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PATTLE DELAMORE PARTNERS LTD

RS Sand – Air Quality Assessment

RS Sand Limited

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RS Sand – Air Quality Assessment

Prepared for

RS Sand Limited

July 2022

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Limitations:

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1.0 Introduction

RS Sand Limited (RS Sand) is proposing to construct and operate a new sand quarry at 77 Newcombe Road, Cambridge. The proposed quarry and quarrying activities will be undertaken in six stages, the first being the enabling works (access road, site buildings, processing platform), followed by quarrying which will be undertaken in five stages as the quarry expands.

Quarrying will start near the northeast boundary of the site and progressively move forward in stages towards the southwest. The stages will vary in size, with the smallest stage being approximately 2.7 hectares in size, and the largest stage being approximately 6.6 hectares in size, giving the quarry a total size of approximately 27 hectare, with material being extracted to approximately 35 metres below the current land height.

RS Sand is proposing to extract 400,000 tonnes per annum of material and based on this extraction rate it should take approximately 25 years to exhaust the available resource.

Pattle Delamore Partners Limited (PDP) has been engaged to assess the air discharges, and in particular dust from the proposed sand quarry. This assessment of air quality effects will be used as supporting documentation for the consent application to the Waikato Regional Council (WRC) and the Waipa District Council (WDC).

2.0 Background Information

The proposed quarry will be located at Newcombe Road, approximately 3.5 kilometres (km) east of central Cambridge. The proposed location of the quarry is shown as a yellow polygon with the quarry pit highlighted in orange in Figure 1.

The quarry is surrounded by a mix of farming activities and lifestyle properties, with State Highway 1 bordering the site to the south. Further afield is the Cambridge Golf Club to the southwest and the outskirts of the Cambridge township approximately 1 km to the southwest and northwest of the site.

Under the Waipa District Plan, the location of the proposed quarry as well as the land immediately bordering the site is zoned Rural.

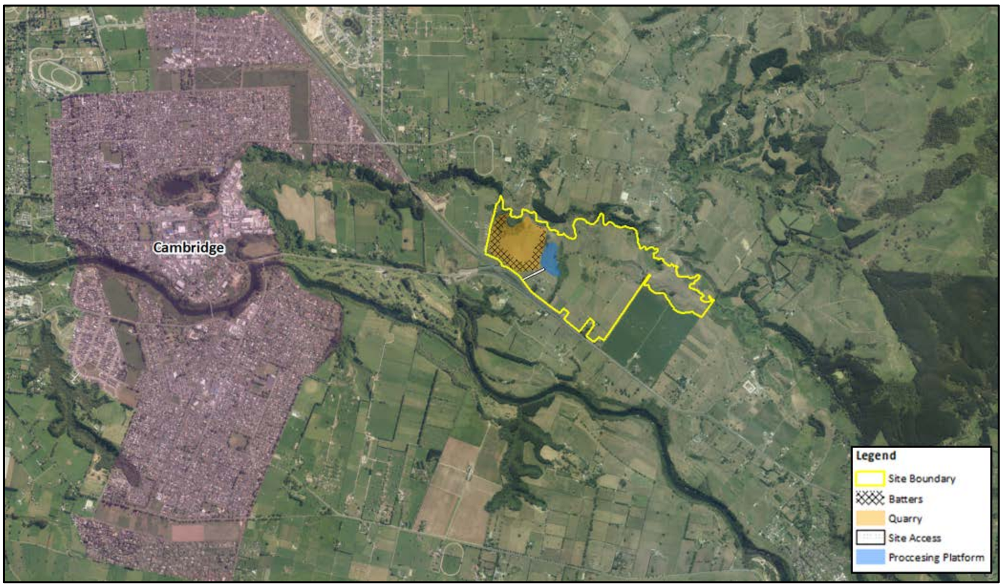

Figure 1: Site Location

2.1 Meteorological

Wind can have a significant effect on dust generation and transportation. The nearest Automatic Weather Station (AWS) that PDP could obtain validated data from is located at Karapiro. However, after reviewing the data from this location, the wind direction appears to be heavily influenced by the local terrain features, and therefore would not represent the likely wind conditions at the proposed quarry. Therefore, for this assessment PDP has used the next closest meteorological data from Hamilton Airport which is located approximately 15 km to the west of the site.

The distribution of hourly average wind speeds and directions recorded at the Hamilton Airport AWS for the five-year period 1 January 2016 and 31 December 2020 is shown in Figure 2 and Table 1 presents the distribution frequency of wind speed. The prevailing wind directions measured at this location are from the west and to a lesser extent from the north and south.

When wind speeds at ground level reach 5 m/s they have the highest potential to transport dust off-site. In the case of the proposed quarry, winds from the northeast to the southwest have the potential to transport dust towards the nearest receptor from the proposed quarry operations, and these winds have speeds in excess of 5 m/s for 0.4 and 1.1 percent of the time.

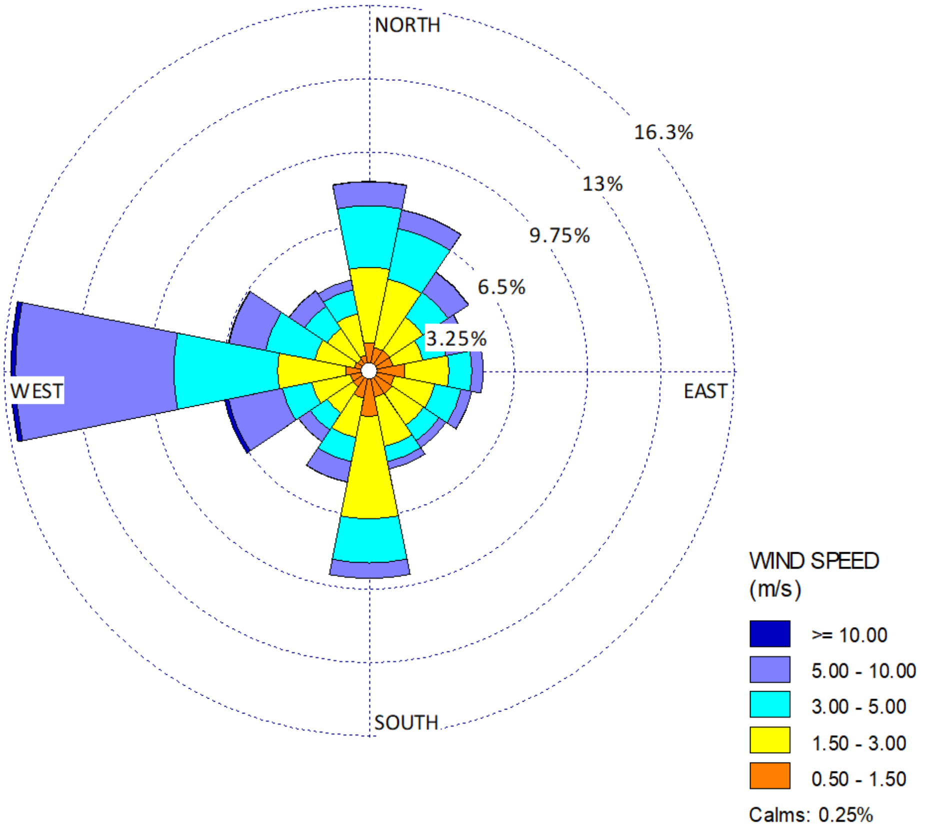

Figure 2: Hamilton Airport AWS Windrose – January 2016 to December 2020

Table 1: Wind Speed Frequency Distribution (2016-2020)

Direction	Wind Speed (m/s)		Total (%)
	0-5	>5	
North	7.4	1.1	8.4
North northeast	6.5	0.9	7.3
Northeast	4.2	1.1	5.3
East northeast	3.5	1.0	4.5
East	4.6	0.5	5.1
East southeast	4.2	0.5	4.7
Southeast	3.8	0.4	4.2
South southeast	4.2	0.3	4.5
South	8.6	0.7	9.2
South southwest	4.1	0.9	5.1
Southwest	3.2	0.6	3.8
West southwest	4.0	2.6	6.6
West	8.7	7.2	15.9
West northwest	4.7	1.7	6.4
Northwest	3.5	0.8	4.3
North northwest	3.7	0.4	4.1

2.2 Environment Performance Standards

2.2.1 Waikato Regional Council

The discharge of contaminants to air (dust) from quarrying operations is a permitted activity subject to the relevant conditions of Rule 6.1.16.1 of the Waikato Regional Plan (WRP) which states that:

Rule 6.1.16.1 – Implementation Methods – Mineral Extraction, Size Reduction, Screening and Storage

a) *Where the operation occurs within 1000 m of a property boundary and there is a discharge of particulate matter beyond the property boundary the following measures shall be implemented:*

   i. *the use of water sprays to suppress dust from crushing and screening plants, access ways, haul roads, stockpiles, load-out areas and access roads.*

ii. the sealing and maintenance of the access road, when it is within 150 m of a neighbouring residential dwelling.

b) As specified in Section 6.1.8 a) to e) of this Plan.

c) When seven working days of commencing works at a new site, the operator of the new quarry site shall provide the Waikato Regional Council with written notification of the location of the site.

d) Should an emission of particulate matter occur that causes adverse effects of an objectionable nature beyond the property boundary as determined in accordance with the decision making guidelines set out in Section 6.4.2.2, the quarry operator shall provide a written report to the Waikato Regional Council within five days of the incident occurring, which specifies:

i. the cause or likely cause of the event and any factors that influenced its severity.

ii. the nature and timing of any measures implemented by the quarry operator to avoid, remedy, or mitigate any adverse effects.

iii. The steps to be taken to prevent recurrence of similar events.

e) There shall be no discharges of hazardous substances into the air.

As the quarrying and processing activities on site will occur within 1,000 metres of a property boundary, the operations at the proposed sand quarry do not meet the permitted activity rule and therefore the site becomes discretionary under Rule 6.1.9.2 of the WRP.

2.2.2 Waipa District Council

The appropriate objectives, policies, and rules under Waipa District Plan that relate to dust state:

Objective 4.3.5 - Rural activity: mineral and aggregate prospecting, exploration and extraction

To meet the District's and Region's mineral and aggregate needs from predominantly local sources and ensure that the location, use and development of the District's mineral and aggregate resources is provided for, subject to the management of the adverse effects associated with such activities.

Policy 4.3.5.3 - Mineral extraction

Mineral extraction activities are managed so that the adverse effects of the activities are internalised, or avoided, remedied or mitigated as far as practicable through methods such as management, mitigation and rehabilitation plans that address matters such as:

a) *Managing dust, noise, vibration, access and illumination to maintain amenity values, particularly during the night time; and*

b) *Ensuring buildings and structures are appropriately located in relation to boundaries, and of an appropriate scale; and*

c) *Undertaking remedial measures during extraction operations; and*

d) *Requiring sites to be rehabilitated and ensuring appropriate materials are used for this purpose.*

Objective 20.3.1 - Air and water quality

To maintain and where possible improve existing air and water quality.

Policy 20.3.1.1 - Contain adverse effects

To ensure that activities avoid, remedy or mitigate nuisance effects beyond the boundary of the site and on any water bodies in order to maintain and enhance amenity and a healthy and safe environment.

Rule 20.4.2.1 - Odour, smoke, fumes or dust

No activity shall produce any objectionable odour, smoke, fumes or dust at or beyond the boundaries of the site from which the nuisance emanates.

Rule 20.4.2.1 of the Waipa District Plan is essentially the same rule that the site needs to comply with for the regional air discharge consent, so provided the site meets the regional rules, it should also meet the district rule.

2.3 Sensitivity of the Receiving Environment

A site investigation as well as a desktop study were undertaken to identify discrete receptors deemed sensitive to changes in air quality as a result of potential discharges to air from the proposed sand 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 dwellings;
- hospitals;
- schools;
- libraries; and,
- public outdoor locations (e.g. parks, reserves, beaches, sports fields).

These receptors are summarised in Table 2 and Figure 3 presents the location of the nearest receptors in relation to the proposed quarry. PDP has identified a number of nearby sensitive receptors within 500 metres of the proposed quarry, excluding dwellings that are on land owned by the applicant. While not every receptor has been identified, the identified receptors are considered to be representative of the surrounding community. However as discussed further in Section 5.1, the identification of properties within 500 metres is conservative as dust is not expected to travel more than 250 metres from the quarry.

Table 2: Location of Receptors located close to RS Sand

Receptor Name	Address	Closest Distance to Quarry pit (m)	Direction Relative to the Quarry pit
R1	42 French Pass Road	300	North
R2	94 French Pass Road	450	North
R3	111A Newcombe Road	380	Southeast
R4	64 Lockley Road	275	South
R5	12 Lockley Road	330	Southwest
R6	41 Newcombe Road	50	West
R7	333 Tirau Road	530	Southeast

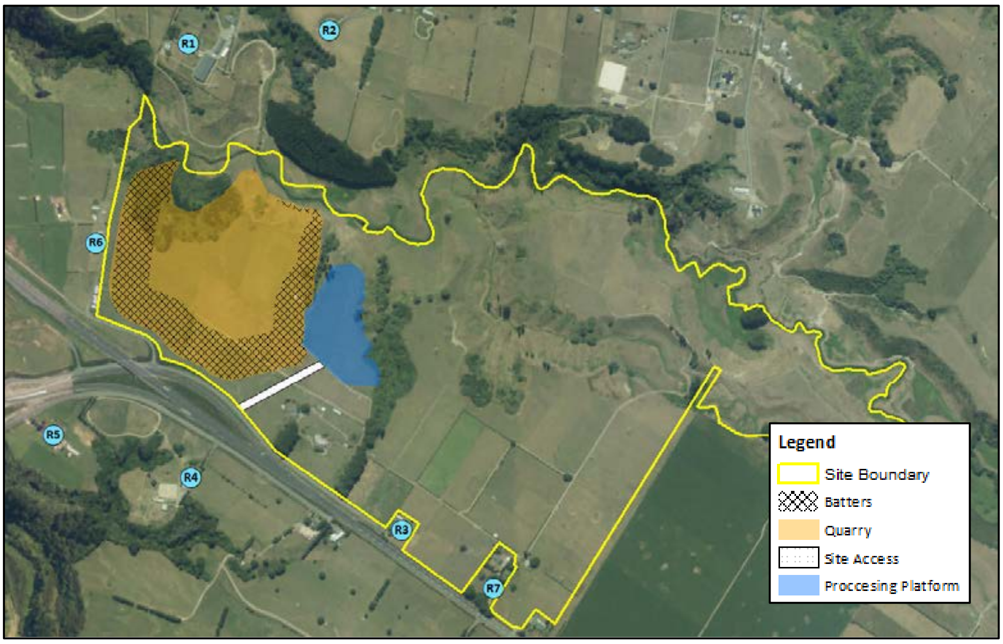

Figure 3: Sensitive Receptors

3.0 Assessment Methodology

This assessment has been undertaken in accordance with MfE guidance for assessing and managing the environmental effects of dust emissions[1] (MfE GPG Dust).

It is common practice 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, 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 effects (e.g. covering or storage of materials, use of water suppression, etc.);
- 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 WRP are based on the FIDOL (Frequency, Intensity, Duration, Offensiveness, Location) 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 of the proposed quarry using the FIDOL assessment tool.

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.

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

- 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 premises 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.

While FIDOL assessments are typically undertaken to assess odour effects, they are also commonly used to assess dust impacts. Some regulatory authorities (Environment Canterbury) recommend FIDOL to assess for dust effects.

4.0 Potential Emission Sources and Proposed Mitigation Measures

The potential for air quality effects associated with the proposal relates almost exclusively to the potential for there to be dust emissions. While there will be a number of vehicles operating on the site, the combustion emissions from these vehicles are considered insignificant and they are unlikely to result in any noticeable off-site changes in air quality.

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 20 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 operations at the proposed quarry that have the potential to generate dust from include:

- Initial enabling works, including construction of the haul roads, removal of overburden, construction of erosion and sediment controls, and construction of bunds.
- Material excavation and processing.
- 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 a regulated by a National Environmental Standard. While there will be no crushing on site that could generate finer particles, there will be silts within the extracted material which will contain finer particle. However, the mitigation measured used to control dust will also control the finer materials and it is PDP's experience at other sites, that PM_{10} from quarry activities is generally not measurable above background levels within a few hundred metres from areas of material processing and handling.

Respirable crystalline silica (RCS) can also present in the dust generated by quarry operations, and it is also 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.

4.1 Overburden Disposal

4.1.1 Process

Once the initial enabling works are completed overburden removal and disposal will occur progressively as more of the active face is opened up. The overburden is stripped from the desirable material using excavators, with the overburden either being sold as pit sand and being loaded directly into trucks and transported off-site or disposed of on-site through the construction of bunds along the southern and western boundaries of the pit and surrounding the processing platform.

4.1.2 Potential Emission Sources

As overburden generally consists of soils, clays and sand there is the potential for dust generation from this material if it is dry. Dust emission can occur from several sources which are:

- wind driven dust off exposed surfaces as the bunds are being constructed and contoured;
- dust being disturbed on haul roads between and within the excavation point and the bund construction; and,
- dust emissions from loading and unloading of trucks.

4.1.3 Mitigation Measures

During overburden removal and placement RS Sand could implement a number of nuisance dust mitigation measures. One example of mitigation is minimising the area of vegetation, overburden and soil removal. This reduces the amount of fine particle sediment able to be transported by physical methods such as wind or physical disturbance from machinery. Limiting the exposed area also allows for effective dust management through the use of other techniques such as water suppressant.

Once the overburden material has been placed and is at its final contour or will not be disturbed for extended periods of time, generally the most effective means of control and usually the most economical way to control wind erosion is through establishing vegetation. 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 whilst vegetation is being established.

4.2 Sand Extraction Operations

4.2.1 Sand Extraction and Truck Loading

Sand extraction will be primarily undertaken with excavators and loaded into dump trucks for transportation to the processing plant. This activity can generate dust both from the excavation and also from the placement of material into the truck, if the material is dry.

4.2.2 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.

4.2.2.1 Mitigation Measures

To mitigate the impacts of nuisance dust RS Sand will use water to dampen exposed areas if required. This is standard industry practice which aims to bind particles together to make the particle less available to aeolian transport. RS Sand will also develop a Quarry Management Plan (QMP) which will be regularly updated to reduce dust nuisance, this plan will include a process for reporting on and responding to complaints.

Additionally, the extraction of sand will occur within the pit, which is below the current ground level. This will provide sheltering effects and reduces the potential risk for the transport of dust as windspeeds within the pit will be much lower. Any potential dust risk is further reduced as the bund surrounding the pit will also provide additional sheltering.

4.3 Sand Processing

4.3.1 Process

Extracted material from the pit is loaded directly into the processing plant feed bin where it is conveyed at a rate of 100 tonnes per hour into the initial wash screen where the larger material (greater than 4 mm) is removed and stockpiled. From there the material less than 4 mm is pumped through to the spiral separators before being further separated with screens and cyclones into other size fractions (light weight sand, <0.6 mm, <1 mm, 0.6 – 3.5 mm and 3.5-4 mm) and stockpiled. The wash water enters the settling ponds to allow for the silts to settle and the water is recycled back through the processing plant.

4.3.2 Mitigation Measures

The greatest potential for dust emission from the sand processing operations is when the raw material is loaded into the feed bin, however this material is generally damp and therefore the dust potential is low. From there on the material is processed wet, which will result in negligible dust emissions from the processing plant.

4.4 Stockpiles, Truck Loading and Transportation

4.4.1 Process

The proposed sand quarry will have on-site stockpiles to provide storage for processed material, with the stockpile size and extent fluctuating over time to reflect product demand. The other purpose of the stockpile is to allow for the material to dry after being wet processed prior to being dispatched. The stockpiles will be located within the processing platform along with the processing plant. As the processing platform will be cut approximately two metres below the current ground level, and there will be bunds surrounding this area, any material stored will be well protected from the wind.

The majority of this product will be washed and therefore there will be low potential for dust generation, with the greatest dust potential coming from the smaller sands (<1 mm) and silts when the settling ponds are cleaned. The stockpiles are located approximately 350 metres away from the nearest residence and will be located below the height of these dwellings, therefore there will be minimal risk of dust nuisance outside of the quarry boundary.

All products are dispatched in trucks which are loaded using an on-site loader. It is expected that there will be an average of 72 trucks per day and a maximum of 200 trucks on peak days (i.e. 400 truck movements).

4.4.2 Potential Emission Sources and Mitigation

Transport

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 this source, but it is possible to ensure that as far as practicable dust emissions from this source are minimised.

The main transport related mitigation methods that will be used at the proposed quarry are roadway watering, speed reduction and road surface management.

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 either by a water cart or sprinklers. 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.

The use of water at the proposed quarry will be the principal means of dust suppression on roads.

Speed Reduction

In general terms, the emission of dust from road traffic is proportional to the 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.

PDP recommends that the QMP specifies a speed restriction of 20 km/h which is enforced on all internal roads to reduce the potential for dust emissions from this source and for safety reasons.

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. RS Sand can avoid this matter occurring by ensuring that the road metal is replaced prior to this becoming a potential dust source on internal roads.

Access Road

The access road to and from a quarry can be a source of dust due to the material being tracked out of the quarry by traffic movement. However, there are several commonly used control measures which can prevent this occurrence, which RS Sand are proposing such as:

- Sealing of the access road as required by Rule 6.1.16.1 of the WRP to reduce dust tracked off-site.
- Employing a wheel washing station near the entrance to minimise dirt tracked onto the road.
- All exiting vehicles transporting unwashed or unprocessed material will either be covered, or the load will be dampened before leaving the site.

Stockpiles Erosion

Typically, between 10 and 20 per cent of the dust from a quarry site is due to wind erosion. 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.

To minimise dust production from erosion of the stockpiles RS Sand will locate the stockpiles below ground level to minimise the potential off-site nuisance dust effects.

4.5 Water for Dust Suppression

The use of water is one of the key mitigation measures proposed for suppressing dust at RS Sand during dry conditions. Therefore, the highest potential for dust emissions to occur is when the evaporation rate exceeds the rainfall rate, and during these times water is required to be applied to suppress dust.

To ensure that the site has adequate water for dust suppression, PDP has reviewed meteorological data from Lake Karapiro to determine water demand based on the peak evaporation rate[2]. Using the 3 years of meteorological data and the maximum unconsolidated area of 6.6 ha (including the largest of the five staged extraction area, the entire processing platform and the unsealed access road), the site would require a maximum of 455 m³ of water per day.

[2] Peak evaporation rate 6.9 mm (daily rainfall – Penman ET)

RS Sand is proposing to extract groundwater at a maximum rate of 1,100 m^3 per day with 600 m^3 being used for the sand plant and the remaining 500 m^3 being used for dust suppression. Based on this extraction rate there is sufficient water available for dust suppression based upon replacement of evaporation loss.

4.6 Dust Monitoring

4.6.1 General Monitoring

There are a range of simple monitoring activities that can be regularly used to ensure that dust is being appropriately controlled at the proposed quarry. These monitoring measures are regularly used at most quarry sites and are typically incorporated into site management plans, and PDP recommends that these measures are adopted for this project. Table 3 sets out these measures.

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
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

4.6.2 Dust Monitoring

RS Sand has installed two continuous PM_{10} dust monitors with telemetry systems. Given that the monitors will be able to measure and send data in 'real time', PDP recommends that dust is controlled using the following triggers.

Trigger Level 1 - (80 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 – (160 µg/m³ as a 1 hour average or 60 µg/m³ as a rolling 24 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.

4.6.3 Wind Monitoring

As well as the dust monitors RS Sand has also installed a meteorological monitoring station on the site. PDP recommends that the alerts are sent to the RS Sand management team when wind speeds go above 5 m/s and 10 m/s. This will allow management to make operation decisions around where work is undertaken or the use of specific mitigation measures.

5.0 Assessment of Environmental Effects

This section provides an assessment of the potential emissions resulting from the proposed quarry.

5.1 Dust Emissions

The most significant potential effect from the quarrying activities is the nuisance associated with dust deposition. The activities that could cause this are discussed in Section 4.0.

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, MfE GPG Dust) states that dust nuisance effects are generally only experienced within 300 metres of unmitigated dust sources. As this Project will apply the various forms of mitigation described in Section 4.0 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[3], with mitigation in place it is likely that effects will only occur within 50 metre of sources that are located at ground level.

Figure 4 depicts the distance potentially travelled by nuisance dust for a range of wind speeds based on a particle diameter of 50 and 100 µm. 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 earth moving activities.

The wind direction has an obvious impact on the potential for a source to be affected, especially those downwind in a predominant wind direction.

Based on the above discussion, 300 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 was to be applied. Based on this guidance properties located further than 300 metres from the site are unlikely to be affected by dust during any wind speed condition. Properties R2, R3 and R5 are greater than 300 metres away from the site therefore effects on these receptors are expected to be minimal with respect to dust nuisance. Therefore these sites have therefore not been considered any further in this assessment. This leaves only receptors R1, R4 and R5 which vary between 50 and 300 metres from the proposed quarrying activities.

[3] AP 42, Fifth Edition, Volume I Chapter 13 Miscellaneous Sources, Section 2.4 - Aggregate Handling and Storage Piles

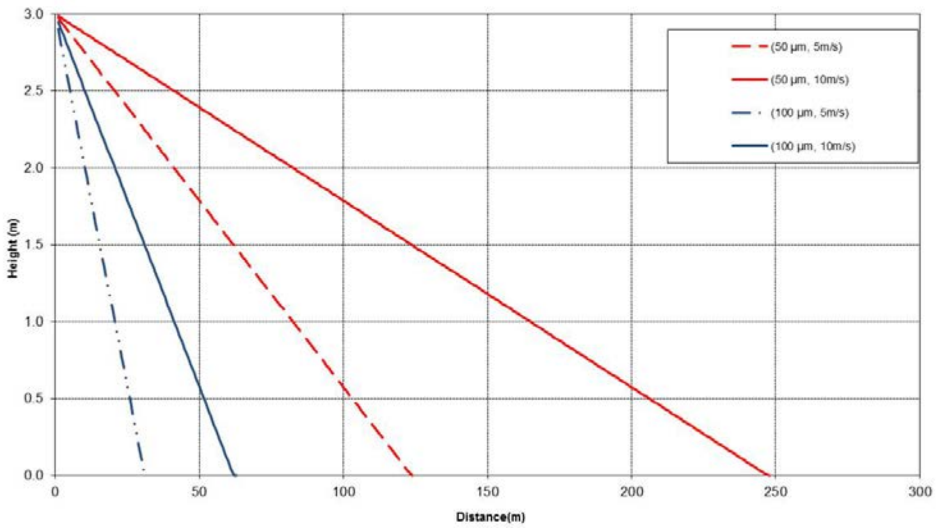

Figure 4: Difference in Particle Travel with Wind Speed

5.2 Assessment of Effects from the Project

PDP has undertaken a FIDOL assessment, as described in Section 3.1, to assess the potential for dust nuisance effects. This assessment is presented in the following sections.

This assessment is based on quarrying activities and wind speeds at the current ground level. As the majority of the works will occur in the pit of the quarry or in the excavated processing platform, which are both well below ground level any assumption made about the distance dust may travel or wind speeds at these locations are very conservative and therefore any dust effects are likely to be significantly less once the enabling works are completed.

5.2.1 Frequency

Frequency relates to how often dust discharges have an effect on sensitive receptors. This is influenced by the frequency in which dust discharges occur and when suitable meteorological conditions exist. To determine the frequency, three parameters need to be established: the direction of sensitive receptors relative to quarrying activities, the frequency at which the wind blows in this direction with sufficient strength that dust can be carried and the frequency of dust discharges. Based on the information contained in Section 2.1, PDP considers that only winds above 5 m/s have the potential to cause dust nuisance effects to the nearest sensitive receptors if the mitigation measures mentioned in Section 4.0 are not implemented.

Based on the wind speed frequency distribution presented in Section 2.1, winds above 5 m/s from the northeast to the southeast which have the potential to blow dust from the proposed quarry towards the nearest receptor R6, could occur between 0.4 and 1.1 percent of the time. For dust nuisance to occur, dust producing activities would need to coincide with the receptor affecting winds. As the two events must occur at the same time the chances of dust nuisance occurring are smaller than 1.1 percent and therefore less likely to occur. This frequency will further reduce as the pit gets deeper and less affected by wind due to sheltering effects.

Most other receptors will experience a very similar frequency of wind speeds capable of transporting dust to that experienced by receptor R6, with winds above 5 m/s typically occurring less than 1.1 percent of the time in all directions. The only exception is winds from the west southwest, west and west northwest which have a higher frequency of stronger wind speeds (between 1.7 and 7.2 percent of the time). However the closest receptor downwind of the proposed quarry in these wind directions is over 2 km away and based on this distance is unlikely to experience nuisance dust from RS Sand even if no mitigation was used.

Based on guidance[4] prepared by the Institute of Air Quality Management, the percentage of strong winds experienced at the nearby receptors is classified as Infrequent. This in combination with the proposed mitigation and monitoring, means that the frequency of any effects associated with the proposed quarrying operations will be low.

5.2.2 Intensity

Intensity relates to the concentration of dust that is likely to be experienced at any potential receptor. Given that the nearest residential sensitive receptor is approximately 50 metres from the proposed quarry, and at this distance this receptor could experience elevated concentrations of dust, however the intensity of the dust can be reduced with good mitigation techniques. However, receptor R6 is only within 50 metres of stage 4 works, and is initially more than 200 metres away from stage 1 works. By the time the works get close to receptor R6 the pit will be deep and the bunds well established, therefore adding to the conservatism of the assessment.

The rest of the sensitive receptors are approximately 300 metres or more from the proposed quarry, the dust concentrations experienced at the receptors should be minimal.

[4] Institute of Air Quality Management, Guidance on the Assessment of Mineral Dust Impacts for Planning, 2016

PDP considers that any dust potential from the quarry can be mitigated using the measures mentioned in Section 4.0, and together with the large separation distance between the source and most of the receptors, any off-site concentrations are unlikely to cause adverse effects.

5.2.3 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 monitoring programme presented in Table 3 that if an event was to occur, at worst the duration would be limited to a period of no more than 1 to 2 hours at any one time, being the time to recognise that dust emissions are occurring and to implement the mitigation.

5.2.4 Offensiveness

PDP considers that dust emissions are unlikely to result in any off-site offensive or objectionable effects. This is based on the limited frequency of suitable meteorological conditions, the activities undertaken, distance to sensitive receptors and mitigation measures that will be implemented.

Additionally, the type of material that comprise the dust can have different levels of offensiveness. For example, coal dust could result in black deposits and depending on the location could be very noticeable. In this case, the material that makes up the dust is soils and sand, which is the same material that would occur regardless of the quarry at the nearby receptors and therefore any dust from the quarry is less likely to be considered offensive. Also, the site is currently used for farming, and the neighbouring area is rural activities, and it is not unusual to experience a higher degree of dust such as the cultivation of land and therefore have a higher tolerance for dust effects.

5.2.5 Location

PDP considers the potential for dust exceedances at most receptors will be low due to the separation distance from the proposed quarry and the low frequency of winds. While receptor R6 is 50 metres from the proposed quarry pit, at this distance there is an increase in the potential for dust effects, however even if dust emissions were to occur given the low frequency of winds capable of transporting dust in the direction of R6 any dust effects will be low.

However, the factor that will have the greatest effect on dust emissions from the site is that processing and the majority of extraction will take place well below ground level. PDP considers that once the site activities are three metres below the ground level, dust emissions from the site will be greatly reduced to the point there where it is unlikely to result in nuisance dust emissions from within the quarry pit or processing platform. This will be further improved with the addition of bunding around these areas.

5.2.6 FIDOL Conclusion

Having assessed the proposed quarrying activities that have the potential to cause dust discharges against the FIDOL factors, PDP considers that it is unlikely that majority of sensitive receptors identified will be affected. As dust producing quarrying activities are 300 metres or more from the receptors, which means that nuisance dust is likely to settle out prior to reaching these dwellings, even in the stronger winds. However R6 which is only 50 metres away from the edge of the pit could experience nuisance dust effects given its close proximity to the works. However, PDP considered with appropriate mitigation dust emissions can be controlled to acceptable levels. There are also other factors that will mean dust effects at receptor R6 will be minimal, firstly that there is a very low frequency of winds capable of transporting dust in the direction of this receptor and once the quarrying activities get below ground level there will be virtually no dust effects beyond the boundary.

Provided that the mitigation measures described in Section 4.0 are implemented, PDP considers that it is unlikely that there will be any nuisance dust as a result of the proposed quarry.

5.3 Silica Assessment

There is no New Zealand standard or guidelines for ambient concentrations of silica; therefore, PDP has considered how silica has been assessed in other jurisdictions. PDP has undertaken a risk assessment using a methodology developed by the United States Environmental Protection Agency (US EPA)[5], to determine the potential risk associated with ambient levels of crystalline silica. The US EPA has carried out an extensive review of all the available monitoring and epidemiology in the United States and overseas, and as a result has been able to produce a methodology to assess the potential risk to the community of exposure to silica. This review included monitoring undertaken in communities located around quarries. While this data is primarily from the United States, PDP considers that the methodology that has been used can be applied to this case to assess the risk to people located in the surrounding community. Figure 5 below presents the results of the US EPA research in terms of potential risk from exposure. As can be seen the data indicates that there is a threshold exposure level of approximately 1 mg/m³ years below which there is no increase in the risk of developing silicosis.

[5] United States Environmental Protection Agency, Ambient Levels and Noncancer Health Effects of Inhaled Crystalline and Amorphous Silica: Health Issue Assessment, November 1996, EPA/600/R-95/115.

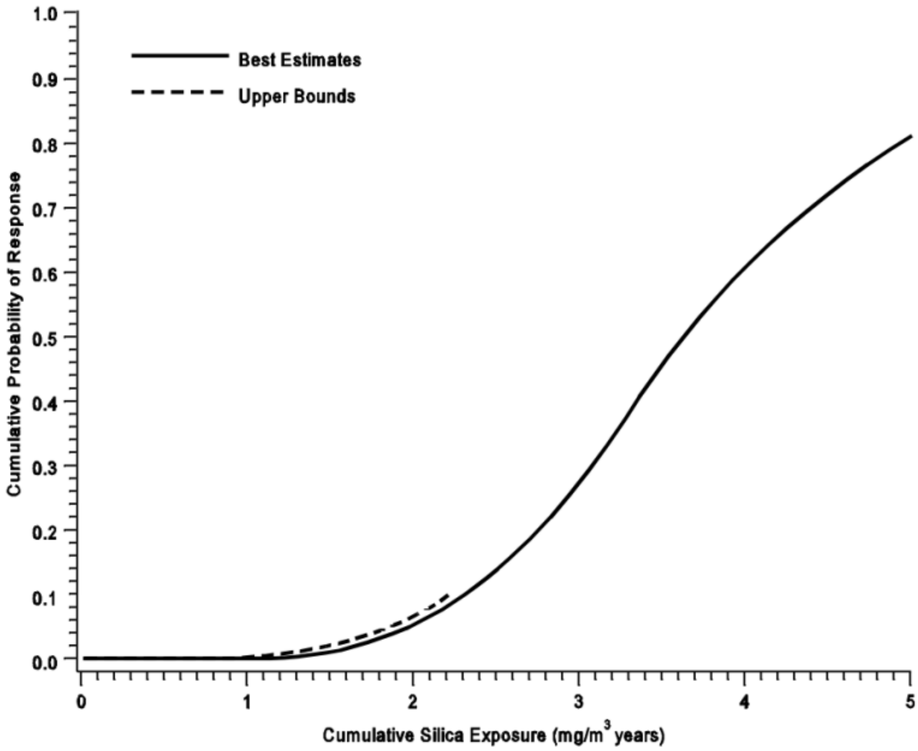

Figure 5: Cumulative Silicosis Risk from, Ambient Levels and Noncancer Health Effects of Inhaled Crystalline and Amorphous Silica: Health Issue Assessment, US EPA

PDP carried out an assessment of the potential risk to people living in the vicinity of the quarry using the US EPA methodology. One of the difficulties that are encountered in an assessment of this type is the question of appropriate variables. To ensure that our assessment has taken into account all the known risks, PDP has used the most conservative input data that we have been able to identify. This input data includes; monitoring PDP has undertaken at other large hard rock and sand quarries and the highest silica concentration based on samples taken on-site. RS Sand collected nine samples from around the site containing different substrates (overburden, fines and sand) and had these samples analysed for silica content. The samples ranged from 7 to 16 percent silica with an average silica content of approximately 11 percent across all the samples, however for this risk assessment the highest silica content of 16 percent has been used. Table 4 summarises the results of that assessment, based on the available data.

Table 4: Estimated Risk of Silicosis

Scenario	Average Ambient TSP ($\mu g/m^3$)	Percentage Silica	Exposure (mg/m^3 years)	Risk Score
Hard Rock Quarry	21	16	0.24	0
Sand Quarry	9	16	0.10	0

Notes:

1. *Silica content is based on analysis from samples taken from the site which ranged from 7 to 16%.*
2. *Exposure (mg/m^3 year) and the Risk Score is based on the US EPA calculations.*

As can be seen from the data presented in Table 4, there is no additional risk to individuals living in the area around the proposed quarry of developing silicosis, as exposure is below 1 mg/m^3 years. PDP notes that the particulate concentration is TSP data and is likely to be an overestimate of the actual PM_{10} averages experienced in the area. Also any actual exposure is likely to be considerably less than that used in the risk assessment which is based on the standard exposure of 70 years. Based on this assessment PDP does not consider that there is any significant additional risk for people currently living near to the proposed quarry to contract silicosis.

6.0 Conclusions

PDP's assessment has concluded that there is some potential for unmitigated air discharges primarily from the overburden removal and construction of western bunds to cause off-site effects at receptors R6 due to the close separation distance between this location and the proposed works. However, the proposed quarry will utilise a number of mitigation measures that, if appropriately implemented, will most likely minimise dust emissions to within 50 metres of the source. Therefore, PDP considers that there is a low likelihood of off-site dust effects at nearby receptor locations. This is based on the following:

- A number of receptors are too far away to be affected by dust from the proposed quarry, and there is only a very small number that are at a distance that they may be affected if no mitigation is undertaken.
- Based on the meteorological data for the area, the most likely affected receptors (R6) would only be downwind of the site during high wind speeds (>5 m/s) between 0.4 and 1 percent of the time. As the dust emission rates from the quarry could be quite varied, there is an even lower probability of high emissions rates occurring at the same time as dust transporting wind speeds blowing in the directions of this receptor.
- The site is currently used for rural activities as well as the surrounding area and it is not unusual for these areas to experience a higher degree of dust, such as from unsealed driveways and the cultivation of land.

Therefore any potential dust generated from the site may not be considered unusual given the current activities.

- RS Sand staff will undertake a visual monitoring programme which will help to identify sources of dust as they occur. Given the frequency of this visual monitoring the duration of any dust event will be limited.
- As the material is extracted it is generally in a damp state before it is wet processed. Given the sand is either handled damp or wet there is very little potential for dust emissions to occur from these processes.
- From a dust perspective having the quarrying operations below the height of the surrounding environment will have the greatest impact on dust emissions. Once the works are either 3 metres below ground level or the height of the bund, any emissions should be fairly well contained.
- Based on the analysis of silica content of the material that will be extracted from the site and concentrations of dust in the air based on similar operations, it is expected that there will be no significant additional risk for people currently living near to the proposed quarry to contracting silicosis.