Sutton Block – Air Quality Assessment

Prepared for

Stevenson Aggregates Limited

March 2025

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Limitations:

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1.0 Introduction

Stevenson Aggregates Limited (SAL) owns and operates the Drury Quarry in Drury. This quarry has been in operation since the 1940s. The quarry currently produces a wide variety of aggregate, including basecourse, concrete aggregates and sealing chip which are used in a wide range of uses, but predominately in civil infrastructure projects in the Auckland region.

Based on the remaining resource in the current pit, and as a result of continual high demand for greywacke rock products, SAL is proposing to expand its current quarry operations by undertaking an expansion into the area known as the Sutton Block. This will require the removal of overburden to gain access to the greywacke resource. That overburden will be disposed of in one of the following ways:

- Used to form the northern bund;
- Transported off-site for disposal;
- Temporarily stockpiled within the Sutton Block pit for disposal in the Drury pit; or
- Placed into the Drury Pit.

Once this overburden is removed and the rock resource exposed, the quarrying operations will commence, with the pit slowly developing towards the northeast over five proposed stages across an estimated 50-year timeframe.

The site holds an existing earthworks consent (Ref: R/LUC/2015/2419 and R/REG/2015/2420) to undertake land disturbance and earthworks activities at and around Drury Quarry over an area of 315 ha, including across the majority of the proposed Sutton Block pit. Additional earthworks activities outside the scope of the existing consent, which consent is sought for, include earthworks within the Significant Ecological Areas, streams, development of the northern bund and aggregate extraction from the Sutton Block. As well as these land disturbance and earthworks activities, the current quarry pit and Front of House (FOH) activities (processing and stockpiling) have an existing air discharge consent. This application will not affect the overall extraction rate, the fixed processing plant or stockpile areas within the existing consented quarry.

Pattle Delamore Partners Limited (PDP) has been engaged in relation to the Sutton Block expansion to assess the air quality aspects, and in particular dust effects, of this proposal. PDP has undertaken observations of the current operations at Drury Quarry and prepared a FIDOL (Frequency, Intensity, Duration, Offensiveness and Location) assessment for the Sutton Block expansion, which is based on these observations as well as 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 application under the Fast Track consenting process.

2.0 Background Information

Drury Quarry is located in the foothills of the Hunua ranges approximately 3.5 kilometres southeast of the Drury township and 2 km east of State Highway 1. SAL owns approximately 562 hectares, which is a mix of quarrying activities, bush and pasture. There is also a concrete batching plant and a perlite processing plant (authorised by separate consents).

The proposed quarrying activities in the Sutton Block expansion site will be predominantly located within the Special Purpose Quarry Zone (SPQZ) (refer to black polygon at Figure 1).

The site is bordered by Drury South Industrial Precinct to the west, which is made up of land zoned for Heavy and Light Industry. There are Rural Countryside Living zoned properties to the immediate northwest and Rural Production zoned properties to the east and southwest. Currently, the nearest dwelling is located approximately 140 m to the northwest of the proposed final pit extent.

It is relevant to note that the Auckland Unitary Plan (operative in part) (AUP) maps show a 500-metre-wide Quarry Buffer Area Overlay surrounding the SPQZ and overlaying the Rural - Countryside Living and Rural - Production zoning (refer to grey polygon at Figure 2). The intent of the overlay is to avoid reverse sensitivity effects on quarries that can result from subdivision, use and development in close proximity. Within the overlay there are restrictions on activities that are sensitive to the effects of mineral extraction activities including noise and dust. For example, under Rule D27.4.1(A1) any new dwellings are controlled activities within this area and Assessment Criteria D27.7.2(1)(a) require consideration as to whether *"the location and orientation of the dwelling and outdoor living areas will ensure occupants are adequately separated and/or protected from the adverse effects of mineral extraction activities, including existing and future noise, dust and vibration."* This rule only applies to new dwellings and any effects from quarry operations on existing dwellings in this area still need to be managed appropriately.

The location of the proposed Sutton Block Life of Quarry Extent (Stage 5, estimated 50-year timeline) is shown in Figure 1 and Figure 2 as a red polygon and land owned by SAL is shown by a yellow polygon. Quarrying within an expanding pit to achieve Stage 5 will be incremental over distinct stages. This dust assessment considers all stages of development up to the final Stage 5 footprint and activities.

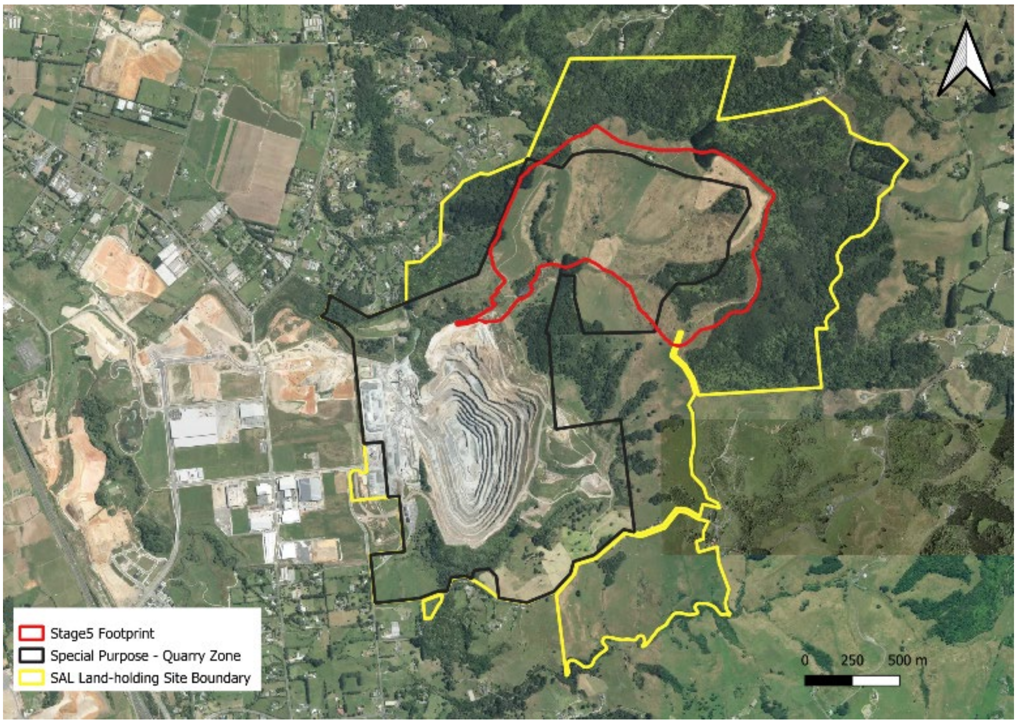

Figure 1: Sutton Block location (Stage 5 extent), showing Quarry Zone and SAL land-holdings

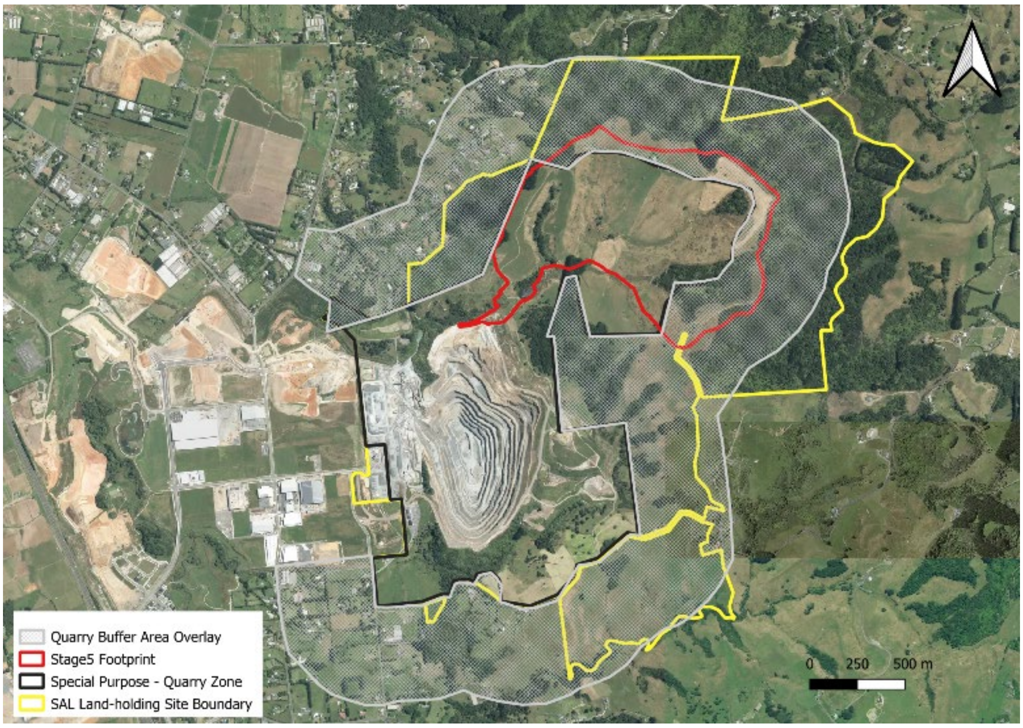

Figure 2: Sutton Block location (Stage 5 extent), showing the Quarry Buffer Area Overlay (grey).

2.1 Topography

The topography of the 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 current Drury Quarry is located within the side of a hill which runs in a north to south direction, with the proposed Sutton Block pit being located to the northeast of the current pit. Once established, the new pit will have fairly steep faces on all sides, which should provide some sheltering effects from winds in almost all directions. To the west of the site, the land flattens towards State Highway 1.

2.2 Meteorology

Wind can have a significant effect on dust generation and transportation.
The Drury Quarry has its own Automatic Weather Station (AWS) to the north of the current FOH processing plant (in the location of the 'Existing Dust Monitor' shown in Figure 6). PDP reviewed the location of the Drury Quarry AWS and the data collected. Given that the sensor was relatively low (approximately 2 m) and the stall speed was 0.4 m/s, the data was indicating a very high percentage of calm conditions (~80%) and PDP considered that the Drury Quarry AWS did not provide a good representation of wind for the Sutton Block area. To resolve this issue, SAL reinstalled the wind sensors on a new mast that is approximately 6.5 m above ground level in September 2023.

An analysis of wind data recorded by the reinstalled Drury Quarry AWS between October 2023 and October 2024 is presented at Figure 3. The wind directions recorded by the Drury Quarry AWS appear to be highly influenced by local terrain, with shielding of the regionally predominant south-westerly and secondary north-easterly wind-flows. The Sutton Block area is approximately 1 km north-east and 150 m elevated from the Drury Quarry AWS and therefore is likely to be more influenced by regional airflows than the Drury Quarry AWS.

To provide wind data that is more representative of the Sutton Block area, a period of further meteorological monitoring has commenced from March 2025. This monitoring utilises an electronic wind sensor mounted at a height of 9 m to collect wind data near to the site's elevated eastern boundary.

For this dust assessment, synthetic wind data for the site was generated using The Air Dispersion Model (TAPM). TAPM was developed in Australia by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and is a prognostic model which is used to predict three-dimensional meteorological data. The TAPM output file was then incorporated into CALMET where it was further developed using refined terrain data. This is a common approach that is adopted when there is no reliable nearby meteorological monitoring data.

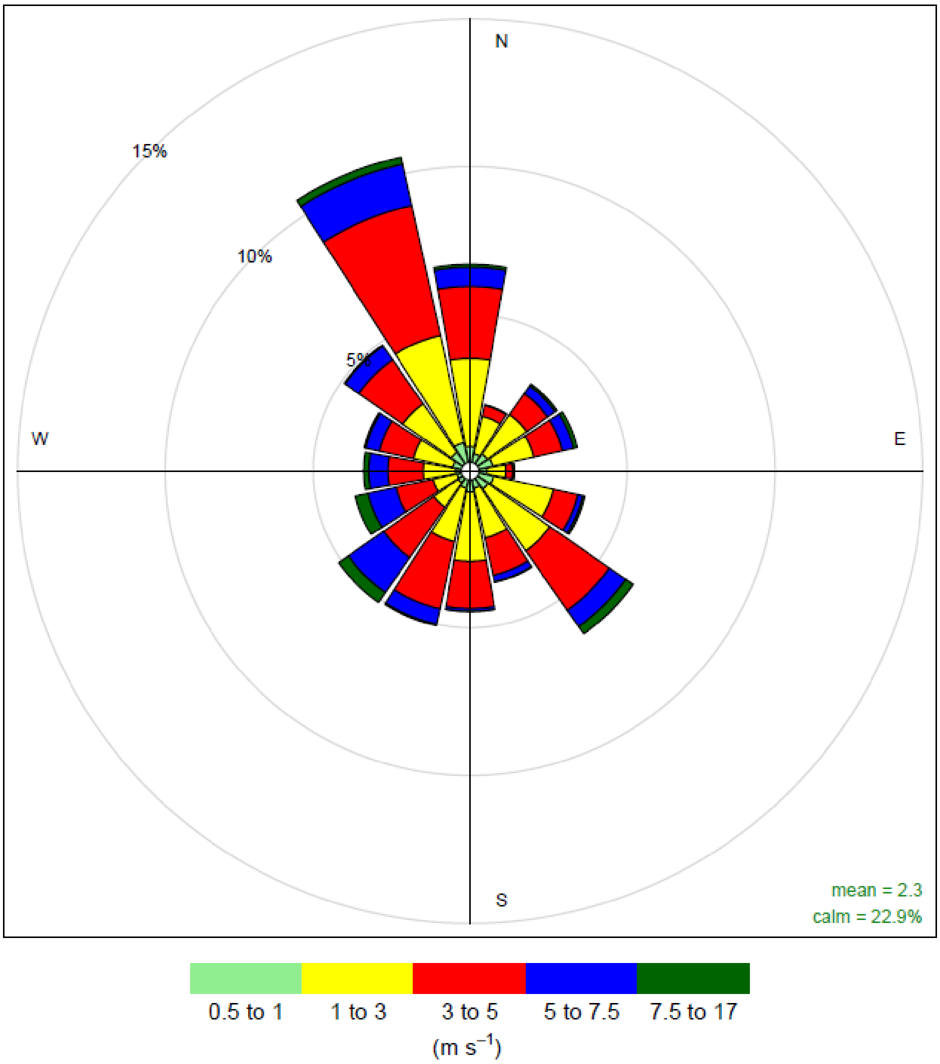

Figure 3: Drury Quarry AWS wind data recorded Oct-2023 to Oct-2024

A wind rose for the site was extracted from the CALMET meteorological dataset and is presented in Figure 4. The wind rose depicts wind speed and direction and the frequency at which they occur. From Figure 4 it is evident that the dominant wind directions are from the west southwest and southwest. Table 1 presents the distribution frequency of wind speed. The predominant higher speed winds (greater than 5 m per second (m/s)) originate from the southwest. Based on PDP’s experience, it is these stronger wind conditions that have the greatest potential to cause off-site dust nuisance effects.

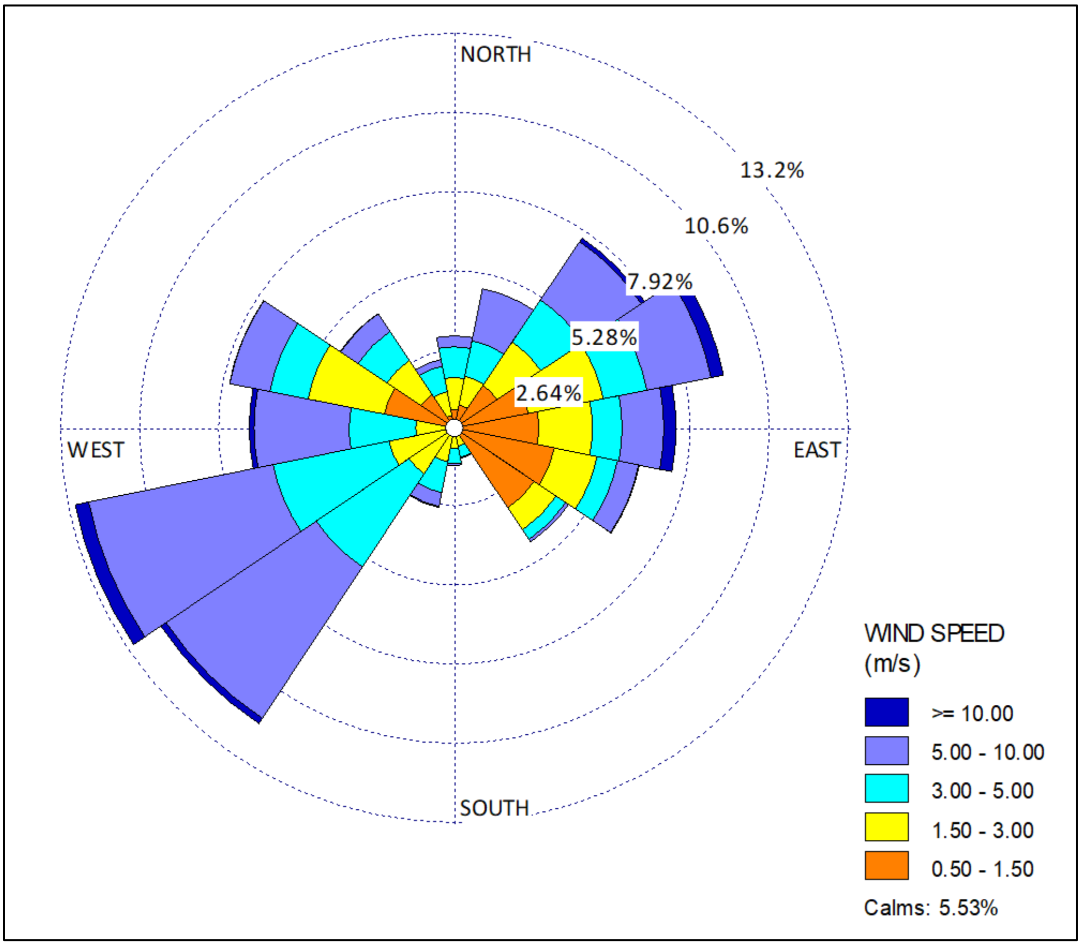

Figure 4: CALMET-derived Wind Rose for the Sutton Block

Table 1: Wind Speed Frequency Distribution for Sutton Block

Direction	Wind Speed (m/s)		Total (%)
	0-5	>5	
North	2.7	0.4	3.1
North northeast	3.0	1.8	4.8
Northeast	5.2	2.5	7.6
East northeast	6.6	2.6	9.2
East	5.6	1.8	7.4
East southeast	5.6	0.7	6.3
Southeast	4.5	0.1	4.6
South southeast	1.0	0.0	1.1
South	1.2	0.1	1.3
South southwest	2.2	0.5	2.7
Southwest	5.6	6.3	11.8
West southwest	6.2	6.7	12.9
West	3.6	3.3	6.9
West northwest	6.3	1.4	7.7
Northwest	3.9	0.7	4.6
North northwest	2.1	0.2	2.4

Rainfall acts as a natural dust suppressant and therefore reduces the potential for dust generation. The average daily precipitation for the years 2019 to 2022 for Pukekohe are shown in Figure 5. The driest months of the year are January and February, therefore greater consideration and management should be given to management during these drier months. Over the four-year period, there were 803 days with <0.2 mm of rain in a 24-hour period (or 'dry days'), which corresponds to almost half of the time (55%). During the drier months (January and February) the percentage of dry days increases to 75% of the days.

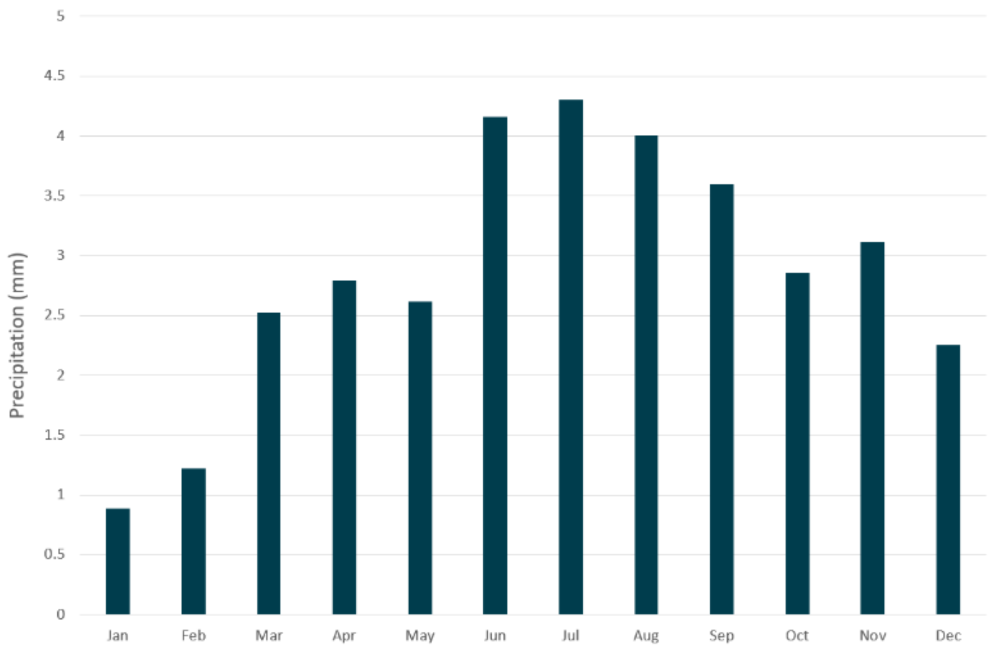

Figure 5: Pukekohe average daily precipitation (2019-2022)

2.3 Existing Air Quality

SAL undertakes total suspended particulate (TSP) monitoring using a Thermo Scientific Partisol Air Sampler (Partisol) located to the north of the current quarry pit. The location of this site is shown in Figure 6.

The Partisol sampler operates on a 1 in 6-day cycle and PDP has reviewed 11 years of data[1] and has presented a summary of the results in Table 2. Condition 29 of the existing resource consent for air discharges (No 36283) for the Drury Quarry requires that TSP concentrations should not exceed 100 µg/m³ over a 24-hour period, and based on the data presented in Table 2 the site meets this condition, with an average concentration of 21.4 µg/m³ and a maximum concentration of 90.2 µg/m³.

When considering that the guidance from the Ministry for the Environment (MfE)[2] is that 80 µg/m³ over a 24-hour period is an appropriate guideline for a moderately sensitive receptor (e.g. a rural dwelling), the average TSP concentrations measured are well below this guidance.

As the existing dust monitor (shown in Figure 6) is located at least 130 m from the closest dwelling, it is expected that dust concentrations will be much lower at these more distant dwellings, and therefore indicates that the current Drury

[1] While the dust monitoring has been undertaken since 2011 it has not been continuous.
[2] Ministry for the Environment (2016) Good Practice Guide for Assessing and Managing Dust

Quarry activities are not generating TSP at levels that would result in nuisance effects.

Table 2: Summary of 24 hour Average TSP Results (2011 to 2022)

Average	21.4
75th Percentile	26.2
Maximum	90.2

Figure 6: TSP Monitoring Location

In addition to the current discrete TSP monitoring, PDP has undertaken a short-term monitoring study of TSP concentrations in the Sutton Block using a MetOne ES 642. Monitoring commenced on 25 November 2021 and ended on 23 June 2022, which covers the dryer period of the year and therefore the highest potential for TSP emissions.

The daily average TSP concentration during this period was 5.9 µg/m³ and the maximum daily concentration was 27.7 µg/m³. As would be expected given the distance of this site from quarry activities both values are lower than the average concentration measured at the current monitoring location. When considering the MfE 1-hour guidance value of 250 µg/m³ for a moderate receptor, there are three occasions when hourly concentrations exceeded this trigger value. These events occurred between five and six in the morning and are likely to have been caused by humidity interference (condensation) within the monitor and not associated with activities undertaken by SAL. During the sampling period, the fields surrounding the dust monitor were cropped and it is possible the higher concentration could be a result of farming operations near the monitor. There was no exceedance of the MfE trigger value for the rolling 24-hour average.

2.4 Complaint History

PDP has approached AC for information on whether there have been any air quality complaints in relation to the current site. AC records state there are four instances of air quality related complaints in the last five years for Drury Quarry, however AC provided no further detail on the nature or magnitude of these complaints. During this same period, based on SAL records there have been two dust related complaints received by the site, with one of these complaints coming from AC. Given the relatively low number of complaints, this would suggest that the current site mitigation is adequate and any activities undertaken on the Sutton Block should have a similar level of compliance.

2.5 Environmental Performance Standards

Under rule E14.4.1(A91) of the AUP *"Mineral extraction activities at a rate exceeding 200 tonnes/ hour from any one quarrying process"* is a controlled activity in the SPQZ provided it meets the controlled activity standard in E14.6.2.2 which is *"The crushing of minerals and aggregates associated with a mineral extraction activity must be located at least 200m from any dwelling located outside the site zoned Special Purpose – Quarry Zone that is not under the control of the quarry operator".* The proposal can meet this standard. However, there will be parts of the pit expansion that will be located outside of the SPQZ and on land zoned Rural. Therefore, under this rule these activities in the rural zone will require a discretionary activity consent under rule A91.

While the primary processing plant will be staying in the current location in the northwest of the existing Drury Quarry pit, SAL are proposing to operate mobile crushers within the proposed Sutton Block pit. The red polygon in Figure 7 indicates 200 m from the proposed Stage 5 pit footprint and northern bund area. The Stage 5 extent does not extend the Stage 4 footprint any further to the north and west (where the nearest dwellings are located). As can be seen in Figure 7 and Figure 8 there is one dwelling (359 Macwhinney Drive) within 200 m of the Stage 4 and Stage 5 pit footprints.

Provided that SAL doesn't undertake any crushing activities within the small area highlighted in purple on Figure 7 (which is considered unlikely), the proposed activities will meet the controlled activity standard.

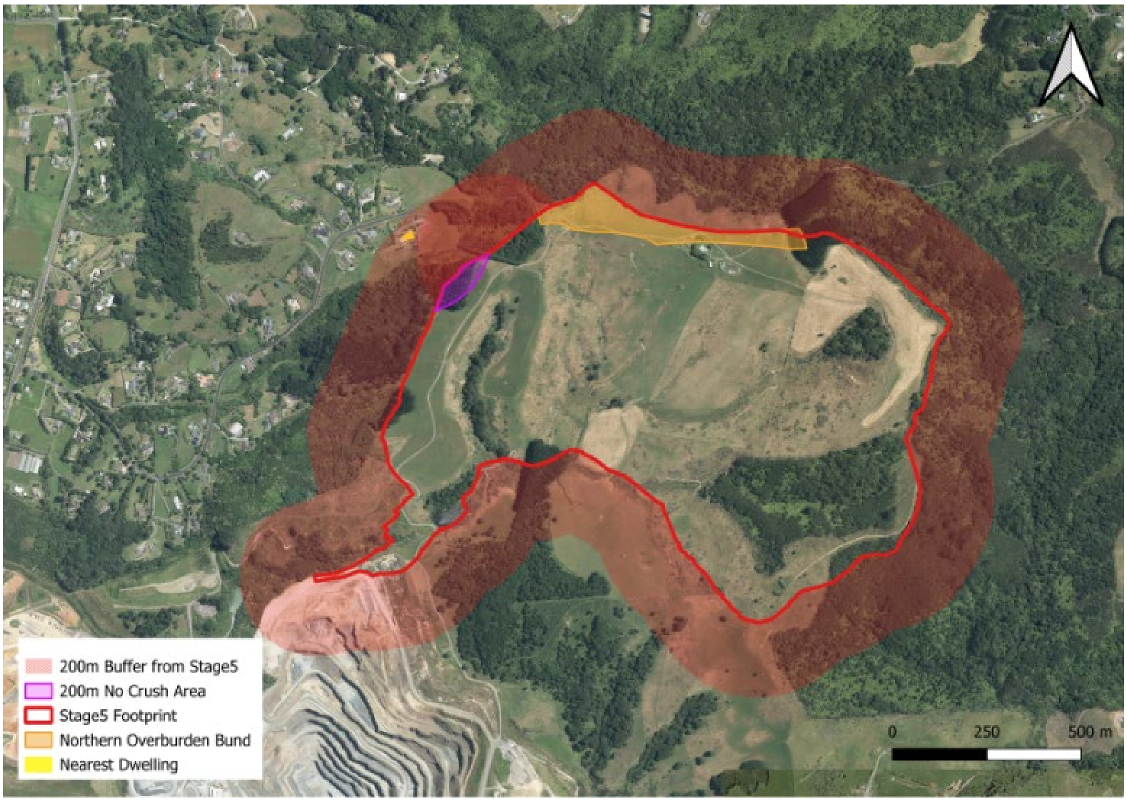

Figure 7: 200 m buffer distance from potential processing activities

2.6 Sensitivity of the Receiving Environment

A site investigation was undertaken to identify discrete receptors deemed sensitive to changes in air quality as a result of potential discharges to air from the potential quarry operations on the Sutton Block. These receptors are summarised in Table 3.

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).

Figure 8 presents the location of the nearest receptors in relation to the Stage 4 Sutton Block extent and northern bund. While not every receptor has been identified, the identified receptors are considered to be representative of the surrounding community that could be affected by nuisance dust from the proposed quarry expansion.

Table 3: Approximate location of receptors located near to the proposed Sutton Block pit (Stages 4 & 5 footprint)

Receptor Name	Address	Approximate Closest Distance to Quarry (m)	Closest Direction Relative to the Quarry
R1	171 Macwhinney Drive	300	West
R2	359 Macwhinney Drive	130	West Northwest
R3	Ecological Area	100	North
R4	Kaarearea paa	80	West

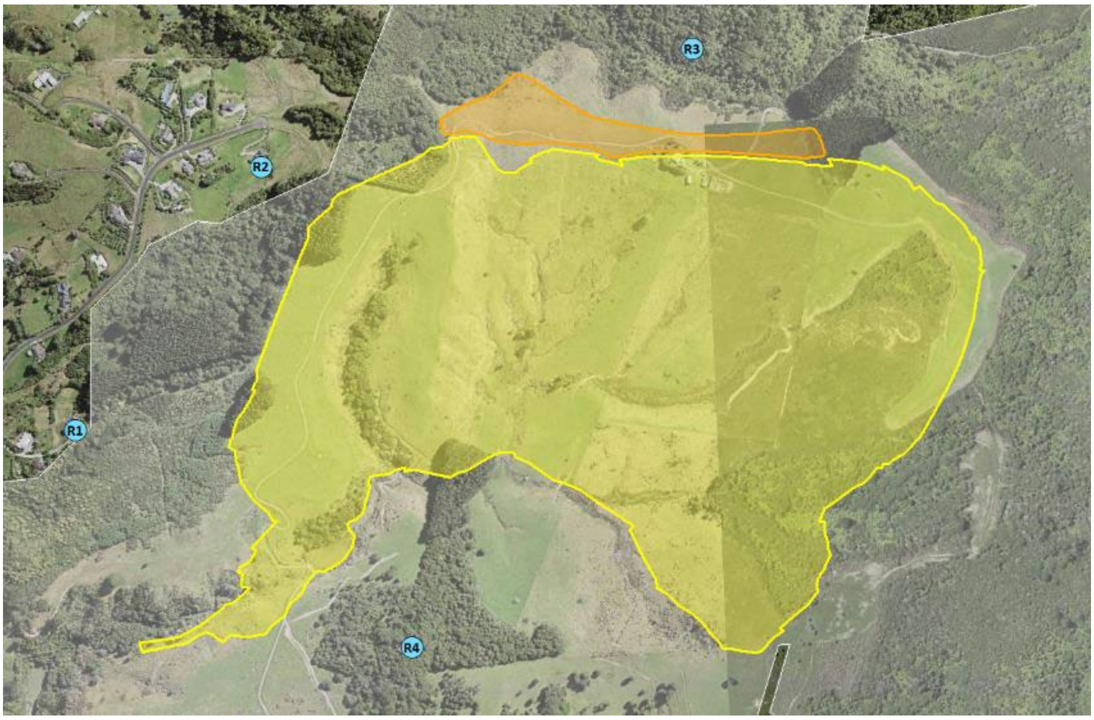

Figure 8: Sensitive Receptors and Stage 4 Sutton Block extent

3.0 Assessment Methodology

This assessment has been undertaken in accordance with MfE guidance for assessing and managing dust.[3]

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 activities that are being 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 matters have been considered:

- The nature of the activity being undertaken;
- How long the activities are likely to occur;
- The nature of the material being quarried;
- Whether mitigation measures can be implemented to control the potential for effects (e.g. use of water carts);
- How close receptors are to the activities;
- The nature of the receptors and their sensitivity to dust; and
- The prevailing meteorological conditions.

3.1 Qualitative Assessment Methodology

PDP has undertaken a qualitative assessment to predict the dust effects from the proposed Sutton Block quarrying activities using the FIDOL assessment tool.

The FIDOL factors are explained in greater 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.

[3] Ministry for the Environment (2016) Good Practice Guide for Assessing and Managing Dust

- 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.
- 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 Current and Proposed Activities

4.1 Project Overview

The Sutton Block is located to the northeast of the existing pit. The ultimate development of the Sutton Block will involve the staged development of an area of approximately 108 ha to a maximum pit depth of approximately RL -60 m RL. The overall site layout, including staging plans, is shown on the drawings in Appendix C attached to the Assessment of Environmental Effects (AEE) report. The Sutton Block is designed to be a separate quarry pit although it will be serviced by the existing Drury Quarry ancillary site infrastructure and facilities. These include the FOH activities such as the weigh bridge, processing plant(s), storage bins and stockpile area, the lamella, staff facilities etc.

It is anticipated that as the existing Drury Quarry pit nears the end of its life and reduces aggregate extraction, the Sutton Block pit will increase its aggregate extraction. This will ensure a continuous aggregate supply to the market.

To enable the development of the Sutton Block, and support the extraction of aggregate, the project will also include the construction of road infrastructure to establish haul road access, overburden removal, stockpiles including bunding; stormwater ponds and supporting infrastructure, and construction of a conveyor belt connecting the Sutton Block pit to the existing Drury Quarry FOH area. The works will also require stream diversions, stream reclamation, wetland reclamation, vegetation removal and mitigation offset. The Sutton Block will generally be developed in the following five stages:

Stage 1 – Infrastructure establishment (three-year plan)

The initial stage of work (Years 1 - 3) involves the construction of the roading infrastructure required to access the site, draining of the existing farm dam to establish a sediment retention pond, associated stream diversion, initial offset planting, commencement of overburden removal, stockpiles (including bunding), and establishment of the conveyor system.

Stage 2 – Operating Quarry (15- year plan)

The second stage of work is the 15- year plan which involves the commencement of quarrying within the interim pit boundary. Whether the interim pit commences within the west or east of the pit boundary will be determined by market demand for blue or brown rock. Regardless, expansion of the pit will be incremental, deepening and widening as resource is extracted. Internal pit roads will be constructed as the pit expands.

Stage 3 – Operating Quarry (30-year plan)

The third stage of works is further expansion of the interim pit boundary. Like Stage 2, the direction of the expansion will depend on market demand. However, in indicative staging plan shows the expansion of the pit to the east. During this stage of the works, the expansion of the pit will be incremental, widening and deepening as resource is extracted. Internal pit roads will be constructed as the pit expands.

The works involved in Stage 3 will generally include the same activities as Stage 2.

Stage 4 – Operating Quarry (40-year plan)

The fourth stage reflects an expanded extent of the quarry pit over an approximate 40-year period. As with Stages 2 and 3, expansion of the pit will be incremental, deepening and widening as resource is extracted. Internal pit roads will be constructed as the pit expands. As discussed earlier, this Stage 4 is likely to be the point in the pit development that has the greatest risk of off-site dust effects.

Stage 5 – Life of Quarry Extent (50-year plan)

The final fifth stage reflects the full extent of the quarry pit, with expansion of the pit east and north (including into the northern bund) across approximately 108 ha and with a pit depth of -60 mRL.

4.1.1 Current Quarry Activities

As already discussed, the current quarry pit at Drury and the ancillary site infrastructure and facilities (known as the FOH) holds an existing air discharge consent. The location of the current pit and FOH which includes the weigh bridge, processing plants, storage bins and stockpile area, the lamella, staff facilities and other ancillary facilities are shown in Figure 9.

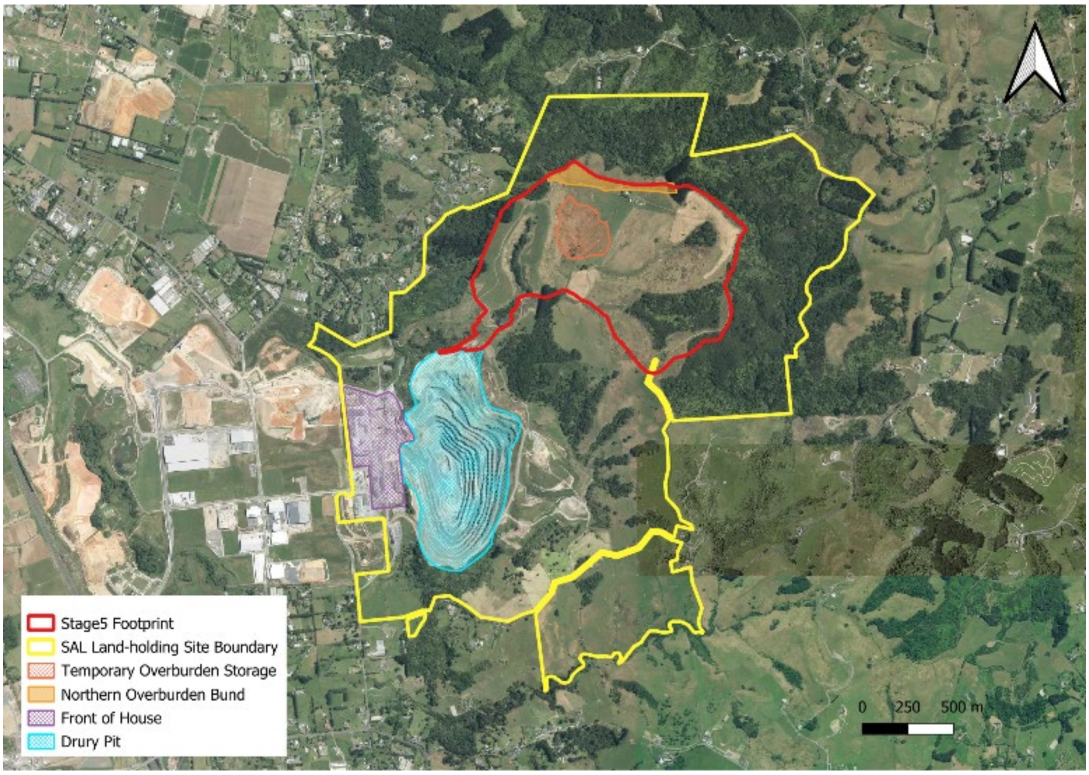

Figure 9: Location of existing consented and proposed activities

4.2 Description of the Quarrying Activities

4.2.1 Removal of Overburden

As new areas are required to be opened up any existing vegetation and the overburden is then removed. The removal of overburden includes topsoil, clay and brown-rock, with this predominantly undertaken by excavators. The material will be loaded into dump trucks for placement within the northern bund and later stockpiled within the overburden area within the Sutton Block. It is proposed to be temporarily stored within the Sutton Block until quarrying advances at that point the overburden will be moved into the Drury pit.

4.2.2 Removal of Rock

Removal of rock requires blasting, which will be undertaken as required, usually approximately twice per week. Blasting at Drury Quarry is currently completed between the hours of 9 am and 5 pm Monday to Friday by an external company, Orica Limited. The subsequent extraction of rock at the quarry face will be undertaken predominantly with excavators, material is then loaded into dump trucks or a conveyor system for transportation to the processing plant within the consented Drury Quarry. It is SAL's intention to transport the majority of material to the processing plant via conveyors however, for conservatism, this assessment is based on trucks moving this material. If conveyors are used, that process will generate less dust and combustion emissions, compared to typical load and cart operations with dump trucks and haul roads.

4.2.2 Processing of Rock

Rock will be processed through the already consented processing plant and the aggregate product will be stockpiled within the Drury Quarry FOH area. Product can be transported from the site at different stages in this process.

Note that there will be no changes to the location and intensity of the FOH area (processing plant, weigh station and office, managers office, workshop, staff rooms and parking) as a result of this proposed expansion as these activities will be staying in the already consent Drury Quarry. The following rock processing is undertaken at Drury Quarry.

Primary and Tertiary Processing Plant

The processed product is used for the manufacture of concrete, asphalt, sealing chip and roading aggregates. The raw product is dumped into a 100-tonne hopper where 65 mm, 40 mm or 20 mm product is scalped off before entering the crushing process. The scalped product is used to make basecourse.

The remaining product passes through a jaw crusher, two to four cone crushers and one or two Vertical Shaft Impactor (VSI) crushers. During this process, different sized fractions are separated using screening decks. The 0-6 mm product is screened out unwashed and the larger size stone is washed.

The products are then stored in overhead product bins to be blended or stockpiled. The blended products are mixed on a conveyor and conveyor loaded into a dump truck and stockpiled. Material is also loaded into a dump truck from overhead product bins and then stockpiled.

Seal Chip and Asphalt Aggregate Plants

Both the Seal Chip and Asphalt Aggregate Plants operate in a similar way. Product 0-40 mm in size is fed into 60-tonne receiving hoppers. The product then passes through a VSI crusher before the <6 mm product is screened out unwashed. The material between 6-25 mm proceeds to the sizing and washing screens where it is washed and sized into the required aggregate sizes. Oversize stone is returned to the VSI for further crushing. The Sealing Chip plant also has a cone crusher for reducing oversize aggregate before going back to the VSI.

Portable Compression Crushing Plants

The Portable Compression Crushing Plants are used for the manufacture of roading aggregates and feed material for the Sealing Chip and Asphalt Aggregate Plants.

The portable crushing plants will be positioned near recently blasted rock. The material is fed into a tracked jaw crusher which then feeds a tracked cone crusher. Sometimes tracked screens are used in conjunction with jaw/cone crusher depending on the product required.

Water for dust control is pumped from a water cart or water tank and enters the process spray nozzles to dampen the product. The water is incorporated in the finished product, so no settling ponds are required.

Primary Processing Plant (Mobile)

Mobile processing plants are used for the manufacture of roading aggregates and sometimes feed for the Static Plants. The plants will be positioned near recently blasted rock. The material is then fed into a tracked Horizontal Shaft Impactor (HIS) or scalping screen using an excavator.

The product will be stockpiled with in the pit using a conveyor before loading onto customer trucks.

Water for dust control is pumped from a water cart or water tank and enters the process spray nozzles to dampen the product. The water is incorporated in the finished product, so no settling ponds are required.

4.3 Emissions to Air

The potential for air quality effects associated with the operation of the Sutton Block 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 to be 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 operation at the Sutton Block has the potential to generate dust from a number of the potential operations. These include:

- Initial enabling works, including construction of the haul roads, vegetation removal, removal of overburden, construction of erosion and sediment controls, and construction of bunds.
- Material excavation and processing.
- Operation of vehicles on the haul roads.
- Conveyor belts.
- Wind erosion of working areas.
- Placement and contouring of overburden to form the northern bund.
- Rehabilitation of the completed areas.

The actions undertaken by SAL will have a direct influence on all of the above activities to generate dust.

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. 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 processing plant.

Respirable crystalline silica (RCS) can also 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 mitigation measures for activities which will generate dust are outlined in the following sub-sections.

5.0 Mitigation Measures

This section of the report presents the mitigation measures that are used to control the effects of discharges to air during the proposed quarrying at the Sutton Block. These mitigation measures are detailed in the Dust Management Plan (DMP) for the Drury Quarry which will also be adopted for the Sutton Block. The DMP will be updated on an annual basis to reflect improvements in dust mitigation and to ensure continual improvement in reducing dust nuisance across the site.

The DMP is a requirement of the existing air discharge consent for Drury Quarry (BUN60409108: LUC60409170 & DIS60409109). PDP has reviewed the conditions of this existing air discharge consent and consider it would be appropriate for these to also apply to a new consent for the Sutton Block area. The key dust mitigation measures within the DMP and Drury Quarry consent conditions that are relevant to each Sutton Block process are discussed below.

5.1 Overburden Disposal

5.1.1 Process

Overburden removal and disposal occurs progressively as more of the active face is opened up. The overburden is stripped from the desirable material using excavators, with overburden that is being sold, loaded directly into trucks and transported off-site and the remaining material is taken to the proposed northern bund. Once the northern bund has been exhausted, material will be temporary stockpiled within the Sutton Block until quarrying advances at that point the overburden will be moved into the Drury pit.

5.1.2 Potential Emission Sources

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

- wind driven dust off exposed surfaces during overburden removal and placement;
- dust being disturbed on haul roads between and within the excavation point and the overburden disposal 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 30 km/h on unconsolidated surfaces;
- dampening of haul roads;
- reducing drop heights, and;
- mulching, grassing and / or planting of bare areas and the northern bund 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.

5.2 Aggregate Extraction Operations

5.2.1 Aggregate Extraction and Truck Loading

SAL will use blasting and mechanical methods to separate the desired rock material with blasting undertaken as required. Aggregate extraction will be primarily undertaken with excavators where aggregate is loaded into trucks for transportation to the either the mobile or fixed processing plants. SAL will likely use an electric conveyor system to transport raw material to the primary crusher and if implemented this will reduce dust emissions from truck transportation. While a conveyor system is likely to be used, for this assessment PDP has considered that material will be transported with trucks as this is more conservative.

5.2.2 Potential Emission Sources

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

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

5.2.2.1 Mitigation Measures

To mitigate impacts from blasting, such as vibrations and nuisance dust SAL employ an experienced blast operator to undertake all blasting. In addition, water can be used to dampen dust. This is standard industry practice that aims to bind particles together to make the particle less available to aeolian transport.

At the beginning of the quarrying process aggregate will be collected near ground level, and this provides additional risk for the transport of dust as particles are more available for wind transport at ground level as they can be blown downhill directly. However, for the majority of the time the aggregate extraction and truck loading will take place below ground level and will therefore have a greatly reduced potential to generate dust emissions. If required SAL will wet the material on the ground prior to the commencement of loading to reduce nuisance dust.

5.3 Aggregate Processing

The primary processing plant located in the FOH and is authorised by consent BUN60359817 for Drury Quarry and therefore is not discussed any further. It is not initially intended that any crushing will be undertaken in the Sutton Block however in the future when crushing is required SAL will utilise portable crushing plant and this is described below with the potential emission sources from this activity.

5.3.1 Process

Once loosened by blasting, rock is excavated and depending on rock quality it is then transported to the crushing plants.

Portable Compression Crushing Plants

The Portable Compression Crushing Plants will be used for the manufacture of roading aggregates and feed material for the Sealing Chip and Asphalt Aggregate Plants. The portable crushing plants will be positioned near recently blasted rock. The material is fed into a tracked jaw crusher which then feeds a tracked cone crusher. Sometimes tracked screens are used in conjunction with a jaw/cone crusher depending on the product required.

Water for dust control is pumped from a water cart or water tank and enters the process spray nozzles to dampen the product. The water is incorporated in the finished product so no settling ponds will be required.

5.3.2 Mitigation Measures

The majority of the aggregates will be processed wet, which results in little potential for dust emissions from the processing plant.

5.4 Stockpiles Truck Loading and Transportation

5.4.1 Process

SAL does not initially intend to stockpile any material within the Sutton Block, with the exception being the placement of overburden material on a temporary basis, as all rock will be transported to the FOH for processing. However if in the future processing was to occur within the pit using portable crushers, both raw material and finished material will be stockpiled. These stockpiles will be located within the pit and will be well sheltered from any strong winds.

All products stockpiled within the pit will be dispatched in trucks which are loaded using an on-site loader.

5.4.2 Potential Emission Sources

5.4.2.1 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.

5.4.2.1.1 Mitigation Measures

The main transport related mitigation methods that will be used at Sutton Block 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 by a water cart. Water carts have a series of spray nozzles attached to a water storage unit which are mounted on a truck body and this enables even distribution of water to hydrate the road. 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 Sutton Block will use water as the principal means of dust suppression on roads as there is sufficient water supply available.

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.

At Sutton Block 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.

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

5.4.2.2 Surface Erosion and Stockpiles

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 areas of exposed soil around the quarry, together with dust from the stockpiles and overburden piles generated during normal operation of the quarry.

5.4.2.2.1 Mitigation Measures

The control of dust emissions caused by wind erosion is usually accomplished by stabilising the soil particles that could be eroded. The main techniques that will be undertaken at the Sutton Block are: minimisation of exposed areas, re-vegetation of excavated areas where practicable, as soon as practicable, and the use of water to bind particles to the surface:

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.

Re-vegetation of Exposed Areas

If large areas of exposed soil are to be exposed for extended periods, vegetating these areas typically with grass is the most effective means of control and usually the most economical way to control wind erosion from these sources. Such areas would be topsoiled, seeded and mulched or covered in geotextile to ensure it is stabilised.

Irrigation with Water

The periodic irrigation of exposed land by water carts may 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 Dust Monitoring

5.5.1 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 Sutton Block. These monitoring measures are regularly used at most quarry sites and have been incorporated into the DMP for Drury Quarry. 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, 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 erosion. 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

5.5.2 Dust Monitoring

SAL undertakes continuous dust monitoring with telemetry at a number of locations around the Sutton Block and the current and proposed locations are shown in Figure 10. The monitors are able to measure PM_{10} concentrations and send data in ‘real time’. PDP has recommended that dust is controlled using the following triggers and these triggers have been incorporated into the DMP:

Trigger Level 1 – (120 µg/m³ as a 1 hour average) – To identify that PM_{10} 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 PM_{10} concentrations have reached a level which is unacceptable, and dust nuisance is likely to 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.

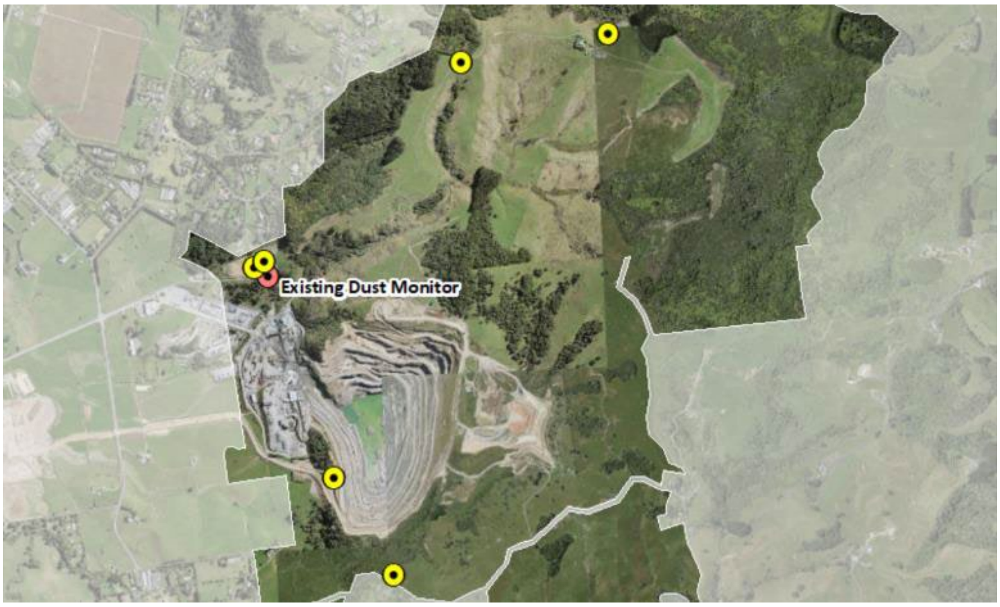

Figure 10: Location of Proposed Dust Monitors

5.5.3 Wind Monitoring

As already mentioned, SAL operates a meteorological monitoring site at Drury Quarry, which is approximately at a height of 6.5 m. PDP recommends that the alerts are sent to the SAL 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.

6.0 Assessment of Environmental Effects

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

6.1 Dust Emissions

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

There are five main factors that are important to understand when determining whether any nuisance is caused by dust emissions from quarrying activities.

These are:

- Particle size;
- Particle density;

- Wind speed;
- Wind direction, and;
- Distance between the source of the dust and sensitive receivers.

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

In general, however, it is possible to make the following statements:

- Heavier and larger particles require more wind (speed) 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.

Considering this range of variables, there are a number of recognised guidance documents that state that dust nuisance effects are generally only experienced within 300 and 500 m of unmitigated dust sources. As discussed in Section 5.0, SAL will employ various forms of mitigation to control dust discharges and therefore is not considered to have unmitigated dust discharges.

PDP considers that the most common type of materials that have the potential to generate dust emissions from the proposed quarry are topsoil and clay from the overburden. Dust from the quarried material is typically denser and consequently does not travel as far. Figure 11 depicts the distance potentially travelled by dry material from the quarry for a range of wind speeds based on a particle diameter of 50 to 100 µm. This is a reasonable assumption based on PDP's experience with dust nuisance. The release height of three metres in Figure 8 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. The receptors along Macwhinney Drive are generally at a lower elevation compared to the nearby terrain at the Sutton Block. For the most part, the surrounding receptors are screened from the Sutton Block by mature vegetation which should reduce dust effects. Near the top of Macwhinney Drive, the vegetation becomes sparser, and number of these trees are over mature, therefore SAL are proposing to remove these trees prior to establishing the pit and replacing them with a 15 metre wide planting buffer. Once established, these plantings should help minimise dust effects. At this location there is an approximate 20 to 30 m difference in elevation and therefore distance based on a 3-metre drop height is not as relevant. Therefore Figure 12 shows an increased drop height of 30 m to allow for this difference in elevation, and as can be seen by this figure, if unmitigated, dust could travel for significant distances.

Given that the quarried material would generally be damp, and essentially at or below ground level, these figures will overestimate the potential for effect from this source.

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

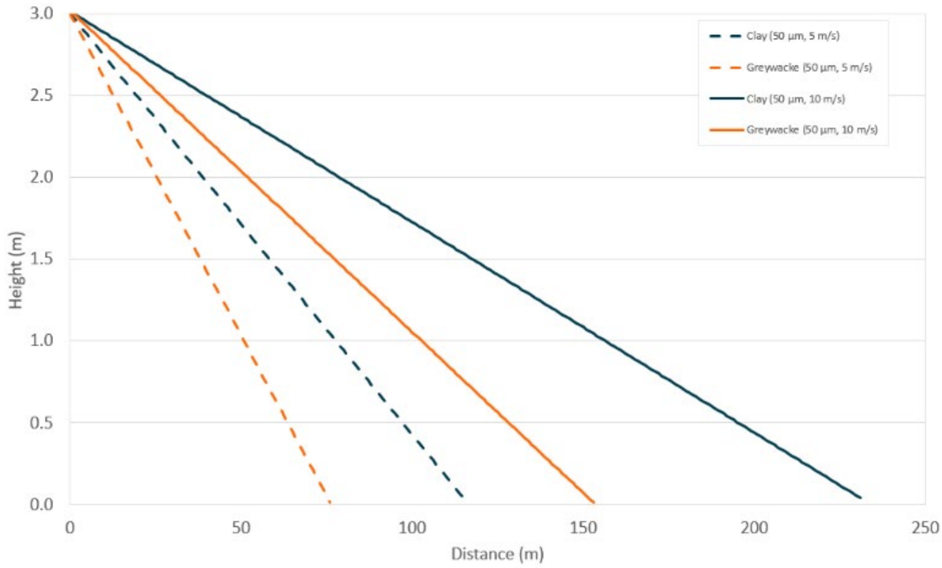

Figure 11: Difference in Particle Travel with Wind Speed

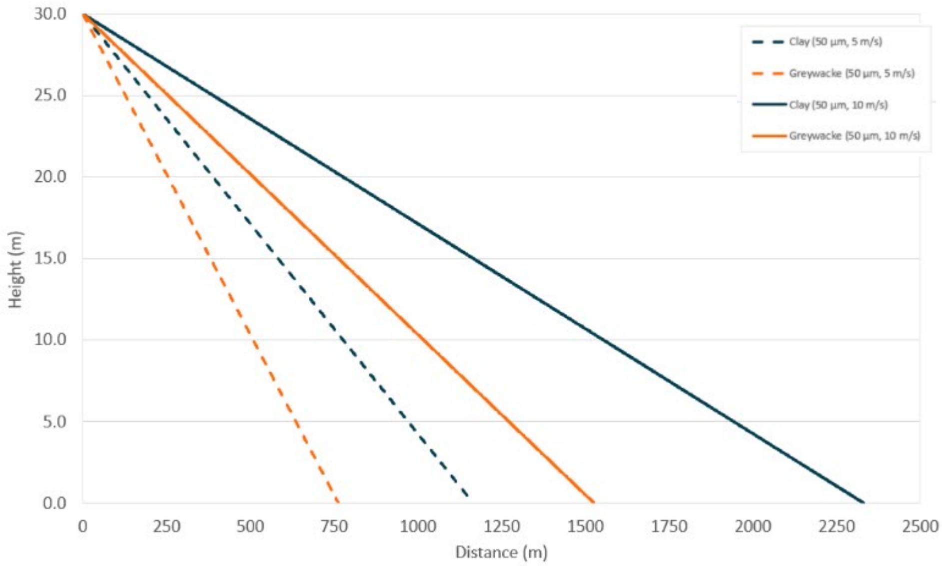

Figure 12: Difference in Particle Travel with Wind Speed with 30 metre Elevation Difference

Based on the above, when activities are undertaken at some elevated exposed locations, effects could be experienced at extended distances if no form of mitigation is used. In PDP's opinion, the main risk for nuisance dust effects on dwellings on Macwhinney Drive is during the overburden stripping near the northwest boundary of the Sutton Block and the placement of overburden to form the northern bund (and later removal of this northern bund) near the Quarry Zone boundary. As part of the assessment, PDP did also consider the properties to the north along Sonja Drive and Laurie Drive as potential sensitive receptors. However, given they are at least 600 m from the nearest dust generating activities, elevated and separated by the proposed northern bund and existing dense vegetation, PDP considered that these locations will not experience any dust effects from the proposed Sutton Block operations.

Once the quarrying activities are below the surrounding ground level and the northern bund is formed, the dust emissions should be contained within the site. Based on these potential dust effects from the associated quarrying activities PDP has assessed receptors R1 and R2 to represent the dwellings along Macwhinney Drive, the Significant Ecological Area (R3) to the north, and the Kaarearea paa (R4).

The dust mitigation procedures and measures undertaken by SAL are described in Section 5.0. These mitigation techniques aim to reduce and control the potential for dust emissions, and therefore the amount of nuisance dust which could be transported will reduce significantly. Based on the types of activities that will be undertaken and guidance provided in US EPA technical documents[4], with mitigation in place it is likely that dust effects will only occur within 50 m of sources that are located at ground level.

6.2 Assessment of Dust 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.

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

6.2.1 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 2.2, 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 2.2, winds above 5 m/s are more frequent from the west southwest and southwest and occur 6.7 and 6.3 percent of the time respectively. These higher frequency winds would impact the vegetative areas to northeast of the proposed pit and unlikely to affect any of the closest receptors on Laurie Drive and Ponga Road due to the distance being greater than 600 m.

In terms of receptor effecting winds, wind from the east to the southeast have the greatest potential to blow dust from quarrying activities towards the receptors on Macwhinney Drive. Winds from this direction could occur between 0.1 and 1.8 percent of the time. Whereas strong winds from the southeast to the southwest which would affect the Significant Ecological Area could occur between 0 and 0.5 percent of the time. While the Kaarearea paa site will be exposed from winds coming from the west to the east (via the north), with these winds occurring between 0.2 and 3.3 percent of the time. 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 predicted wind frequencies and therefore less likely to occur.

Based on guidance prepared by the Institute of Air Quality Management (IAQM),[5] this percentage of winds is classified as Infrequent, except for the southwest winds which are considered to be moderately frequent. This in combination with the proposed mitigation and monitoring, means that the frequency of any effects associated with the proposed quarrying operations will be infrequent based on the IAQM guidance.

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

6.2.2 Intensity

Intensity relates to the concentration of dust that is likely to be experienced at any potential receptor. While some of the receptors at the northern end of Macwhinney Drive are close to the proposed Stage 5 pit edge (140 m), the vast majority of work will be undertaken sufficiently far from dwellings that dust effects will not occur at them. Dense vegetation along the site boundary will also help reduce dust intensity. While there currently some over mature vegetation which may need to be removed and some areas of vegetation that is sparse in places, SAL has developed a planting plan which will mean there is a least 15 m of vegetation separating the quarry operation and these dwellings.

At its closest point the Kaarearea paa will be approximately 80 m from the proposed Sutton Block which is a similar distance from the current Drury Quarry. Given that the Sutton Block will utilise the same dust mitigation as Drury Quarry, it is expected that the Kaarearea paa will experience a similar level of dust intensity.

Additionally, the current dust monitoring at Drury Quarry indicates that the majority of the time dust concentrations are well below the MfE guidance for nuisance dust at moderately sensitive locations. Given that the primary activity undertaken on the Sutton Block will be mineral extraction, dust concentration should be lower than what is being measured at Drury Quarry. This is primarily due to the crushing operations undertaken a Drury Quarry which has a greater potential to result in dust emission than mineral extraction. While there may be some crushing undertaken within the Sutton Block this will be on a much smaller scale compared to the existing FOH operations at Drury Quarry.

PDP considers that any dust potential from the quarry can be mitigated using the measures mentioned in Section 4.0, and together with the reasonable separation distance between the source and the receptors, any off-site concentrations are unlikely to cause adverse effects. Additionally, while there are no nuisance dust guidelines for fauna and flora, provided that the mitigation and monitoring ensures that dust effects are below human based guideline values presented in Section 5.5.2, there should be no effects to the fauna and flora within the Significant Ecological Area.

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 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 1 to 2 hours at any one time, being the time to recognise that dust emissions are occurring and to implement any additional mitigation that might be required.

However as continuous monitoring of TSP and wind conditions will be undertaken and the alerts in Sections 5.5.2 and 5.5.3 will also be implemented, then PDP considers that the duration of dust emissions could be reduced to 30 minutes or less.

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 limited frequency of suitable meteorological conditions, the activities undertaken, distance to sensitive receptors and mitigation measures that will be implemented.

In addition, based on the Drury Quarry current compliance history with only six[6] air quality related complaints received in the last 5 years, and that the activities and mitigation at Sutton Block will be similar, PDP considers that a good level of compliance will occur at the Sutton Block and therefore not result in nuisance off-site dust effects.

For the Significant Ecological Area to the north of the Sutton Block, the main source of dust will be from topsoil and clay from the placement of overburden in the northern bund. This is unlikely to cause offence, primarily due to the expected low concentrations and that this material that already within this area.

6.2.5 Location

PDP considers the potential for dust exceedances at the nearby receptors to be low due to a number of reasons relating to the locations of the quarry and receptors. There is a good separation distance between the quarry activities and the nearby dwellings, for the majority of the time with most work being undertaken more than 300 m from these dwellings, therefore it is unlikely dust effects will be experienced off-site. There are times when work will be undertaken within 140 m of a dwelling, during these time PDP recommends that a dust monitor is installed on the site boundary. In addition, the frequency of winds which have the potential to carry nuisance dust from the main quarrying areas to sensitive receptors will be low (see Figure 13). Therefore, the potential for dust nuisance at these locations is unlikely and will be further minimised through the implemented mitigation measures.

[6] Four complaints received by Auckland Council and two received by SAL.

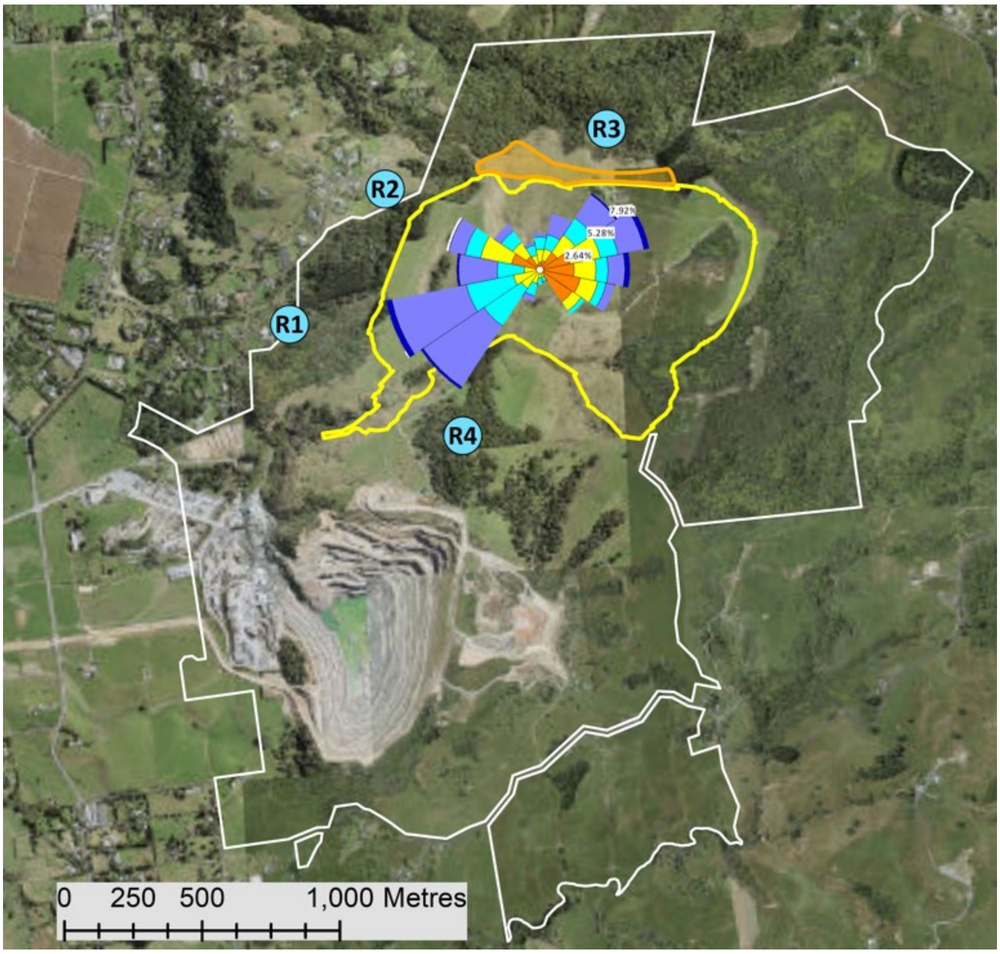

Figure 13: Location of sensitive receptors with respect to the Stage 4 pit extent and windrose

6.2.6 FIDOL Conclusion

Having assessed the quarrying activities that have the potential to cause dust discharges against the FIDOL factors, PDP considers that it is unlikely that any sensitive receptors will be affected. The primary activity that will be occurring within the Sutton Block is mineral extraction and once this activity is below the surrounding ground level the potential for dust nuisance is extremely low.

If dust emissions were to occur especially during the removal of overburden, based on the frequency of winds capable of blowing this dust in the direction of these dwellings being infrequent, the potential for nuisance dust effects is low. However during the placement of the overburden in the northern bund, moderately frequent winds from the southwest might result in dust deposition within the Significant Ecological Area.

6.3 Cumulative Dust Effects

The proposed works has the potential to result in cumulative effects from the currently consented quarrying activities. For a receptor to be affected by cumulative dust effects from the existing quarry operations and proposed Sutton Block operations, the receptor must be downwind of both sources at the same time dust emissions are occurring.

Figure 14 shows the potential dust effects from both the Drury Quarry and the proposed Sutton Block if no mitigation is undertaken with the purple shaded area indicating the possible cumulative effects. Given the orientation of the site, the current consented quarry and the Sutton Block would only be downwind of each during either northeast or southwest winds and therefore there will be no location that could be affected by dust and downwind of each other at the same time. However, based on the shaded purple area in Figure 14 the Kaarearea paa site could be affected by dust from both the Sutton Block and Drury Quarry, but not at the same time. This means that intensity of the dust is unlikely to increase at the Kaarearea paa site as a result of activities in the Sutton Block, however it is more likely to result in an increase in dust frequency as there is more locations which dust may originate from.

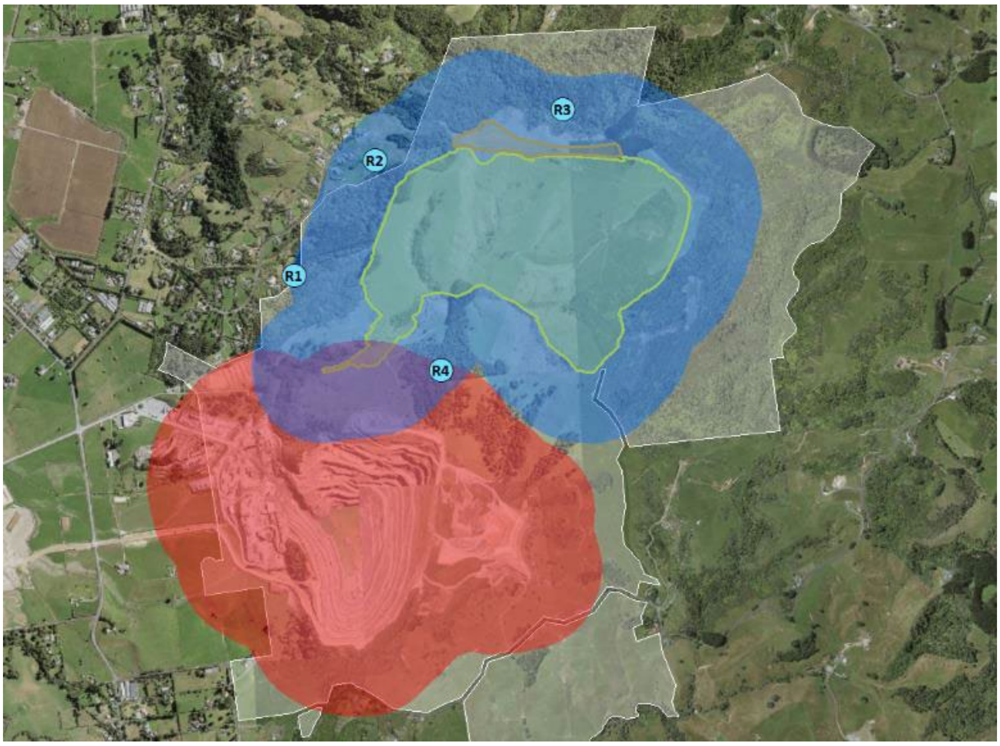

Figure 14: Area of Potential Dust Effects from Unmitigated Dust Emissions

6.4 Assessment of Health Effects

6.4.1 PM_{10}

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 that will be discharged from the Sutton Block, PDP considers that the human health impact from the discharge of dust from the site operations will likely to be low because:

- PM_{10} and particularly $PM_{2.5}$ are generally not significant components of the dust generated from quarry activities, and is therefore any dust emitted is not generally in the inhalable fraction;
- Given low background PM_{10} concentrations in the surrounding environment, with the small contribution to PM_{10} from quarry activities, total cumulative concentrations of PM_{10} will be maintained well below the National Environmental Standard for Air Quality (NESAQ) criteria of 50 µg/m^3 as a 24-hour average and the AAQG criteria of 20 µg/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 various guidance documents to understand the likely proportion of PM_{10} found in dust from quarrying activities. The United States Environmental Protection Agency (US EPA) estimates that PM_{10} from overburden material is 35 percent of the TSP concentration. The National Pollution Inventory[7] has produced a number of PM_{10} emissions factors in its emission estimation manual for mining. This document provides a range of PM_{10}/TSP ratios from 0.25 for activities such as topsoil removal through to wind erosion from stockpiles with a ratio of 0.5.

Based on the review of these documents PDP considers that the proportion of PM_{10} from quarrying activities would be between 25 and 50 percent of the TSP discharged depending on the specific activity and type of material generating the dust.

Based on the TSP data presented in Section 2.3 (measured 24-hour average concentration of 21.4 µg/m^3 and maximum concentration is 90.2 µg/m^3), and the TSP/PM_{10} ratios discussed above, it is estimated that the average 24-hour PM_{10} concentrations would be between 5.4 and 10.7 µg/m^3 and a maximum 24-hour PM_{10} concentration would be between 22.6 and 45.1 µg/m^3 which is below the NESAQ assessment criteria.

[7] Australian Government – Department of Climate Change, Energy, the Environment and Water.

To further support this assessment of potential PM_{10} concentrations, PDP has reviewed the Yaldhurst quarry area monitoring[8] commissioned by ECan between 22 December 2017 and 21 April 2018. 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 compared to the Sutton Block.

A summary of the results from the Yaldhurst study applicable to this assessment is 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 24-hour average PM_{10} concentrations for all of the sites were between 21 and 27 µg/m³.
- There were 17 exceedances of the MfE PM_{10} nuisance dust trigger level (150 µg/m³ as a 1-hour average). However, the majority of these exceedances occurred within 100 m of the quarries.

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 Sutton Block. This data set provides robust information to inform a conservative (worst case) health impact assessment for the Sutton Block. Overall PDP considers that PM_{10} concentrations as a result of the quarry operations will be at a level that will not result in adverse health effects at nearby sensitive locations.

6.4.2 Respirable Crystalline Silica

While there is no ambient monitoring of RCS undertaken at Drury Quarry, SAL has undertaken silica analysis of processed material which indicates a silica content of between 0.5 and 13 percent.

PDP has undertaken some conservative screening calculations to assess whether there is any potential for RCS to result in any form of effect.

PDP has assumed that the annual average TSP is the same as the average TSP concentration of 21.4 µg/m³ and that 13 percent of the TSP is silica. This results in an annual average RCS concentration of 2.8 µg/m³.

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

In New Zealand, the Californian[9] (USA) and Victorian[10] (Australia) annual average RCS health guideline of 3 µg/m³ is commonly adopted, therefore as the calculated value is below the guideline value, it is at an acceptable level.

This calculation is of course very conservative because as already discussed PM_{10} is expected to be between 25 and 50 percent of TSP and the respirable component (PM_4), which is the fraction of concern for RCS would be even less again.

PDP has also reviewed the literature to identify an appropriate short-term health assessment criteria for RCS. This review found a Texas[11] (USA) 24-hour average health assessment criteria of 24 µg/m³. Again, using the TSP data corrected for PM_{10} and assuming the worst-case silica content of 13 percent, the 24-hour average and maximum RCS concentrations are expected to be between 0.7 - 1.4 µg/m³ and 2.9 and 5.9 µg/m³ respectively. Considering that the respirable portion of PM_{10} will be much lower, the predicted RCS concentrations will be below the Texas 24-hour health assessment criteria (24 µg/m³).

Again when comparing the study that was undertaken at Yaldhurst, out of 20 samples collected for RCS only two sample detected RCS (within 50 m of the quarry), and these were well below the recommended guidelines.

Based on the above PDP concludes that the potential for off-site RCS effects will be very low.

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

7.0 Conclusion

PDP's assessment has concluded that there is some potential for unmitigated air discharges from proposed quarrying activities on the Sutton Block to cause off-site effects, primarily at the end of Macwhinney Drive (around receptor R2) due to the height of the proposed works relative to this location and having less dense vegetation bordering the site. However, SAL utilises a number of mitigation measures that, if appropriately implemented, will most likely minimise dust emissions to within 50 to 100 m of the source. Therefore, PDP considers that there is a low likelihood of off-site dust effects at nearby receptor locations for all stages of the proposed Sutton Block quarrying operation. This is based on the following:

- For the majority of the time the receptors are either too far away to be affected by dust from the proposed works or located in areas where dust effects would not reach i.e. works are undertaken at large distances relative to the nearby dwelling or there is dense vegetation screening any dust generating activities.
- Based on the meteorological data for the area, the receptors along Macwhinney Drive would only be downwind of the proposed works between 0.1 and 1.8 percent of the time. As the dust emission rates from works 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 direction of this receptor.
- With the extensive network of dust monitors that SAL proposes around the Sutton Block, if dust emissions were to occur, these would be detected early and the duration of any dust event will be minimal.
- Based on the orientation of the Drury Quarry and the Sutton Block there are no receptors that will be downwind of both locations at a distance that is likely to result in cumulative effects. However, the Kaarearea paa site could be affected by dust from both the Sutton Block and Drury Quarry, but not at the same time. This would result in a higher frequency of dust effects at this location.
- Based on the silica concentration and the monitoring data from the Drury Quarry, PDP does not consider that there is any additional risk for people currently living near the proposed Sutton Block expansion to contract silicosis.