore the closer the receptor a wider angle of wind direction is used.*
2. *<5% infrequent, 5-12% moderately frequent, 12-20% frequent, >20% very frequent.*

[11] IAQM, 2016. *Guidance on the Assessment of Mineral Dust Impacts for Planning*

6.2.2 Intensity

Intensity relates to the concentration of dust that is likely to be experienced at any potential receptor, with dust concentration decreasing with increasing distance from the source. Finer suspended dust will disperse and dilute with increasing distance from the emission source and larger particles will deposit on surfaces close to the source. Therefore, dust intensity is a function of mitigation to manage concentration at the source, location of the dust source, windspeed and the pathway between the source and the receptor.

Receptors R1 and R2 are between 100 and 170 metres from the proposed works whereas receptors R3 and R4 are over 330 metres from the proposed works. These distances are based on the closest quarrying activity relative to the receptor over the entire life of the quarry and therefore the majority of works will be undertaken at distances much greater than these from receptors. For example, the processing plant will be at least 1 kilometre from any receptor, and at this distance, it is very unlikely dust from this source will have any noticeable effect on intensity at receptor locations. Based on the closest distance to the receptors, even without any mitigation, dust concentration would typically reduce by half within 100 metres of the source.

In addition to distance, the pathway in which dust must travel between the source and receptor will also affect dust intensity. Initial works such as overburden stripping and enabling works will occur at the same ground level relative to the surrounding receptors. However, the road boundaries with Aylesbury Road and Grange Road have been planted with evergreen trees that are now approximately 5-6 metres in height and the western boundary has also been planted with evergreen trees which means the pathway for the dust is not directly open and therefore these trees will also help to reduce dust intensity in certain metrological conditions. Once the pit is established, extraction will work from the centre outwards and from the toe of the pit, this means there will always be a pit wall between the activity and the receptors and the pit wall will have the same effect on the dust pathway, which should result in containing most dust effects.

When considering the potential screening of the trees around the boundary of the site, that most work will be undertaken below the surrounding ground and that Winstones will be implementing mitigation, dust intensity at nearby receptors should be low.

6.2.3 Duration

Duration relates to the length of time that dust discharges are likely to occur. In this case it is the time taken to mitigate dust discharges, should they arise. PDP considers based on the visual monitoring programme presented in Table 4 that if an event was to occur, at worst the duration would be limited to a period of no more than 2 to 4 hours at any one time. This being the time to recognise that dust emissions are occurring and to implement the mitigation.

With the use of continuous monitoring of dust and wind conditions using the alerts suggested in Sections 5.7.2 and 5.7.3, PDP considers that the duration of dust emissions could be reduced to 30 minutes.

On a larger scale, while this application assesses effects over a 35-year period, quarrying operations near the receptors will be for a much shorter duration due to the proposed quarrying sequence and the scale of the quarried site. For example, when quarrying activities will be undertaken in the southeast corner of the site, which has the potential to affect receptor R1, albeit low due to the mitigation and distances of the work, the duration of these works is expected to be between 5 and 8 years. Once quarrying moves away from this location and the land is converted back to farming, it is unlikely there will be any further dust effects on this location.

6.2.4 Offensiveness

PDP considers that dust emissions are unlikely to result in any off-site offensive or objectionable effects. This is based on the activities undertaken and the extraction methodology, distance to the sensitive receptor and mitigation measures that will be implemented.

Additionally, the type of materials that the dust comes from will be from overburden (soils and clay) and rock, which will be the same material that is found in the surrounding area when fields are cultivated or the material used in unsealed roads and driveways, and therefore any dust from the Burnham Quarry is likely to be of a similar nature to what would be around the area.

6.2.5 Location

Winstone considered several different sites before choosing the one at Burnham. One of the key criteria was striking a balance between locating the quarry away from populated areas to avoid any potential effects on a larger number of receptors, but while still keeping the quarry within a viable distance of its main markets. This site meets those locational criteria.

In terms of the surrounding environment, the majority of the nearby receptors are to the southeast of the site as well as located near the southern boundary. In recognising the relative closeness of these locations, the quarry design has excluded some areas of the site from quarrying to ensure that there is at least a

120 metre buffer distance to any dwelling. Likewise, the location of the processing plant in the centre of the site will minimise noise and dust effects.

In addition, PDP considers the potential for elevated levels of dust at receptors to be low due to a number of reasons relating to the locations of the quarry activities and the receptors. Most of the quarrying activities relative to the receptors are either at a sufficient distance or have intervening features such as wind breaks and bunds that will restrict the transportation of dust towards these locations, and therefore the potential for nuisance dust is low.

Also, the surrounding area is rural in nature, with a number of rural activities being undertaken, and it is not unusual to experience a degree of dust from working the land or unsealed roads. It is generally considered that there is a greater tolerance to dust effects in a rural setting.

6.2.6 FIDOL Conclusion

Having assessed the proposed quarry activities that have the potential to cause dust discharges against the FIDOL factors, PDP considers that it is unlikely, albeit with a low potential, that any sensitive receptors will be affected by site activities. While there will be some parts of the quarrying activities which will get close to some of the nearby sensitive receptors, given the mitigation and monitoring that will be undertaken the potential for nuisance dust effects will be low.

6.3 Assessment of Health Dust Effects

The potential human health impacts are driven primarily by the smaller size fraction of particulate (PM_{10} and smaller). Given the sources and type of dust which will be discharged from the proposed Burnham Quarry, PDP considers that the human health impact from the discharge of dust from the proposed development and operation of the pit likely to be low because:

- PM_{10} and particularly $PM_{2.5}$ are not significant components of the dust generated from quarry activities, and is therefore dust emitted is not generally in the inhalable fraction;
- Given low background PM_{10} concentrations of the rural environment, with the small contribution to PM_{10} from quarry activities, total cumulative concentrations of PM_{10} will be maintained well below the NESAQ criteria of 50 $\mu g/m^3$ as a 24-hour average and the AAQG criteria of 20 $\mu g/m^3$ as an annual average; and,
- Suppression of dust also suppresses PM_{10}.

To help understand the potential level of PM_{10} concentrations from quarrying activities, PDP has reviewed the monitoring commissioned by ECan between 22 December 2017 and 21 April 2018 around the Yaldhurst quarry area[12]. In this study, monitoring for PM_{10} was undertaken at 10 locations at a variety of different distances around the Yaldhurst quarries. The Yaldhurst study measured PM_{10} and RCS concentrations to assess the dust nuisance and the potential risk to public health. Yaldhurst represents a large area (230 ha) containing multiple quarries and a range of processing activities at a larger scale approximately five times larger than the proposed Burnham Quarry (40 ha active area).

A summary of the results from the Yaldhurst study applicable to this assessment are as follows:

- There were no exceedances of the NESAQ for PM_{10} as measured by the reference instruments (50 µg/m³ as a 24-hour average).
- The average PM_{10} 24-hour average concentrations for all the sites were between 21 and 27 µg/m³.
- There were 17 exceedances of the Ministry for the Environment (MfE) PM_{10} nuisance dust trigger level (150 µg/m³ as a 1-hour average). However, the majority of these exceedance occurred within 100 metres of the quarries.
- Out of 20 samples collected for respirable crystalline silica (RCS) only two sample detected RCS (within 50 metres of the quarry), and these were well below the recommended guidelines.

While this data is from a different location, it is a high quality and comprehensive data set collected from a combined site that is larger than the proposed Burnham Quarry. This data set provides robust information to inform a conservative (worst case) health impact assessment for the proposed Burnham Quarry.

While background monitoring presented in Section 2.2.1 has indicated that there is currently low concentrations of RCS, the data from the Yaldhurst study would indicate that quarrying activities are unlikely to significantly increase concentrations of RCS and therefore will still be below the health based guidelines.

Overall, based on this assessment PDP considers that there should be very low potential for health effects as a result of the proposed Burnham Quarry.

[12] Yaldhurst Air Quality Monitoring – Summary Report: 22 December – 21 April 2018. Prepared by Mote Ltd, 19 June 2018.

6.4 Cumulative Effects

PDP has reviewed the surrounding area for potential sources of nuisance dust. Based on this review there a number of potential sources such as horse training tracks, fields that are cultivated and an army vehicle training facility, but nothing that has the potential to generate significant nuisance dust concentrations other than the Road Metals Quarry 2.5 kilometres to the northeast of the site.

As already discussed, the likely distance that nuisance dust from the proposed Burnham Quarry could travel if no mitigation were undertaken is 400 metres and the same would apply for the Road Metals Quarry. Therefore, for a receptor to be affected by cumulative effects from the proposed Burnham Quarry and Road Metals Quarry, both these activities must be generating dust within 400 metres of a receptor at the same time when winds are blowing towards the receptor. Given that the distance between these two quarries is 2.5 kilometres it is unlikely that the proposed Burnham Quarry will result in cumulative nuisance dust effects.

7.0 Conclusion

PDP's assessment has concluded that there is some potential, if no mitigation measures were undertaken, for air discharges from the proposed Burnham Quarry to cause off-site effects. However, Winstones will utilise a number of mitigation measures that, if appropriately implemented, will most likely minimise dust emissions to within 100 metres of the source. Therefore, PDP considers that the potential for off-site dust effects at nearby receptor locations will be low and at a level that would be considered acceptable. Further, PDP considers that the potential for off-site dust effects at nearby receptor locations will be less than minor. This is based on the following:

- Most receptors are too far away to be affected by dust from the proposed quarry and there is only a small number of receptors that are close enough that could be affected if no mitigation was implemented.
- Based on the meteorological data for the area, the receptors to the southeast and south of the site would be downwind of the site during Frequent and Moderately Frequent (10.1 – 15.9 percent of the time) high wind speeds (>5 m/s) and receptors to the west would be downwind during high wind speeds infrequently (1 percent of the time). As the dust emission rates from the quarrying operations could be quite varied, there is an even lower probability of high emission rates occurring at the same time as dust transporting wind speeds blowing in the direction of these receptors.

- The frequency of dust emissions will be further reduced as Winstones will be continuously monitoring wind speed and direction and dust concentration to ensure that the appropriate mitigation is undertaken especially during wind conditions that might impact nearby receptors.
- Based on the distances between the dust sources and the receptors, dust particles are unlikely to affect a large number of the receptors. It is only the finer particles in strong wind conditions that have the potential to travel extended distances but given that the boundary of the site is planted with dense trees and there will be bunding around those parts of the boundary where quarrying is occurring, dust effects on the receptors will be minimised.
- Based on the Yaldhurst monitoring data, PDP does not consider that there is any additional risk for people currently living near to the quarry to experience health related effects as a result of dust.
- The proposed quarry will not result in cumulative effects as the closest source of potential nuisance dust is located approximately 2.5 kilometres away and therefore it is unlikely both sources will interact.

Appendix A: Draft Dust Management Plan

Dust Management and Monitoring Plan – Burnham Quarry

Prepared for

Winstone Aggregates

August 2023

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PATTLE DELAMORE PARTNERS LTD
Level 5, PDP House
235 Broadway, Newmarket, Auckland 1023
PO Box 9528, Auckland 1149, New Zealand

Office +64 9 **523 6900**
Website **http://www.pdp.co.nz**

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Quality Control Sheet

TITLE	Dust Management and Monitoring Plan – Burnham Quarry
CLIENT	Winstone Aggregates
ISSUE DATE	8 August 2023
JOB REFERENCE	C04096800R002_Draft.docx

Revision History

REV	Date	Status/Purpose	Prepared By	Reviewed by	Approved
1.0	8 August 2023	Draft	Jonathan Harland	Andrew Curtis	Andrew Curtis

DOCUMENT CONTRIBUTORS

Prepared by

SIGNATURE

Jonathan Harland

Reviewed and Approved by

SIGNATURE

Andrew Curtis

Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Winstone Aggregates and others (not directly contracted by PDP for the work), including Pro-Manage Consulting Limited. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Winstone Aggregate for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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1.0 Introduction

This Dust Management Plan - Burnham Quarry (DMP) has been prepared by Pattle Delamore Partners Ltd (PDP) on behalf of Winstone Aggregates (Winstones) for the proposed quarry near Burnham.

This document is a draft DMP and provides a draft framework for managing dust emissions from the proposed quarry. Following the consent being granted, the DMP will be reviewed and updated to reflect any consent requirements.

1.1 Purpose

The purpose of the DMP is to provide a framework for managing dust emissions from the proposed quarry to avoid or mitigate potential dust effects and in particular to:

- facilitate the avoidance, remediation, and mitigation of any adverse effects of discharges of dust generated from the reclamation and construction works associated with the expansion; and,
- promote proactive solutions to the control of dust discharges from the site.

1.2 Background

The proposed Burnham Quarry will produce a wide variety of aggregates, including basecourse, concrete aggregates and sealing chip that will be used in civil infrastructure projects in the Canterbury region. The site activities will include, overburden removal and bund construction, gravel extraction, aggregate processing, stockpiling and reinstatement of quarried land.

An assessment of the sensitivity of the receiving environment and identification of the location of highly sensitive receptors is provided in Section 2.5 of the Air Quality Assessment of Environmental Effects (AEE), dated August 2023). The location of the proposed quarry and the location of the nearby sensitive receptors are shown in Figure 1.

Figure 1: Site location and nearby receptors

1.3 Objectives

The objectives of the DMP are to inform the quarry operations and site personnel of management and mitigation measures for quarry activities to minimise the adverse impacts of potential dust discharges on the receiving environment.

The DMP methods are designed to be practical for Winstones to implement, while the document is intended to be continuously improved to adapt mitigation where needed to ensure the required outcomes.

2.0 Consent Compliance and Key Performance Indicator

The environmental objective of the DMP is to ensure that the site will be managed to comply with the consent conditions related to the discharge of dust to air. The relevant performance indicator to ensure that the site activities will not result in dust that is objectionable to the extent that it causes an adverse effect beyond the boundary of the site.

Relevant consent condition(s) will be included here if applicable.

3.0 Site Activities

There are a number of activities that will be undertaken in the course of quarrying the proposed site, this includes the following:

- Site Establishment and Enabling Works – Overburden material is removed for the establishment of the quarry entrance, site office, amenities, parking and weigh bridge, production zone and stockyards. Overburden material from this activity will be used to form a permanent bund along sections of Aylesbury Road and Grange Road.
- Creation of the Pit - The first extraction of material will create the production zone and stockpiling areas. Extraction will use the top-down method utilising excavators, wheel loaders and trucks.
- Entrance and Site Access - The entrance and exit of the site will be located on Aylesbury Road. The entrance to the site will include offices, meeting rooms, amenities, light vehicle parking and the weigh bridge. From the entrance platform there will be a ramp leading down to the quarry floor which will include a wheel wash and a flood wash. The site entrance and the ramp down to the quarry floor will be sealed.
- Production Zone - The production zone will house the processing plant which will include fixed plant as well as mobile plant as required.
- Primary and Secondary Stockyards - The primary stockyard will contain those products which have a higher risk of dust emissions, whereas the secondary stockyard is intended to contain products with a lower risk of dust emissions, bulk volume base coarse products, or slow-moving products.
- Extraction Zone – Before accessing the resource overburden will be removed first during a stripping campaign, with this material being stored in temporary bunds along the border of the site. Extraction of the resource will be undertaken using excavator, front-end loaders or wheel bucket excavators. Extracted material will be transported to the Production Zone using either trucks or conveyors.
- Silt Management – That exact methodology is yet to be confirmed; however it is most likely to be in the form of mechanical settling.

4.0 Sources, Management, and Mitigation Measures

4.1 Factors Influencing Dust Discharge

The key factors influencing the discharge of dust from the proposed Burnham Quarry are:

- The size and the density of the material being handled. Coarse aggregate material content is unlikely to give rise to dust emissions when compared to fine clay material that might be found in overburden;
- The moisture content of the material. A high moisture content will act to bind particles and control any dust emissions;
- Strong winds blowing across exposed surfaces on dry days resulting in entrainment of dust material; and
- The extent of exposed areas.

4.2 Sources of Dust

The Site's key dust sources are as follows:

- Development and remediation of the site;
- Excavation of gravel;
- Site access road and other unsealed surfaces;
- Disturbing stockpiles; and
- Stockpiling.

4.3 Dust Control

Water will be the primary mitigation tool that Winstones will implement to control dust. The use of water prevents (or suppresses) fine particulate from leaving the surface and becoming airborne through the action of mechanical disturbance or wind. In effect, the water acts to bind the small particles to the larger material, thus reducing the emission potential.

While it is still unknown exactly how the water will be applied, it is expected to be undertaken using a combination of methods such as water carts, fixed and mobile sprinklers, etc., with water being applied at a rate as required to suppress dust.

As a benchmark for dust suppression the Ministry for the Environment Good practice guide[1] on assessing and managing dust recommends a water application one litre/m^2/hr.

[1] Ministry for the Environment. 2016. *Good Practice Guide for Assessing and Managing Dust.* Wellington: Ministry for the Environment.

4.4 Tiered Mitigation Measures

The proposed dust prevention on site uses a two-tiered approach. Tier 1 controls are employed routinely, and Tier 2 controls are implemented additionally in the unlikely situation that the Tier 1 controls do not prove to be fully effective. These control measures are summarised in Table 1.

Application of water for dust suppression as described in the Tier 1 and Tier 2 controls should be prioritised as shown in Table 1.

Table 1: Sources of Dust and Tiered Controls to be Employed		
Source of Dust	**Tier 1 Controls (Routine)**	**Tier 2 Controls (Additional, as needed)**
Unpaved surfaces such as site access roads	⁘ Limit the area of exposed surfaces as much as practical. ⁘ Cover surfaces with coarse materials where practicable. ⁘ Compact all unconsolidated surfaces where practicable. ⁘ Trafficked unsealed surfaces will be watered on a regular basis using sprinklers and/or water cart system. ⁘ An onsite speed limit of 30 km/hr will be enforced.	⁘ Increase water application rate to ensure that in-use unpaved roads are kept damp. ⁘ Use polymer additives or chemical stabilisation to assist in forming a surface crust on site access roads only in rare occasion all other options are insufficient. ⁘ Further reduce speed limits.
Vehicles	⁘ Limit load sizes and ensure even loading to avoid spillages. ⁘ As far as practical minimise travel distances and/or maximise buffer distances between site access roads and site boundary through appropriate site layout and design. ⁘ Deep sided trucks (dump trucks) are used for transport within the site to reduce spills. ⁘ As above, an onsite speed limit of 30 km/hr will be enforced. ⁘ The main haul road into the site is sealed to prevent dust. ⁘ Sweeping of the sealed road is undertaken as required. ⁘ Any spills of soil from vehicles are swept up and washed down on the same day as the spill. ⁘ All vehicles exiting the quarry will pass through the wheel before leaving the site.	⁘ Limit vehicle speeds on unsealed surfaces to 10 km/hr when traveling within 250 m of the site boundary or when vehicle generated dust plumes approach the boundary of the site. ⁘ Dry soil material in trucks will be covered or wetted.

Table 1: Sources of Dust and Tiered Controls to be Employed		
Source of Dust	**Tier 1 Controls (Routine)**	**Tier 2 Controls (Additional, as needed)**
Disturbing all materials including the working faces	⁘ The loading on to or removal of material from stockpiles will be only undertaken during low dust risk wind conditions (one hour average windspeed < 7.5 m/s). ⁘ Good practice machine operation will be implemented including minimizing drop heights and wetting dusty materials when needed (wind speeds above 5 m/s). ⁘ No materials will be disturbed when wind speeds are above 7.5 m/s.	⁘ Adequate water suppression systems must be available at the site to dampen areas that are to be worked prior to any earthwork commencing and shall be used on the site until further earthworks in that area are not required.
Aggregate Processing	⁘ Fitting water sprays and/or misters on the screens, crushers and conveyor transfer points. ⁘ Minimise drop heights from the loading of raw materials into the feed hopper and from stacking of stockpiles. ⁘ Locate mobile processing plant away from dwellings and below ground-level where possible (only applicable during the intimal phase if mobile plant is used). ⁘ Enclosing dry screens.	⁘ Dampen down raw material before entering the processing plant. ⁘ Reduce material throughput until any dust emissions can be controlled. ⁘ Use fog cannons as required.

Table 1: Sources of Dust and Tiered Controls to be Employed		
Source of Dust	**Tier 1 Controls (Routine)**	**Tier 2 Controls (Additional, as needed)**
Stockpiles (including placement and removal)	⁘ Locate stockpiles as far away as practicable from identified sensitive receptors, with high-risk material stored within the primary stockpile area and lower risk material within the secondary stockpile area. ⁘ Orientate stockpiles to maximise wind sheltering as much as possible. ⁘ Maintain the height of gravel stockpiles to a practical height, but no more than 5 metres above the surrounding ground-level. ⁘ Maintain the height of bunds to a practical minimum of 3 metres. ⁘ Load and remove stockpiled material from site as soon as practical. ⁘ No materials will be disturbed when wind speeds are above 7.5 m/s.	⁘ Use polymer additives or chemical stabilisation to assist in forming a surface crust on stockpiles only in rare occasion all other options are insufficient. ⁘ Further limit the height and slope of stockpiles to reduce wind entrainment. ⁘ Vegetation of long-term stockpiles and bunds. ⁘ Dampen stockpiles if they are producing visible dust emissions.
Bund removal and rehabilitation	⁘ Areas are incrementally backfilled at regular intervals and re-grassed with suitable grass species as soon as practicable to limit potential for dust generation from exposed surfaces.	⁘ Use polymer additives or chemical stabilisation to assist in forming a surface crust on soil surfaces if delays in vegetation. ⁘ Addition of nutrients (fertiliser) to increase fertility and promote and maintain even revegetation. ⁘ Soil moisture management via irrigation (if available) to promote and maintain even revegetation.

Table 1: Sources of Dust and Tiered Controls to be Employed		
Source of Dust	**Tier 1 Controls (Routine)**	**Tier 2 Controls (Additional, as needed)**
Miscellaneous	⁘ Plan site layout so that mobile machinery and dust causing activities are located away from receptors as far as is practicable. ⁘ Ensure sufficient water is available on site. ⁘ Take account of daily forecast wind speed, wind direction and soil conditions before commencing an operation that has a high dust potential. ⁘ All site machinery should be regularly maintained to ensure optimal operation. ⁘ Targeted watering on areas within 250 m of sensitive receptors during high dust risk conditions.	⁘ Targeted watering on areas identified as high-risk for dust discharge as a result of visual inspections.

Table 2: Priority of Water Application for Dust Suppression			
Water Priority	**Type of Source**	**Proximity to Boundary**	**Wind Direction**
1	Overburden removal and bund construction / deconstruction	Any	Any
2	Active Haul Roads and Site Access	Any	Any
3	Processing Plant and Stockpiles	Within 250 m of the site boundary	Towards closest boundary with nearby receptors.
4	Working Area	Any	Towards closest boundary with nearby receptors.

5.0 Monitoring

To ensure that dust mitigation measures are implemented and are effective at minimising dust emissions, presented in Table 3 is a monitoring plan developed for Winstones. The frequency of the monitoring is defined but it must be noted that in the instance of strong winds, dust emissions off-site, or a complaint, the monitoring programme should be undertaken more regularly.

Table 3: Visual Dust Monitoring Programme	
Monitoring Activity	**Frequency**
Check weather forecasts for strong winds and rainfall to plan appropriate work schedule and dust management response.	Daily
Inspect land adjacent to the site, site exits and adjoining roads for the presence of dust deposition.	At least daily and more frequently if the wind is blowing from a potentially dust operation towards the boundary or sensitive receptor and the TSP or meteorological monitoring conditions are triggered (See Table 4)
Ensure instrumental monitors are operating correctly.	Daily
Observe weather conditions including wind and rain via observations and data outputs from weather stations.	Daily and as conditions change

Table 3: Visual Dust Monitoring Programme	
Monitoring Activity	**Frequency**
Inspect all exposed surfaces for dampness and to ensure that the exposed un-stabilised area is minimised.	Daily and as conditions change
Inspect dust generating activities to ensure dust emissions are effectively controlled.	Daily and as new activities are commenced
Inspect watering systems (sprays and water carts) to ensure equipment is maintained and functioning to effectively dampen exposed areas.	Weekly

5.1 Instrumental Monitoring and Trigger Levels

Winstone's will continuously monitor meteorological conditions including wind speed, direction and rainfall as well as PM_{10}. The dust monitors will be located along each boundary near where sensitive receptors might be located. The monitors will be located in accordance with AS/NZS 3580.1.1:2007 "Methods for sampling and analysis of ambient air Part 1.1: Guide to siting air monitoring equipment". The monitors will be maintained and calibrated by a suitably qualified person such as the instrument provider and in accordance with the manufacturer's instructions.

The meteorological site will be co-located with the dust monitor located on the southern boundary and will be installed and maintained where practicable in accordance with AS/NZS 3580.14 Methods for sampling and analysis of ambient air - Part 14: Meteorological monitoring for ambient air quality monitoring applications.

The instruments will provide continuous, real-time information on PM_{10} concentrations and wind conditions. Trigger values will be set for PM_{10} concentrations, wind speed and rainfall, and if reached will require additional dust mitigation measures as described in Section 4. There will be two dust trigger levels; a lower value which warns that dust concentrations are increasing above "normal" levels and an upper limit trigger level which should not be exceeded. The recommended trigger levels are shown in Table 4

The trigger level thresholds in Table 4 are preliminary values and may need to be adjusted depending on the monitor type and any subsequent feedback from neighbours. If there are any exceedances of the trigger level, Winstone's will undertake an investigation to determine the reasons for the exceedance and identify any remedial measures that can be taken to prevent further exceedances.

Table 4: Monitoring Trigger Levels		
Trigger		**Value**
TSP Trigger Levels	Warning	120 µg/m³ (1-hour average)
	Stop Work	150 µg/m³ (1-hour average)
Meteorological Trigger Levels	Wind speed	5 m/s (1 hour average)
	Rainfall	Less than 1 mm for previous 24 hours

6.0 Contingency Measures

The following contingency measures have been identified to ensure the dust management is working as intended:

- Break-down or failure of water suppression systems: As this is a vital control method, all dust generating activities may need to cease until the system can be restored if an alternative way of watering the surface is not available.
- If dust impacts, or a large number of complaints, occur, Winstone's will reduce the trigger levels presented in Table 4.
- If the monitoring equipment is offline either due to planned maintenance, equipment malfunction or power failures, Winstone's will use the water cart on all potentially dusty surfaces within close proximity to the boundary or dwelling whether or not dust is being generated, unless raining. This will continue until the instrument is back online.
- Water supply for dust suppression. In the extremely unlikely situation of not having the required level of water for dust suppression during prolonged dry periods, all dust generating activities will cease until an alternative water supply can be obtained.
- Ensure vehicles moving on-site have undergone regular maintenance so that vehicle emissions are kept to a minimum.

7.0 Roles and Responsibilities

7.1 Site Manager and Staff

The Quarry Manager will have day-to-day responsibility for the implementation of the DMP. The Quarry Manager will have the following responsibilities in respect of the management of dust. They shall ensure:

- That the conditions of all relevant resource consents are complied with at all times;

- That the dust control and mitigation measures and procedures outlined in the DMP are implemented effectively;
- That there are adequate personnel and equipment on-site at all times to enable the prescribed dust control;
- That the meteorological and dust monitoring programmes are carried out as required, including recording of daily observations;
- There is sufficient water supply for dust management;
- That any complaints received are investigated and resolved as far as practicable; and
- That all records are kept and are available for the relevant regulatory authorities.

All personnel working on the site have responsibility for the requirements of the air discharge consent conditions and the DMP and reporting to the Site Manager on these issues.

7.2 Staff Training

Successful dust management depends on appropriate actions by site personnel in the day-to-day operations of the site. Environmental training for all staff will be undertaken as part of the site induction programme. The environmental induction will include the following information specific to this DMP:

- Information about the activities that may cause dust discharges within the site with the potential to impact neighbouring areas;
- Consent requirements;
- Dust mitigation procedures;
- Description of dust and meteorological monitoring for the site; and
- Complaints management procedures.

Staff training records will be maintained on-site. The records will include:

- Who was trained;
- When the person was trained; and
- General description of training content and whether follow-up/refresher courses are required at a later date.

8.0 DMP Review

The DMP will be reviewed once per year and updated, with the necessary approval from Environment Canterbury. Approval will be required for any relevant revisions of a material nature for the DMP. The review will take into consideration:

- Any significant changes to dust management activities or methods;
- Key changes to roles and responsibilities;
- Changes in industry best practice standards or recommended dust controls;
- Results of inspection and maintenance programmes, logs of incidents, corrective actions, internal or external assessments;
- The outcome of investigations into discharges of dust or other air pollutants; and
- Changes to site operations i.e. once the site starts undertaking container operations.

Reasons for making changes to the DMP will be documented. A copy of the original DMP document and subsequent versions will be kept for the project records and marked as obsolete. Each new/updated version of the DMP documentation will be issued with a version number and date.

9.0 Complaints

While the measures in the DMP are aimed at preventing dust emissions as a result of on-site activities, there may be occasions when an incident occurs and a complaint from the public is received. Any complaint made will be promptly investigated to resolve the source of the dust emission and implement appropriate actions to mitigate the effects.

The following outlines guidance for receiving and keeping records of any complaints made.

9.1 Receipt Procedure

It is important to ensure that any complaints are recorded and promptly investigated to identify and resolve the cause of the complaint. Requirements and procedures for complaints are detailed below.

The Quarry Manager has the responsibility to respond to and follow up on all complaints regarding dust, and to ensure that suitably trained personnel are available to respond to complaints at all times.

Actions to be taken as soon as possible, following the receipt of a complaint, by the Quarry Manager include:

- Undertake a site inspection. Note all dust-producing activities taking place and the mitigation methods being used and take photographs for reference as appropriate. If the complaint was related to an event in the recent past, where possible, note any dust-producing activities taking place at that time;
- Initiate any remedial action necessary, which may include a stop work period;
- Note the time and date of the complaint/s and (unless the complainant refuses to provide them) the identity and contact details of the complainant. Ask the complainant to describe the discharge:
  - Is it constant or intermittent?
  - How long has it been going on for?
  - Is it worse at any time of day?
  - Does it come from an identifiable source?
- Meteorological data from the on-site station shall be downloaded;
- Note if the complaint has been referred to Environment Canterbury;
- As soon as possible (within 1 hour, where practicable), visit the area from where the complaint originated to ascertain if dust is still a problem;
- If it becomes apparent that there may be a source of dust other than the quarrying activities causing the complaint, it is important to verify this. Photograph the source and emissions;
- As soon as possible after initial investigations have been completed, contact the complainant to explain any problems found and remedial actions taken. Initiate a damage assessment if required; and
- If necessary, update any relevant procedures to prevent any recurrence of problems and record any remedial action taken.

9.2 Response Procedure

Following the receipt of the complaint, the following actions will be undertaken:

- Fill out the appropriate complaint form, attached as Appendix B to this DMP;
- Advise Environment Canterbury within 48 hours that a complaint has been received, what the findings of the investigation were, and any remedial action taken;

- Advise site personnel as soon as is practicable that a complaint has been received, what the findings of the investigation were, and any remedial action taken; and
- Call or visit the complainant to update them on the actions taken and to check that the issue has been resolved.

10.0 Emergency Contacts

Internal contacts for the site in the event of an emergency of other problems are provided in Table 5 and Table 6 below.

Table 5: Internal Environmental Emergency Contact Details

Role	Name	Organisation	Phone	Email
Quarry Manager	TBC	Winstone's	TBC	TBC
After Hours Contact	TBC	TBC	TBC	TBC

Table 6: External Environmental Emergency Contact Details

Role	Name	Organisation	Phone	Email
Consents Compliance Team	TBC	Environment Canterbury	TBC	TBC

11.0 References

Institute of Air Quality Management (IAQM). (2016). *Guidance on the assessment of mineral dust impacts for planning.*

Ministry for the Environment. (2016). *Good Practice Guide for Assessing and Managing Dust*. Available at www.mfe.govt.nz.

Pattle Delamore Partners Ltd, *Air Quality Assessment – Burnham Quarry,* August 2023.

Appendix A: Daily Log Form

Daily Dust Inspection Log

Date: _____ Time: _____

Inspection by: _____

Current weather conditions (e.g., sunny, cloudy, rainy):_____

Wind speed and direction (e.g., light, moderate, strong):_____

Weather forecast for next 24 hours (e.g., rainy, windy):_____

Area(s) inspected: _____

Scope of Inspection	Circle Relevant Item	Comments
Is there visible dust from site work activities, stockpiles, earthworks areas or haul roads?	Y N N/A	
Are unsealed surfaces dry and need spraying with water cart?	Y N N/A	
Are any exposed earthworks visibly dry and need water spray?	Y N N/A	
Stockpiles covered/stabilised where needed?	Y N N/A	
Are there any signs of dust going off site as a result of site activities? [Inspect land adjacent to the site exits and adjoining roads for the presence of dust deposits.]	Y N N/A	
If wind speeds are strong or forecast to be strong (over 5 m/s) are additional inspections, activity restrictions and mitigation measures being put in place? (e.g., increase water application, restrictions on dusty activities)	Y N N/A	
Are watering systems (e.g., water carts, wheel wash) operating effectively to minimise dust?	Y N N/A	
Are trucks carrying loose (uncovered) material entering or leaving the site?	Y N N/A	

Scope of Inspection	Circle Relevant Item	Comments
How frequently has water sprinkling/spraying been used today (i.e., number of water carts, time, area watered)		
Note and dust control equipment malfunctions (and remedial actions taken as appropriate)		
Any unusual on-site activities today?		
Complaints received / community feedback		

Appendix B: Complaint Record

DUST COMPLAINT & ASSESSMENT FORM

PART A: Complaint Details

Date: Time:

Complaint Received By:

Name:

Address:

Contact phone numbers:

Possible source:

Anonymous: Y/N

Is dust occurring now?

Complaint details (include impacts/effects experienced by complainant:

PART B: Complainant Location Assessment

Date: Time:

Assessors Name:

Person spoken to at complaint location:

Reason for investigation: COMPLAINT/PROACTIVE

Complaint details (include impacts/effects experienced by complainant:

INITIAL IMPRESSIONS:

Type of dust

Time of the intial impression:

Any visible dust deposits: Y/N

Plume width (if known):

VISIBLE DUST DEPOSITS

Describe approximate quantites and extent

When was surface last cleaned?

Frequency of cleaning:

Describe the appearance of the deposits:

Colour		Any odour	
Shape		Water soluble	
Size		Other	
Crystalline or powdery			
Hard, soft			

Weather Data (see over)

Wind direction:
Wind velocity:
Cloud cover:
Temperature:
Rainfall in past 24 hrs:

Photos Taken: Y/N Samples taken Y/N

Diagram/description of where photos were taken.

Diagram/description of where samples were taken:

Sample collection: Use a small paintbrush (clean) to sweep samples of the dust onto a sheet of paper and then into a clean plastic bag. At least half a teaspoonful will be required for analysis. Lesser amounts may be colected on strips of clear cellotape, which should then be stuck onto sheets of clear plastic to preserve the samples. Label all samples and record date, time, location, etc on a separate sheet of paper if required.

Based on your assessment on this occasion, which of the following applies:

	I did not find any dust
	I did find dust and consider it would not be objectionable at any location for any duration or frequency
	I did find dust and consider it would be objectionable if it became continuous
	I did find dust and consider it would be objectionable if it occurred on a regular or frequent basis
	I did detect dust and consider it to be objectionable even in periods of short duration.

FINAL CHECKLIST

	Upwind assessment completed. Record details below. If not, detail reason:
	Aerial photo/sketch showing location of assessment and upwind assessment attached
	Are there potential witness statements to obtain YES/NO

REMARKS

PART C: Off-site dust and 360° assessment

Assess the dust upwind of the suspected source and if possible conduct a 360° sweep around the source assessing the odour at different points

OTHER POTENTIAL SOURCES **Time:**

Check for road works, ploughing, construction activities, burn-offs, unsealed roads, unsealed sites

Site 1:

Wind direction: Wind strength: Wind stability: GPS Loc:

Visible dust: Desciption of dust

Comment:

Site 2:

Wind direction: Wind strength: Wind stability: GPS Loc:

Visible dust: Desciption of dust:

Comment:

Site 3:

Wind direction: Wind strength: Wind stability: GPS Loc:

Visible dust: Description of dust:

Comment:

Diagram of Suspected source, dust assessment sites and dust plume:

N

COMMENTS

PART D: Source On-site Investigation

If source of dust identified, visit site, identify yourself and show warrant. Explain the findings of your investigation to staff.

Date: Time: Source Identified:

Staff spoken to:: Position:

Staff contact phone number:

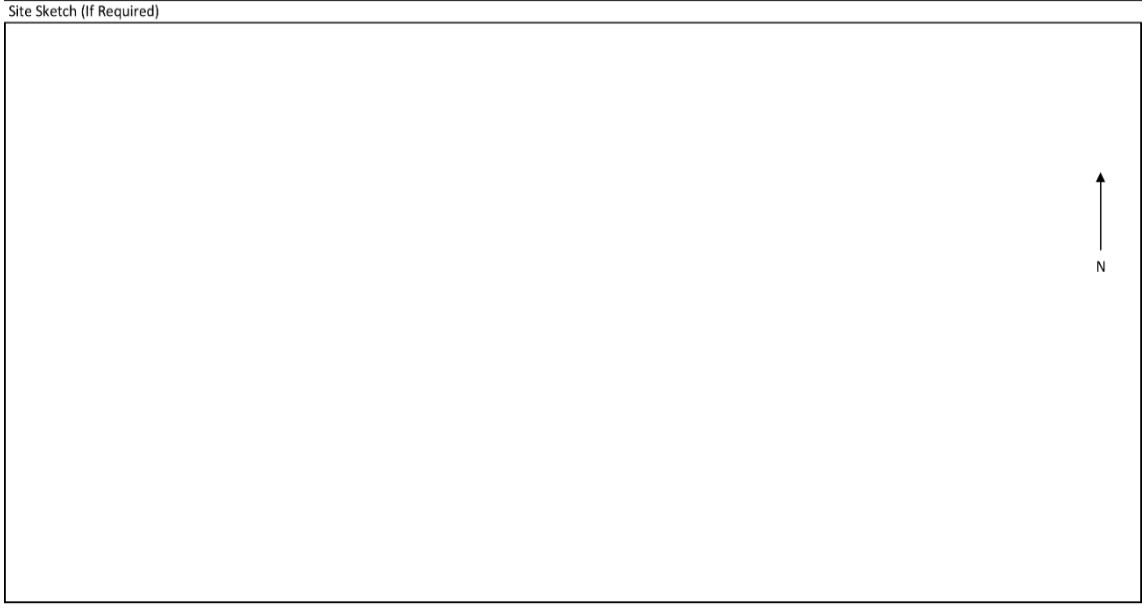
Current site operations:

Reason/explanation given for dust

Other Comments

Monitoring results/samples/other records

Site Sketch (If Required)



SIGNED BY ASSESSOR _____ DATE: _____

PART E: Dust Reference Sheet

Definitions

Objectionable The term objectionable is the term used in consent conditions and is an ingredient of any subsequent enforcement action. It is a subjective term and is open to interpretation. There is guidance from case law which defines objectionable as: unpleasant or offensive or repugnant; open to objection or undesirable or disapproved of; noxious or dangerous. A test will be applied by the court that the term objectionable will be as it applies to "the minds of a significant cross section of reasonable people in the community". The assessor must bear this test in mind when completing their assessment.

Frequency How often an individual is exposed to dust nuisance events

Intensity As indicated by dust quantity/concentration and the degree of nuisance

Duration The length of the particular dust event

Character How objectionable the dust is, having regard to the nature of the dust

Land Beaufort Wind Scale

B. No.	Description	How to Recognise
0	Calm	Smoke rises straight up
1	Light Air	Smoke drifts
2	Light Breeze	Wind felt on face; leaves rustle
3	Gentle Breeze	Flags flap; twigs move all the time
4	Moderate Breeze	Papers blow; small branches move
5	Fresh Breeze	Small trees sway
6	Strong Breeze	Large branches move, wind whistles
7	Near Gale	Whole trees sway

Measuring Temperature

Use descriptions below or obtain local meterological data, especially temperature from websites such as www.metservice.govt.nz

Cold
Cool
Mild
Warm
Hot

Measuring Cloud Cover

Okta No.	Description
0	Clear Sky
1	Sunny
2	Mostly sunny
3	
4	Half the sky is covered in cloud
5	
6	Mostly cloudy
7	Considerable cloudiness
8	Overcast
F	Fog / Mist

During the day the sun is always shining, so the amount of sunshine reaching the ground depends on the amount and duration of any cloud cover. The amount of cloud cover is usually given in units called oktas. Each okta represents one eighth of the sky covered by cloud.