



**State Highway 1 North
Canterbury – Woodend
Bypass Project (Belfast to
Pegasus)**

Construction Air Quality Assessment

Prepared for

Aurecon NZ Ltd and New Zealand Transport
Agency Waka Kotahi

Prepared by

Tonkin & Taylor Ltd

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Works definitions

Acronym/Term	Description
Construction Works	<p>Those works necessary to construct and establish the Project, including:</p> <ul style="list-style-type: none"> • Bulk earthworks (including cut and fill activities). • Ground improvement works. • Establishment of bridges, culverts, drainage, stormwater treatment and disposal systems, noise mitigation features, and other structures. • Temporary construction yards, buildings, and laydown areas. • Temporary haul roads, access points, and traffic management. • Temporary drainage and erosion and sediment control measures. • Landscaping and planting. • Pavements and surfacing. • Road furniture and ancillary works. • Site reinstatement and rehabilitation activities.
Early Works	<p>The Kaiapoi Bridge strengthening and quarry lakes partial reclamation authorised under CRC260612, CRC230304, CRC230305, CRC230306, CRC230307 and RC255072.</p>
Enabling Works	<p>Those works preceding and supporting Construction Works, including:</p> <ul style="list-style-type: none"> • Geotechnical investigations. • Land investigations. • Relocation of existing utilities and services. • Temporary haul roads and access. • Establishing mitigation, offset, or compensation measures (such as erosion and sediment control, noise mitigation).

Acronyms, abbreviations and definitions

Abbreviation/Definition	Meaning
AQA	Construction Air Quality Assessment.
CAQMP	Construction air quality management plan.
CARP	Canterbury Air Regional Plan (October 2017 version).
CMS	Construction Methodology Statement.
Designation	As the context requires: <ul style="list-style-type: none"> Existing: The designation for the Project and State Highway 1 in an operative version of the Waimakariri District Plan. Proposed: The existing designation inclusive of the alterations sought by the NZTA shown in Volume 2C (conditions) and Volume 4D (boundaries) of the SAR.
DRI	Dust Risk Index.
EWS	Electronic weather station.
FIDOL	Frequency, Intensity, Duration, Offensiveness, and Location.
FTAA	Fast-Track Approvals Act 2024.
km	Kilometre.
IAQM	Institute of Air Quality Management.
m	Metre.
NO ₂	Nitrogen dioxide.
NZTA	New Zealand Transport Agency Waka Kotahi.
PM ₁₀	Particulate matter less than ten microns in diameter.
PM _{2.5}	Particulate matter less than 2.5 microns in diameter.
Project	State Highway 1 North Canterbury - Woodend Bypass Project (Belfast to Pegasus) (the construction, operation, and maintenance thereof).
Project Site (or Site)	The land contained within the area delineated as "Project Site" in Volume 4C of the SAR.
PWDP	Proposed Waimakariri District Plan.
RCS	Respirable Crystalline Silica
SAR	Substantive Application Report.
Sensitive receptor	For consistency with the 'sensitive activity' definition in the CARP a 'sensitive receptor' refers to an activity undertaken in: <ol style="list-style-type: none"> the area within 20 m of the façade of an occupied dwelling; or a residential area or zone as defined in a district plan; or a public amenity area, including those parts of any building and associated outdoor areas normally available for use by the general public, excluding any areas used for services or access areas; or a place, outside of the Coastal Marine Area, of public assembly for recreation, education, worship, culture, or deliberation purposes.
SH1	State Highway 1.

Executive summary

This Construction Air Quality Assessment (**AQA**) provides technical support to the Substantive Application Report (**SAR**) for the State Highway 1 North Canterbury – Woodend Bypass Project (Belfast to Pegasus) (**the Project**). The AQA and SAR have been prepared for submission with applications by New Zealand Transport Agency Waka Kotahi (**NZTA**) for the Project under the Fast-track Approvals Act 2024.

The Project involves the construction, operation, and maintenance of an approximately 11 km four-lane, grade-separated motorway bypassing Woodend township, designed for improving transport efficiency, safety, and public health outcomes.

Under the Canterbury Air Regional Plan (**CARP**), discharges to air from **land development and unsealed surfaces** associated with the Construction Works phase of the Project (including any Enabling Works)¹ are permitted subject to conditions. Requirements of the permitted activity conditions include avoidance of offensive or objectionable effects beyond the Project Site.

Conversely, discharges to air from **outdoor storage of bulk solids material** during the Construction Works are not permitted under the CARP. Resource consent is sought by NZTA for these discharges.

The purpose of this AQA is therefore to assess the actual and potential of air quality effects of discharges to air from the Construction Works for the following purposes:

- Informing the consent application for discharges from **outdoor storage of bulk solids material**.
- Assessing the potential for offensive or objectionable air quality effects of the discharges from **land development and unsealed surfaces** to determine compliance with relevant permitted activity conditions.

Proposed modifications to the road alignment that was designated in 2015 are considered unlikely to result in any material changes to the effects on air quality during the operational phase of the Project. Operational air quality effects have therefore not been assessed in this AQA.

The primary contaminant likely to be discharged to air from the construction activities is coarse particulate matter (dust). A relatively small component of fine particulate matter (PM₁₀ and PM_{2.5}) may also be emitted from these activities.

Other potential discharges, such as respirable crystalline silica (**RCS**), odour and combustion emissions, are likely to be small in scale and are associated air quality effects are considered to be negligible.

The risk of adverse dust effects has been evaluated in accordance with the guidance on assessment and management of dust effects associated with construction activities published by NZTA, the Ministry for the Environment (**MfE**) and Institute of Air Quality Management (**IAQM**).

The assessed risk of dust impacts varies across the Project, depending on the nature of both the activities being undertaken and adjacent receptor activities. The highest assessed dust risks are associated with construction activities occurring in and around the urban residential areas of Kaiapoi and Woodend. A range of dust mitigation and monitoring measures are recommended to be implemented, with enhanced mitigation and monitoring measures recommended near the urban residential areas to respond to the identified elevated dust risk.

¹ Resource consent for the corresponding discharges to air from the preceding Early Works phase of the Project is being sought separately by NZTA.

The recommended measures will form part of a Construction Air Quality Management Plan (**CAQMP**), which is to be developed in accordance with the proposed resource consent conditions following contractor appointment, prior to the commencement of construction.

With implementation of the CAQMP, the assessment concludes that the discharges to air from the Project construction activities will be effectively mitigated, and offensive or objectionable effects beyond the Site are unlikely.

1 Introduction

1.1 Purpose and overview of the Project

The New Zealand Transport Agency Waka Kotahi (**NZTA**) proposes to construct, operate, and maintain the *State Highway 1 North Canterbury – Woodend Bypass Project (Belfast to Pegasus)* (the **Project**).

The Project will extend the State Highway 1 (**SH1**) Christchurch Northern Corridor between Belfast and Pegasus and spans a linear length of approximately 11 kilometres (**km**), commencing from approximately 600 metres (**m**) south of the Kaiapoi River Bridge and ending approximately 700 m north of the Pegasus/Ravenwood intersection. The Project includes upgrades to approximately 4 km of the existing SH1 and a new approximately 7 km bypass of Woodend township.

Key features of the Project are shown in Figure 1.1.

The purpose of the Project is to provide an efficient and reliable state highway connection between Belfast and Pegasus, while delivering improved access, community safety and public health outcomes, and reduced severance through Woodend.

1.2 Previous authorisations and assessments

The Project alignment was designated in the Operative Waimakariri District Plan in 2015. While the design and alignment of the Project remains largely as designated in 2015, alterations to the designation are being sought by NZTA to facilitate the introduction of a new Pegasus interchange (to replace the roundabout in the scheme design) and to allow for construction laydown and infilling of a remnant lake in the Quarry Lakes area of the Project.

Neither of these modifications are anticipated to result in the alignment being located closer to sensitive activities than was assessed in relation to air quality impacts (MWH, 2013) under the 2015 designation. The Transportation Assessment (**Volume 3C** of the **Substantive Application Report (SAR)**) indicates that the Pegasus Interchange alteration will reduce traffic congestion in (and is therefore likely to reduce air contaminant emissions). As a result, material changes to the effects on air quality from the operational phase of the Project compared to those of the designated alignment are not anticipated. Consequently, changes to the operational air quality effects have not been considered further in this report.

Early Works packages have been identified that are able to commence in 2025/2026, in advance of the Construction Works phase (including any Enabling Works). Air quality effects from the Early Works packages have been previously assessed in the Early Works – Assessment of Environmental Effects (NZTA, 2025b), which is consented separately and are not considered further in this assessment.

1.3 Regulatory context

The Canterbury Air Regional Plan (**CARP**) was made operative in 2017 and includes a number of rules relating to discharges to air which are applicable to the Project.

Discharges to air from stockpiling of bulk solid materials, such as aggregate and spoil material, for the Project are unable to meet all permitted activity criteria for **outdoor storage of bulk solids material**, under Rule 7.36 of the CARP as the stockpiling will occur within 100 m of a sensitivity activity and within Silent File areas. Consequently, resource consent is required for the discharges to air from stockpiling activities associated with the Construction Works.

Discharges to air from **land development and unsealed surfaces** associated with the Enabling Works (temporary haul roads) and Construction Works are a permitted activity under Rule 7.32 of the CARP, subject to the conditions of this rule, including Condition 3:

“The discharge does not cause an offensive or objectionable effect beyond the boundary of the property of origin, when assessed in accordance with Schedule 2.”

1.4 Purpose and scope of this technical report

This document describes a technical Construction Air Quality Assessment (**AQA**) of the effects on air quality of discharges to air associated with construction activities during the Enabling Works and Construction Works phases of the Project.

This report provides technical support to the **SAR** for applications made by NZTA under the Fast-track Approvals Act 2024 (**FTAA**).

Specifically, the purpose of the report is as follows:

- To assess the actual and potential of air quality effects of the discharges to air from **outdoor storage of bulk solids material** to inform an application for resource consent as described in Section 1.3.
- To assess the potential for offensive or objectionable air quality effects (in accordance with Schedule 2 of the CARP) from the **land development and unsealed surfaces** of the Project to determine compliance with condition 3 of Rule 7.32 (described in described in Section 1.3).

1.5 Content of this technical report

This report includes the following:

- A description of the activities as they relate to the generation of discharges to air.
- A description of the nature of discharges to air from the activities.
- A description of local topographical and meteorological influences on dispersion of discharges to air.
- A description of the sensitivity of activities located in adjacent areas.
- The methodology, results, and findings of the assessment of the actual and potential effects on air quality of the discharges to air, including a description of mitigation measures and monitoring.
- Conclusions in relation to the effects of discharges from the Project.

While this is not a matter before the Environment Court, the authors of this report have each read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 ('Code'). The authors have each complied with the Code in the preparation of this report.

The data, information, facts and assumptions the authors have each considered as part of this report are set out in this report. The reasons for the conclusions of the report are also set out in this report. Unless stated otherwise, this report is within each of the authors' expertise and the authors have not omitted to consider material facts known to them that might alter or detract from the opinions expressed.



Figure 1.1: Project alignment and key features of main work activities.

2 Description of project

2.1 Overview

Overall, the Project is an approximately 11 km four-lane motorway extension of the Christchurch Northern Motorway, finishing just north of Pegasus.

Activities associated with the Project are detailed in the **Construction Methodology Statement (CMS) (SAR, Volume 3A)** and the **30 % Design Statement (SAR, Volume 3B)**. In summary, the works involve:

- 1 **Existing SH1 Upgrades** – Upgrade SH1 from approximately 600 m south of Kaiapoi River Bridge to the Cam River (a total distance of approximately 4 km), including:
 - a **Additional southbound lane** –Between approximately 600 m south of the Kaiapoi River Bridge to the bridge itself. Note: The southbound lane extends beyond the Project Site to approximately 200 m south of the Ohoka Road Overpass, but these works are beyond the scope of the Project.
 - b **Kaiapoi River Bridge upgrades** – Seismic strengthening and widening to provide additional southbound lane. Note: Some strengthening works forms part of the Early Works consenting package.
 - c **Four-lane upgrades** – Upgrade the SH1 carriageway from two lanes to four lanes from Lineside Road Overpass to the Cam River.
- 2 **Woodend Bypass** – A new four-lane motorway, bypassing Woodend township, from the Cam River to approximately 700 m north of the Pegasus/Ravenwood intersection (a total distance of approximately 7 km), including:
 - a **Cam River Bridge upgrades** – A new bridge to the east of the current bridge (SH1 and southbound on ramp). Note: these works integrate with the Williams Street interchange.
 - b **Williams Street interchange** - A new interchange and SH1 overbridge at the existing intersection of Williams Street and SH1.
 - c **Quarry lakes embankment and southern remnant lake infilling** – A new tiered embankment through two artificial lakes (formed through quarrying), including dynamic compaction. Note: The initial (partial) reclamation is part of the Early Works consenting package. The southern remnant lake created by the causeway will be partially filled and a wetland constructed in this area.
 - d **Woodend Beach Road overbridge**– A new local road bridge over SH1, including a realignment of and upgrades to Woodend Beach Road.
 - e **Gladstone Road overbridge** – A new local road bridge over SH1, including upgrades to Gladstone Road.
 - f **Pegasus interchange** – Remove existing roundabout at the intersection of SH1 / Pegasus Boulevard / Bob Robertson Drive and replace with a new grade-separated diamond interchange overpass, including traffic signals and local road upgrades including connection of Garlick Street to SH1.

- 3 **Project wide** – Features and activities applying at various locations along the entire length of the Project (a total distance of approximately 11 km):
- a **Stormwater infrastructure** – swales, drains, culverts, and stormwater detention and treatment facilities.
 - b **Watercourse and drainage works** – including the permanent realignment and culverting of portions of Waihora Stream, Taranaki Stream and McIntosh Drain.
 - c **Landscaping and planting** – landscape features and planting.
 - d **Ecological offsetting and compensation** – planting and wetland creation.
 - e **Noise mitigation** – earth bunds and acoustic fences.
 - f **Utilities and services** – relocation of existing utilities and installation of new utilities.
 - g **Road features and furniture** – including but not limited to emergency bays, signage, and barriers.

The construction phase of the Project will include the following activities with the potential to generate emissions to air:

- Clearing of existing vegetation.
- Exposing of bare earth.
- Excavation and earthmoving (earthworks).
- Handling and stockpiling of excavated and imported material.
- Vehicle movement within the Site on unsealed haul roads/tracks.
- Removal of a limited number of buildings.
- Loading and unloading of materials.
- Transportation of material.
- Respreading of silt and topsoil.
- Dynamic compaction (see Section 2.5).

Earthworks, stockpiling, and movement of vehicles along the unpaved haul roads are considered to be the greatest potential for dust generation. These activities are detailed further in the **CMS (SAR, Volume 3A)** and reproduced in the following sections.

The extent of construction works will not be confirmed until completion of detailed design and a contractor is appointed. This assessment has conservatively assumed that earthworks can occur anywhere within the Project Site (as per the drawing in the **SAR, Volume 4C**).

2.2 Earthworks

Earthworks will comprise stripping of existing soil and filling with imported hardfill to achieve the proposed design alignment and embankment profile. Fill slopes are primarily to form up new traffic lanes within the designation.

Approximate earthwork volumes have been calculated by zone, as illustrated in Figure 2.1 and Table 2.1. However, the overall fill volume may be in the order of 700,000 m³, as part of refining the geometrics through to 50 % design and taking into account earthbunds for the noise walls (refer to Section 4.4 of the **CMS (SAR, Volume 3A)**).

The general earthworks strategy will be developed in more detail once the contractor is appointed. However, the general earthwork strategy currently assumed for the works is to import fill (from local quarries/river sources where possible) for all fill embankments.

There are limited opportunities to cut to fill on site due to very low cut volumes and the requirement for these site won materials to be both suitable for structural fills. Site won fill is likely to be reused onsite for landscaping and noise bunds.

Embankments will generally incorporate geogrids placed within the slopes as constructed as required to ensure slope or wall stability.



Figure 2.1: B2P Alignment by Constructability Zones [Source: refer SAR, Volume 3A].

Table 2.1: Preliminary earthwork volumes by Constructability Zones [Source: refer SAR, Volume 3A]

Zone		By Zone		Are	Subtotals		Total	
		Cut (m³)	Fill (m³)		Cut (m³)	Fill (m³)	Cut (m³)	Fill (m³)
Zone A	South of Kaiapoi	10,000	6,000	Widening	65,000	160,000	135,000	680,000
Zone B	Kaiapoi to Cam	52,000	13,000					
Zone C	Cam to Williams	3,000	137,000					
Zone D	Quarry Lakes	15,000	147,000	Bypass	70,000	520,000		
Zone E	Lakes to Woodend Beach Rd	7,000	87,000					
Zone F	Woodend Beach Rd to Gladstone	5,000	35,000					
Zone G	Gladstone to Pegasus	13,000	58,000					
Zone H	Pegasus Interchange	26,000	68,000					
Zone I	Woodend Beach Bridge	2,000	75,000					
Zone J	Gladstone Road Bridge	2,000	47,000					

2.3 Stockpile sites

It is expected that some cut material may be suitable for the construction of the bulk fill, non-structural landscaping fill and topsoiling the finished works. It is likely that some of this material will need to be temporarily stockpiled to suit the logical construction sequencing and provide a material buffer in case of supply disruption. Stockpiling of imported fill is also likely to be required.

In addition, a stockpile of aggregate materials for embankment and pavement construction may be established adjacent to the main worksites in laydown areas. This will allow continuity of working in the event of disruption to material supply from offsite.

The number and locations of the potential stockpile areas will be determined in the final design and construction methodology of the contractor.

2.4 Haul Roads

The transport of imported and site sourced material will generally be on haul routes within the designation of the Project. For most of the bulk fill and pavement materials this will be within the footprint of the permanent works with haul roads formed using imported gravels or rockfill.

Use of local roads adjacent to the site will generally be limited to light vehicles with the exception of the northern section of Williams Street to access the quarry lake area and south to Cam River. While the occasional heavy vehicle may use the adjacent local roads along the alignment the vast majority of heavy vehicles will access along the proposed alignment from Williams St (near the Lees Road intersection) or SH1 at Pegasus. For the online section of works access will be directly from SH1.

2.5 Infilling of remnant lake

North of Williams Street the alignment is proposed to cross an existing quarry lake, requiring construction of a causeway, as illustrated in Figure 2.2.

Creation of the causeway by partial reclamation of the quarry lake (using pitrun as fill) is proposed to be carried out during the Early Works phase (for which authorisation is sought under separate consents and is beyond the scope of this application – see NZTA, 2025b). However, further filling and dynamic compaction of the causeway is proposed to occur as of the Construction Works.

In addition, a remnant waterbody (circa.2.5 ha) will be created through the further reclamation of the quarry lakes. This area will be backfilled and a wetland constructed as part of the Construction Works.

Backfilling and wetland creation in this area will broadly comprise:

- Site establishment - will use facilities developed in the Early Works and as set out in the CMS.
- Filling the remnant lake up to about 0.5 m- 1.0 m below water level (note water levels vary). Approximately one third of the area will remain as shallow open water, the remaining area will be formed as wetland.
- A total fill volume is approximated at 50,000 m³ (assuming filling to current water level – approximately 1 m below typical lake water levels).
- The bulk fill material shall comprise pitrun. The pit run shall contain stone between 10 to 400 mm particle size, will be free of organic matter, and the fraction passing the 75-micron sieve shall be substantially non-plastic.
- The upper 200 to 300 mm of the land area shall be formed using topsoil either site-won or imported. The approximately volume of topsoil required is 10,000 m³.

- The lakes will be filled from starting from the causeway embankment within the existing designation. The filling will occur through the progressive end tipping from the embankment using the haul road along the lake embankments for material importation.
- Later stages of filling and access for wetland planting may occur from the existing southern lake margin, via access from the Lees Road Construction Support Area. No excavation or earthworks will be required to create haul roads in this area beyond vegetation clearance and placement of gravel.
- Earthworks around the lake margin to tie in the infilling will not extend further than 20 m from the upper lake shore, in part so that works within 100 m of the Barkers Road wetland are avoided. This offset from the lake edge is to provide access around the lake during construction and establishment of the offset wetland area.
- Trucks will deliver material directly to the remnant lake edge where heavy machinery will distribute the material into position. If the material is unable to be immediately manoeuvred to the lake, it will be temporarily stockpiled to the north of the quarry lakes, as shown in Figure 2.3
- Daily fill placement volumes are expected to range between 1,000 and 2,000 m³.

The timing of the works in this area will depend on the contractors programming but is expected to occur following the completion of the early works to form the causeway crossing the lakes. Approximately 25 to 50 working days of filling will be required based on the estimated fill rates.

Once filled to required levels, wetland construction works will comprise planting out of the area, fencing to protect planting and for predator control.

The infilling of the remnant lake and construction of the wetland is unlikely to give rise to significant dust emissions as the fill material (pitrun) is mostly comprised of large particles (10 to 400 mm particle size) and it is not proposed to fill above the existing water level.



Figure 2.2: Plan of Quarry Lake Crossing and proposed wetland shown by green polygon [Source: refer SAR, Volume 3A].

2.6 Construction support areas

Construction support areas (CSAs) will be required for the provision of contractor and welfare facilities, plant/material storage, and earthworks stockpiling as required. All CSAs will be wholly located within the existing Designation, with the exception of the primary CSA at Lees Road, (a designation alteration for temporary occupation at this location forms part of the Project). The location of all CSAs is shown in the CMS (SAR, Volume 3A), with the CSAs at Lees Road (outside the existing Designation) shown in Figure 2.3 below.

This assessment has conservatively assumed that stockpiling of earthworks could occur within any part of the Project Site. Provision of contractor welfare facilities and plant storage is not considered to be a significant source of dust so is not considered further in this assessment.



Figure 2.3: Construction Site Requirements at Williams Street [Source: CMS Statement (SAR, Volume 3, A)].

2.7 Duration of project

The Project works will be undertaken over an approximate 3 – 4 year programme. The target programme is as follows:

- Early Works commencing end of 2025 (subject to separate applications). These have been identified to enable the Project to proceed in a timely and efficient manner.
- Contract award mid-2026 to enable Construction Works to commence on site by October 2026.
- Target opening date end of 2030/31.

In order to achieve the target completion date, many elements of the Project will likely need to be undertaken concurrently during the construction period, including the completion of works in sections. All dates are indicative and subject to detailed design, funding approvals, land acquisition, contractor appointment, and other influences such as weather.

2.8 Hours of work

The majority of discharges to air associated with the proposed Construction Works will occur within operating hours, this is discussed further in Section 3.4. Table 2.2 sets out the likely hours of operation for construction activities. Night works will generally be limited to key activities that cannot be undertaken during the day (due to safety and operational impact on traffic along SH1). No construction works will occur on Sundays or public holidays.

Extended working times between 5 am and 10 pm may be needed to achieve the construction programme dates, critical path items, or in respect of some works where night work is unavoidable, e.g. works that interface with the current state highway network, or bridge works above live traffic or rail.

Table 2.2: Likely hours of work

Activity	Likely hours of work
<ul style="list-style-type: none"> Dust suppression. 	Anytime
<ul style="list-style-type: none"> General traffic switching along SH1. Bridge beam and truss installation at key structures, as well as installation of the overhead VMS gantry and signal poles where adjacent to live traffic. Utility service connections and switches. Final surfacing and lane marking works along the existing SH1. 	Night works
<ul style="list-style-type: none"> All other works. 	07:00 to 19:00, Monday to Saturday

3 Discharges to air

3.1 Overview of contaminants discharged

Coarse particulate matter (dust) is the main discharge to air associated with the activities described in Section 2. The dust emissions will be predominantly comprised of coarse particulate matter – particles greater than 10 µm but less than 100 µm². These activities may also give rise to minor discharges of fine particulate matter, which comprises particulate matter smaller than 10 microns in diameter (PM₁₀) and smaller than 2.5 microns (PM_{2.5}). The nature of dust and fine particulate discharges is discussed further in the following sections.

Crystalline silica maybe present in aggregate material used in construction or in material removed through demolition. The respirable fraction of crystalline silica (RCS) dust emitted from demolition and aggregate related activities may cause respiratory health effects with sufficient exposure. However, in relation to the Project, demolition activities involving concrete and other materials containing crystalline silica are relatively small in scale and no on-site crushing and screening of aggregate material. As a result, RCS emissions from the Project are likely to be relatively small in scale and are unlikely to result in appreciable exposure to RCS beyond the Project Site. RCS discharges are not considered further in this report.

The operation of vehicles and machinery during construction will give rise to combustion emissions. The relative proportion of combustion emissions from the Project is considered negligible in comparison to urban areas with high traffic and congestion. Accordingly, the potential adverse effects of vehicle combustion emissions during construction are expected to be negligible, and no further consideration is given in this report to combustion emissions.

Odour could potentially be emitted during the construction phase if odorous contaminated soil is disturbed. A preliminary site investigation (PSI) has been undertaken for the Project, which identifies a range of HAIL activities surrounding the Project (Jacobs, 2025). A **Ground Contamination Investigation (SAR, Volume 3F)** undertaken for the Project evaluates these HAIL activities and concludes that they are unlikely to give rise to the discharge of odour when the material is disturbed. Furthermore, the investigation, while focused on a selected locations within the Project Site; did not encounter odorous materials. Investigations at Gladstone Landfill (2013 and 2024), which are described in the Ground Contamination Investigation, did not report on the presence of putrescible materials so odour discharges are expected to be minimal. Given the above, odour discharges are not considered further in this report.

3.2 Dust

Coarse dust particles are generally too large to be inhaled into the lower respiratory tract, although they may cause irritation to the eyes and throat. Dust discharges are instead primarily associated with nuisance effects and impact amenity by soiling surfaces or property or by impairing visibility. Nuisance effects can depend on the colour, texture and chemical composition of the dust. It is expected that the materials disturbed and handled (largely soil or aggregate material) will be relatively inert and have a relatively ‘natural’ colour.

The distance at which deposition of this dust can occur will depend on the scale of the emissions and meteorological conditions. However, the vast majority of dust usually settles from the air within a short distance (approximately 100-200 m) (Liu, et al., 2024) from the source.

² Particles greater than 100 µm (0.1 mm) in diameter are too large to be suspended by wind (Queensland Government, 2011, PASSEL 2024).

Consequently, the greatest potential for high rates of dust nuisance effects is within 100 m of the Construction Works and deposition beyond a distance of 200 m is minimal in most circumstances³. However, intermediate-sized particles (10 µm to 30 µm) may travel up to 400 m (IAQM, 2016).

3.3 Fine particulates

PM₁₀ and PM_{2.5} are able to penetrate the lower respiratory tract and exposure to particles of this size can cause adverse respiratory and cardiovascular health effects. The comparative size of PM₁₀ and PM_{2.5} particles to a grain of sand is illustrated in Figure 3.1. However, the dust generating activities described in Section 3.4 (Table 3.1) are likely to generate emissions that are substantially comprised of coarse dust particles with a relatively small component of PM₁₀ and PM_{2.5}. Given this, our assessment has focused on the effects of coarse dust.

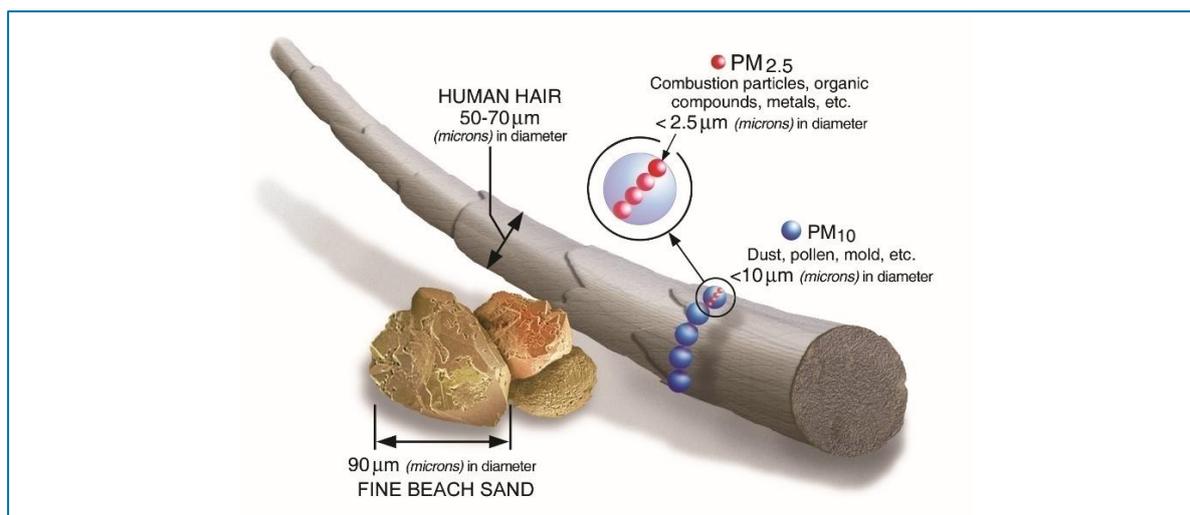


Figure 3.1: Size comparison of particles (source: USEPA).

3.4 Dust generating activities and factors influencing dust generation

Various construction activities associated with the Project, generally involving mechanical disturbance or handling of soil, aggregate or bulk solid materials, have a potential to generate dust emissions. These activities and factors influencing dust generation from them is described in Table 3.1.

³ The Institute of Air Quality Management (IAQM, 2024) 'Guidance on the assessment of dust from demolition and construction' (herein referred to as the IAQM Construction guidance) assessment methodology discussed in Sections 5.3 and 6.3 utilises a range of assessment distances, including out to 250 m of the of the dust source. However, sensitivity of an area to dust soiling effects based on the number of receptors located between 100 m and 250 m is always classified low due to the low potential for dust deposition exposure at this type of distance.

Table 3.1: Description of dust generating activities during construction

Activity	Description
Excavation and earthmoving	<p>The scale of dust emissions from excavation will be influenced by a range of factors, including:</p> <ul style="list-style-type: none"> • Rate of material excavated and extent of exposed excavation area. • Particle size of the excavated material. Coarse material with low fine particle content is unlikely to give rise to dust emissions whereas soil or aggregate material with a high fines content will pose a greater risk of dust emissions. It is expected that most material excavated will be soil. • Moisture content of the excavated material. Moisture content (e.g. as a result of ground water, rainfall or application of dust suppression water) will suppress dust generation through agglomeration of dust particles. • Wind conditions during excavation – higher wind speeds will result in increased transport and propagation of disturbed dust. Wind speeds will generally be reduced by depth of excavation below ground.
Handling and stockpiling of soil and aggregate materials	<p>Once excavated, material is likely to be stockpiled on-site prior to reuse or removal from site. Disturbance of dust from stockpiling (and associated handling) of material may occur mechanically or through wind erosion. The scale of dust emissions from handling and stockpiling will be influenced by a range of factors, including:</p> <ul style="list-style-type: none"> • Degree of disturbance – dust emissions will generally increase with increased mechanical disturbance (e.g., rehandling of material). • Moisture content agglomerates dust particles to reduce potential lifting and discharge. Moisture content of the stockpiled material, which will be influenced by moisture content at placement, rainfall and application of water for dust suppression. • Wind exposure of stockpiled material – dust generation through wind erosion of exposed surfaces can start to occur when hourly average wind speeds exceed 5 m/s and significantly increase above 10 m/s ⁴. Stockpile emissions can be reduced by through enclosure or covering of piles and reducing stockpile and drop heights.
Vehicle movements over unsealed ground	<p>Vehicle movements over unsealed surfaces are often one of the larger potential dust sources associated with linear infrastructure construction works. Dust emissions from this activity will be influenced by:</p> <ul style="list-style-type: none"> • Frequency of movements over unsealed surfaces. • Extent of unsealed surfaces featuring traffic movements. • Speed of vehicles – in general, dust generation increases with increased vehicle speed. • Size of vehicles – dust generation will increase with size of vehicles traversing exposed surfaces. • Particle size of surface material – fine material has a higher potential for dust disturbance. Vehicle movements may result in pulverisation and size reduction of surface material. • Surface moisture content. • Wind conditions will influence the transport and propagation of disturbed materials.

⁴ Air and Waste Management Association. 2000. "Air Pollution Engineering Manual". 2nd Edition.

Activity	Description
Vehicle movements over sealed roads and surfaces	Sealing will prevent disturbance of underlying material and dust generation from sealed surfaces will only be expected if material is deposited on the sealed surface through spills, deposition of dust or tracking on vehicle wheels. Deposited material may then be re-entrained in air through mechanical disturbance (e.g., vehicle movements) or wind erosion but will be reduced by moisture content of the deposited material (which may in turn be increased through rainfall or water application).
Building and structure demolition and removal;	Demolition of buildings and structures and removal/handling of demolition material can generate dust emissions. The scale and nature of demolition dust emissions will be dependent on the scale of the buildings or structures demolished, the nature of construction materials and demolition and handling methods.

4 Existing environment

4.1 Land use and sensitivity to air pollutants

The sensitivity of neighbouring activities to air pollutants, such as dust, varies depending on a range of factors including expectations for amenity, duration of human occupation, and presence of particularly sensitive sectors of the community. The nature of activities present is broadly represented by zoning and the type of land use provided for. Figure 4.1 shows the zoning of the Project and surrounds under the Operative Waimakariri District Plan.

Descriptions of the zones are provided in the **SAR (Volume 2A)** and their general sensitivity to dust (based on MfE GPG Dust guidance) are presented in Table 4.1.

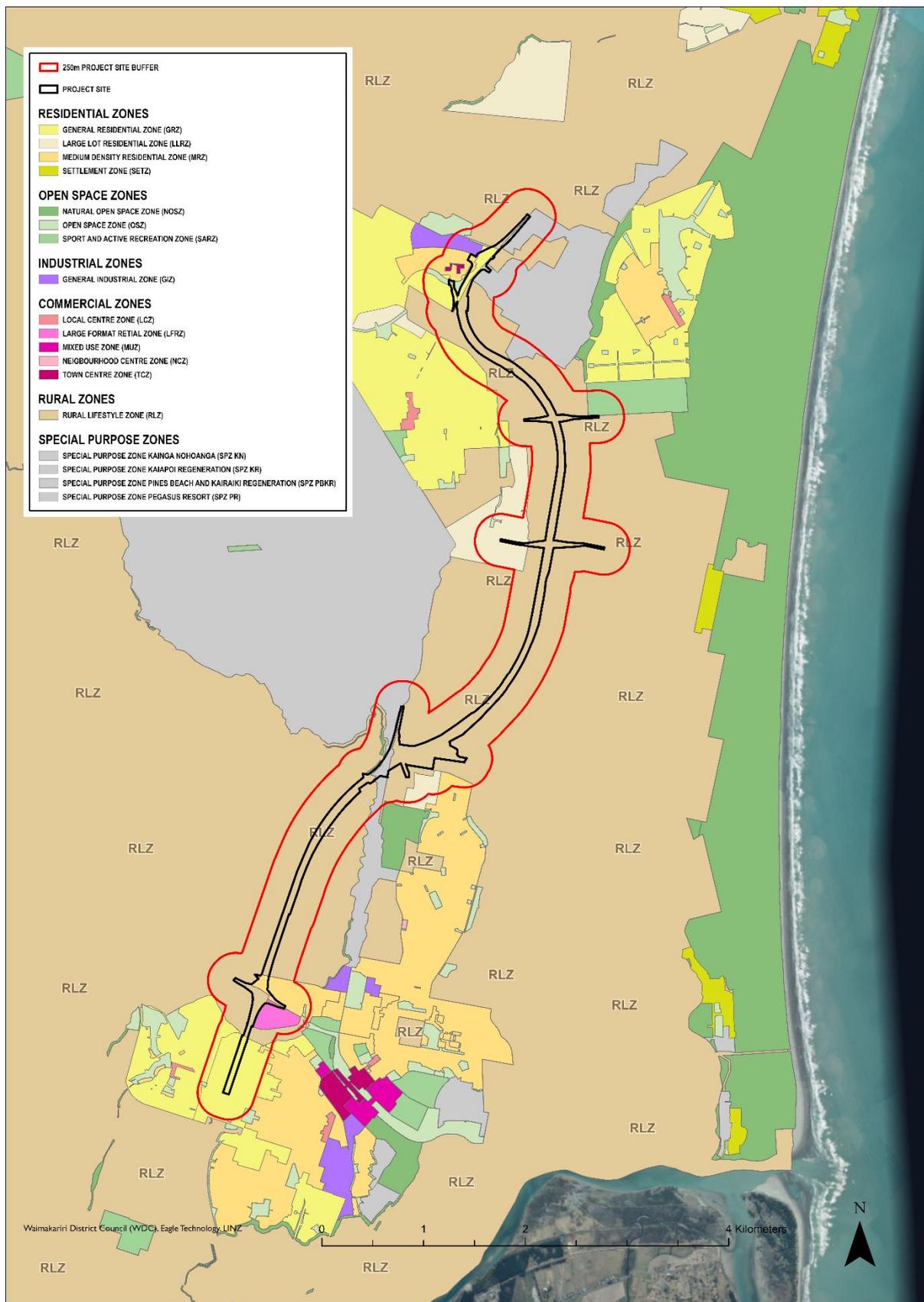


Figure 4.1: Project Site with 250 m buffer overlain on map of the Proposed Waimakariri District Plan (PWDP).

Table 4.1: Description of adjacent land use zones to the Project Site and an assessment of sensitivity to dust

Operative Plan Zone	Proposed Plan Zone	Description	Sensitivity to air pollutants
Residential (urban)	Residential, Medium Density Residential Zone, Large Lot Residential Zone	This zone features low to medium density residential development, including dwellings and outdoor space.	High: Expectation of amenity (and sensitivity to dust deposition) at these locations will generally be high. Given potential for continuous occupation and presence of sectors of the community susceptible to respiratory ailments (e.g., infants and the elderly) at residential properties.
	Special Purpose Zone - Kāinga Nohoanga	Provides for activities within all of Māori Reserve 873.	
Business	Town Centre Zone	Provides for the district's principal employment and commercially focussed areas.	Moderate to high: Commercial properties are likely to be occupied primarily during office/retail hours. Expectations of amenity are likely to be moderate in general though may be increased at outdoor amenity spaces (e.g., outdoor food service areas) or where there are mixed use/upper floor dwellings.
	Local Centre Zone	Provides for activities to support local communities and small settlements.	
	Whaitua Ahumahi - Industrial Zones	Provides for light industrial activities.	Low to moderate: Sensitivity will be similar to other business zones except at existing light industrial properties where sensitivity in general is likely to be low.
	General industrial zone	Provides for general industrial activities.	
Rural	Natural Open Space Zone, Open Space Zone, Sport and Active Recreation Zone	These areas will be intermittently occupied throughout the day, primarily intended for recreation activity.	Moderate to high: Although the expectation of amenity will be high in open recreation spaces, there will be a limited duration of exposure.
	Rural	Provide for primary productivity activities, activities that support rural activities and those that rely on the natural resources that exist in the zone.	Moderate to high for rural dwellings and low for other rural land: People living in and visiting rural areas generally have a high tolerance for dust that may be discharged from rural activities. However, people are likely to have moderate to high amenity expectations at rural when occupying rural dwellings.

4.2 Sensitive receptors

As discussed in Section 4.1, the zoning surrounding the Project is mixed. Table 4.2 lists the number of receptors that have been identified through a desktop geospatial analysis to be located within 250 m of the Project Site that are likely to have a moderate to high sensitivity to dust discharges from the construction of the Project. As discussed in Section 3, beyond 250 m potential adverse dust effects are expected to be negligible. Dust effects at receptors located within 250 m of the Project Site is assessed in Section 6.

The significant majority of the receptors are located within the urban areas of Kaiapoi and Woodend adjoining the Project Site.

Table 4.2: Number of receptors identified that are likely to have a moderate to high sensitivity to construction dust impacts located within 250 m of the Project Site)

Receptor type	Number of receptors identified within 250 m of the Project Site	Likely sensitivity/amenity expectations
Residential	717	High (urban) and moderate to high (rural)
Recreation	9	Moderate to high (while in occupation)
Education	1	High (while in occupation)
Community	1	High (while in occupation)
Commercial	23	Low to High (case by case)

4.3 Topography

The local topography and meteorology determine how dust is dispersed and transported. This is particularly relevant when assessing potential effects on sensitive activities.

The meteorology of the Canterbury Region is dominated by the effects of the Southern Alps on the prevailing westerly wind flow over South Island. The Southern Alps are responsible for the north-westerly föhn wind that occurs periodically over much of the Canterbury Plains. The Southern Alps are also responsible for the prevailing 'lee-trough' northeasterly wind that is experienced in Christchurch and other coastal areas. Canterbury also experiences cold southwest and southerly winds associated with the passage of cold fronts up the South Island.

The Project is located on the Canterbury Plains, north of Christchurch and situated approximately 4 km from the Pacific Ocean at Pegasus Bay. The proximity and orientation of the coastal marine area and associated land-sea breeze interactions are likely to contribute to the strong predominance of east-west winds illustrated in Section 4.4.1.

The topography in all directions is generally flat (see Figure 4.2) and unlikely to cause any significant spatial variability in wind conditions in the area.

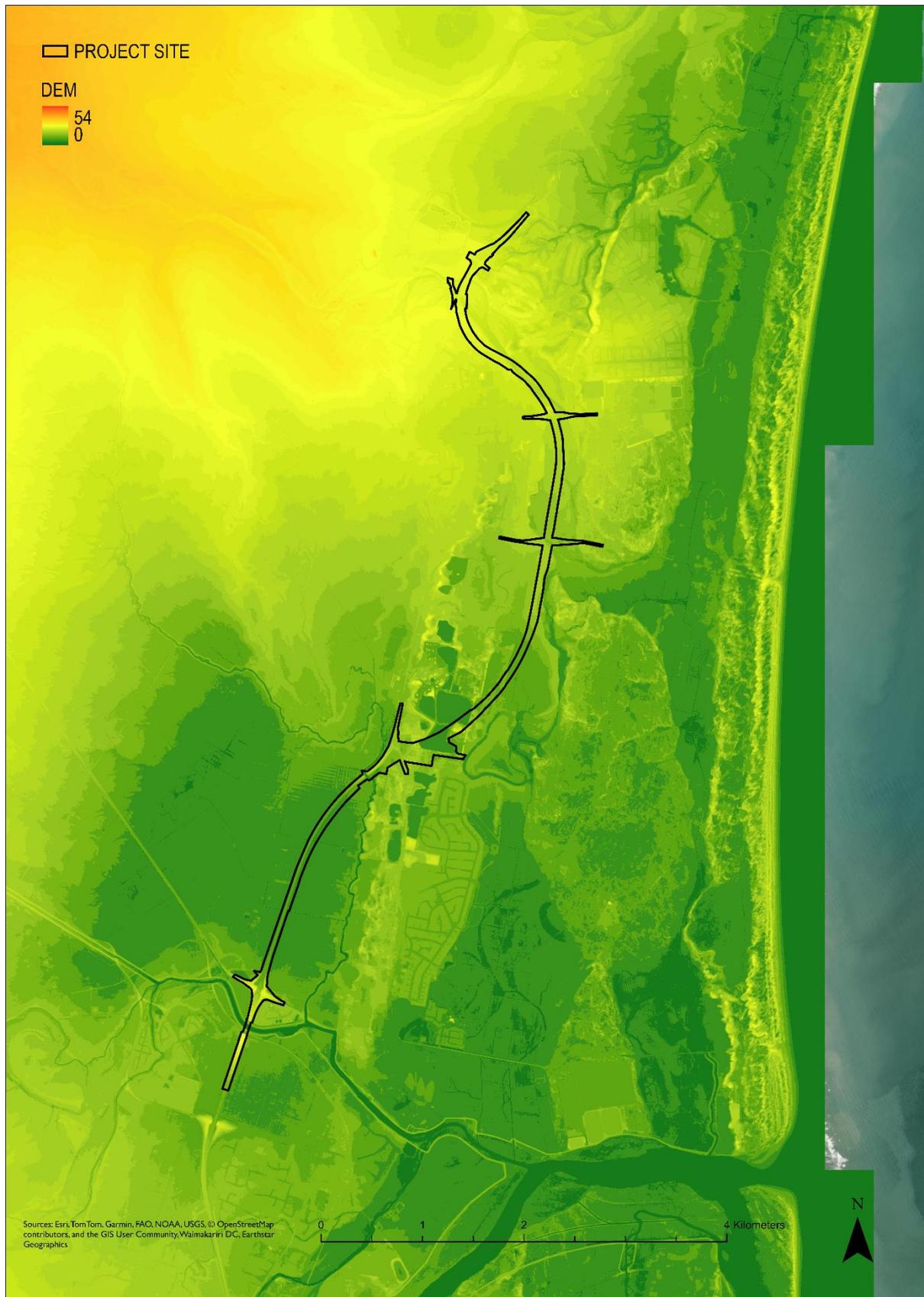


Figure 4.2: Topography surrounding the Project Site.

4.4 Meteorology

4.4.1 Local meteorology

The nearest meteorological monitoring location (with readily available data) to the Project is that operated by the Canterbury Regional Council at Peraki Street, Kaiapoi (Kaiapoi weather station). Following a review of this site it was noted that the wind measurements at this monitoring site were potentially impacted by nearby vegetation and other structures (i.e., houses). Consequently, wind roses were used to compare measurements recorded at the Kaiapoi weather station to measurements for other nearby Christchurch weather stations where data was readily available⁵.

Figure 4.3 compares wind measurements recorded at the Bromley Electronic Weather Station (EWS) to those recorded at the Kaiapoi weather station. The comparison shows that the wind patterns are very similar at the two monitoring locations. However, Kaiapoi has a notable absence of wind speeds greater than 7 m/s (compared to Bromley), which is likely due to the lower mast height and sheltered location. Given that dust emissions are exacerbated by strong winds, data from the Bromley EWS site have been used to describe local wind conditions for the Project.

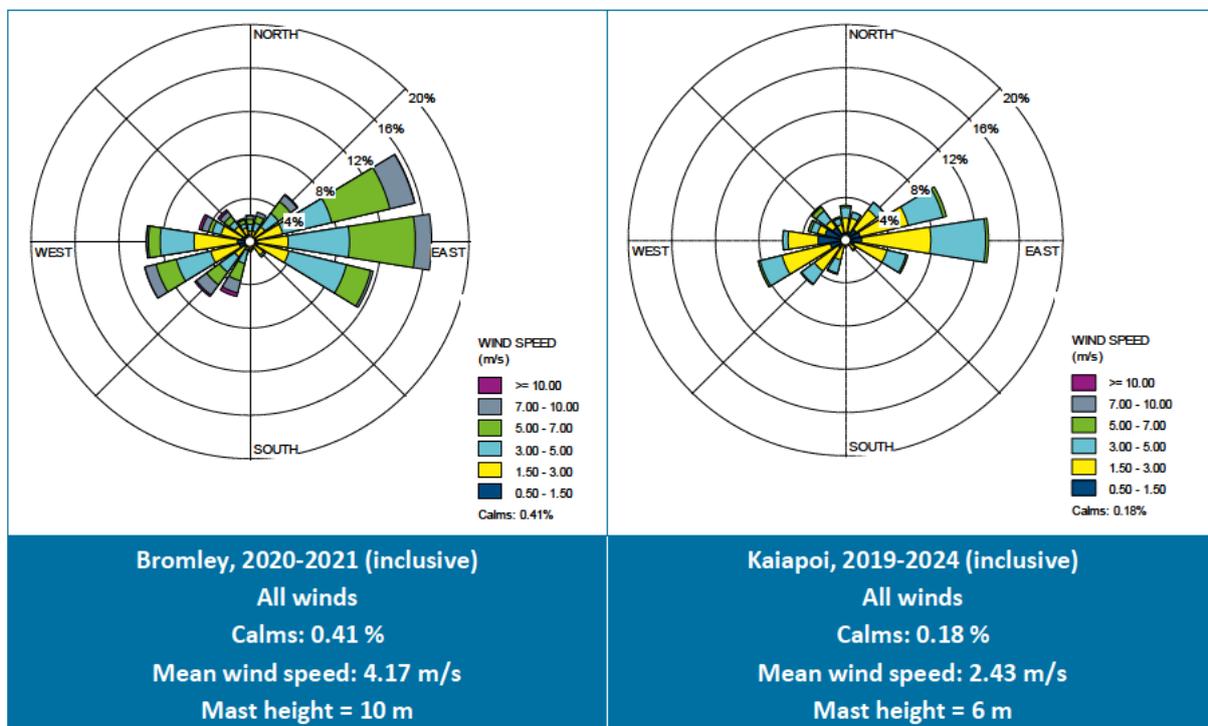


Figure 4.3: Windrose generated from the Bromley monitoring station (left) and Kaiapoi weather station (right), 1-hour average data, winds blowing-from.

4.4.2 Dry weather periods

Rainfall and evaporation data from Christchurch Airport from 2017 to 2021 (inclusive) was used to calculate the frequency of dry days per month. A 'dry surface' day is when evaporation exceeds rainfall by more than 1 mm on the given day.

⁵ Readily available data included: Rangiora EWS (operated by NIWA), Ohoka EWS (operated by NIWA), Bromley EWS (operated by NIWA), Christchurch Airport (operated by Met Service), and Woolston (operated by CRC).

Figure 4.4 shows the seasonal pattern of winter having fewer dry days than months of October to March. The months with a higher frequency of dry days have an increased risk of dust emissions as there is less rainfall to suppresses dust.

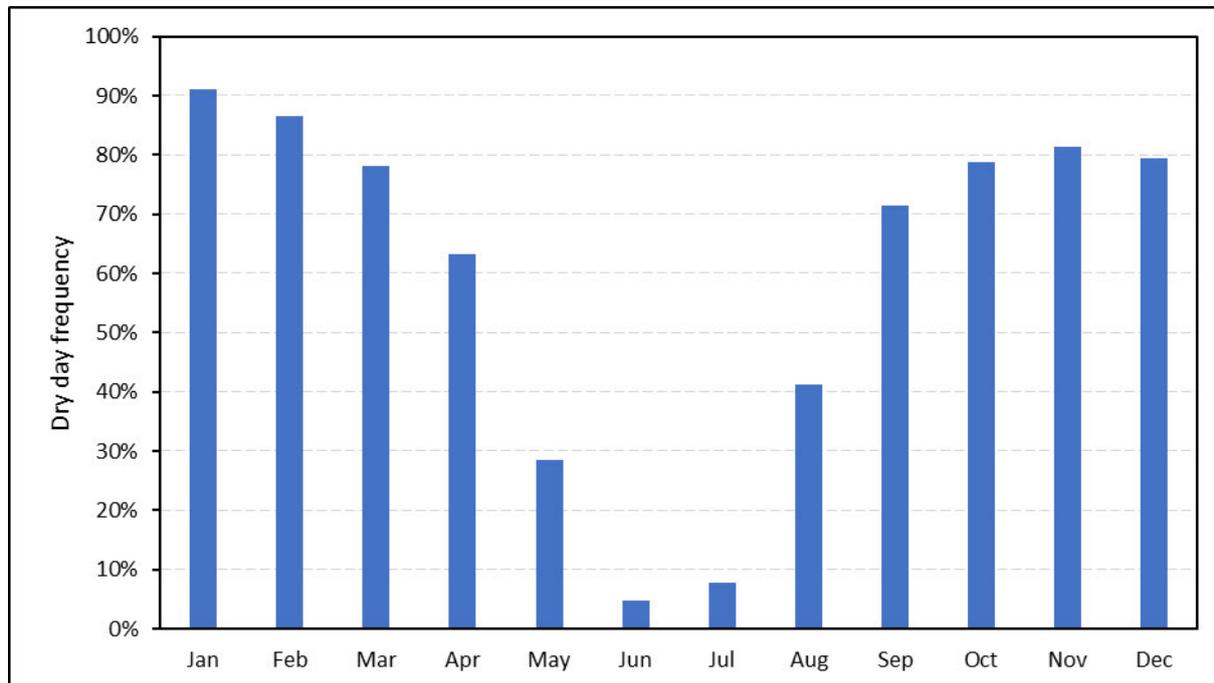


Figure 4.4: Monthly dry surface day frequency by month for Christchurch Airport, 2017 to 2021.

4.4.1 Influence of meteorological condition on dust generation and dispersion

Dust generation from wind occurs when the wind speed is above a certain speed, enabling pick up of dusty materials. In addition, wind entrained dust can occur when dust is generated through handling activities and carried beyond the Site boundary by the wind.

The re-suspension and entrainment of dust from ground surfaces can occur on dry days and when the wind speed is sufficiently high. In this regard the United States Environmental Protection Agency (USEPA), (1995) states:

“...dust-generation process is caused by ... Entrainment of dust particles by the action of turbulent air currents, such as wind erosion of an exposed surface by wind speeds over 19 kilometres per hour (km/hr)” (5.3 m/s)

Csavina, et al., (2014) considered the effects of wind speed and relative humidity on dust concentrations and reached similar conclusions that:

“At wind speeds less than 6 m/s, PM₁₀ concentrations are low and insensitive to either wind speed or relative humidity. However, at high winds speeds, the maximum PM₁₀ concentration with relative humidity is clearly seen”.

The Air Pollution Manual (Watson, Chow, & Pace, 2000) similarly notes:

“Large increments in PM₁₀ are not seen ... until wind speeds exceed 7 m/s with concentrations increasing rapidly for winds speeds in excess of 10 m/s”.

Given the above, wind erosion of dusty material from can begin to occur with wind speeds of 5 – 7 m/s.

4.5 Background ambient air quality

As discussed in Section 3, the main discharge to air from construction activities associated with the Project is dust. As discussed in Section 4.1, the sensitivity of activities in the receiving environment is mixed. Figure 4.1 shows that the majority of land use surrounding the Project Site is rural. Consequently, the background air quality (in terms of dust) in the vicinity of the rural zones surrounding the Project Site is likely to be influenced by rural background sources of dust, such as unsealed roads, cultivation of paddocks, and dry riverbeds. The intensity of dust will vary with meteorological conditions and seasonality. For example, dust generation will be more intense in the summer months as surfaces dry out.

The southern end of the Project (Zone A and small portion of Zone B in Figure 2.1) is situated within the Kaiapoi Airshed, see Figure 4.5. This airshed is considered to be 'polluted' under Regulation 17 of NESAQ in terms of measured ambient PM₁₀ concentrations (LAWA, 2025). Consequently, background concentrations of PM₁₀ are likely to be elevated in this area (i.e., Zone A) in winter months due to domestic home heating emissions. As discussed in Section 3, the majority of emissions from the Project are likely to be coarse particulate matter and mitigation measures used to control dust (discussed in Section 6.4) will also control PM₁₀. Background sources of dust (coarse particulate matter) are likely to be limited due to the high density of residential dwellings.

Dust discharges may also occur from other commercial/industrial businesses. Canterbury Maps was used to review other sites (within 250 m of the Project Site) holding resource consents for discharges to air that may give rise also to dust discharges. The review identified the following resource consent:

- Resource consent CRC224842 for discharges to air from a quarry operated by Christchurch Ready-Mix Concrete Limited, at 808 Main North Road (referred to as the 'North End Quarry').

The 'North End Quarry' is located within the Project Site. Quarrying activities have ceased within the Project Site but are ongoing within the wider North End quarry extending beyond the Project Site. The operation of the 'North End Quarry' will give rise to dust discharges that will be similar in nature to those generated by the Project, which are discussed further in Section 6.6.



Figure 4.5: Location of the Kaiapoi airshed in relation to the Project Site.

5 Assessment methodology

5.1 Overview

The key consideration when assessing nuisance effects of dust is whether the discharge gives or may give rise to ‘offensive or objectionable’ effects beyond the site boundary.

This AQA has been undertaken in accordance with recognised best practice in New Zealand as set out in the guidance documents listed in Table 5.1.

The Ministry for the Environment (MfE) *Good Practice Guide for Managing and Assessing Dust (MfE GPG Dust)* sets out methods or techniques for assessing dust and whether it may cause ‘offensive or objectionable’ effects. The NZTA (2025a) *Guide to assessing air quality impacts from state highway projects (NZTA AQA Guide)* briefly provides guidance specifically in relation to the assessment of road construction air quality impacts, with reference to the MfE GPG Dust.

The IAQM (2024) ‘*Guidance on the assessment of dust from demolition and construction*’ provides evaluation distance criteria allowing for a judgement of dust risk based on distance between source and receptor.

The IAQM (2016) ‘*Guidance on the assessment of mineral dust impacts for planning*’ provides additional guidance for evaluating the frequency of time that a sensitive receptor is downwind of a potential dust source. Although this guidance relates specifically to dust from mineral extraction and processing activities, it encompasses a number of activities associated with the Project (such as heavy vehicle movements over unsealed surfaces and bulk solid materials handling) and the wind exposure frequency guidance in the environment surrounding the Site.

Key tools and assessment methods from each guidance documents are discussed in the subsequent sections.

Table 5.1: List of key guidance documents

Abbreviation	Reference
NZTA AQA Guide	NZTA 2025a. Guide to assessing air quality impacts from road transport projects. NZ Transport Agency Waka Kotahi. Version 3 – June 2025.
MfE GPG Dust	MfE 2016. Good Practice Guide for Assessing and Managing Dust. Ministry for the Environment.
IAQM Construction guidance (2024)	IAQM (2024). <i>Guidance on the assessment of dust from demolition and construction</i> . Institute of Air Quality Management. January 2024 (Version 2.2).
IAQM Mineral guidance (2016)	IAQM (2016). <i>Guidance on the assessment of mineral dust impacts for planning</i> . Institute of Air Quality Management, United Kingdom, May 2016 v1.1.

5.2 NZTA AQA Guide

5.2.1 Overview

The NZTA (2025a) provides the following tools for evaluating the risk of air quality impacts from construction projects:

- 1 Environmental Screen.
- 2 Construction air quality risk assessment checklist.
- 3 Dust Risk Index (DRI).

The Environmental Screen includes questions that can highlight potential air quality risks during construction of a roading project. If the Environmental Screen indicates an elevated risk of dust impacts, then the construction and air quality risk assessment checklist questions can be used to provide a preliminary indication of the potential for dust nuisance effects. The DRI can then be used for projects with a high air quality risk. The level of detail required for assessing construction effects depends on the overall dust risk calculated for the project.

The Environmental Screen questions and the construction and air quality risk checklist questions have been evaluated in relation to the Project in Table 5.2 and Table 5.3, respectively.

Overall, the Environmental Screen indicates an elevated risk of air quality impacts due to the relatively large scale of the proposed Project and the number of nearby highly sensitivity receivers (HSRs).

As the response to all three of the questions in the construction and air quality risk checklist is affirmative, the preliminary evaluation indicates the construction air quality risk for the Project is high. The DRI has been used to further assess the construction air quality risk (see Section 6.2) and to ascertain the need for a more detailed assessment.

Table 5.2: Evaluation of the NZTA (2025a) Environmental Screen questions in relation to air quality risks and opportunities

Question	Considerations	Evaluation
<p><i>Human health: Are there known potential activities sensitive to noise, vibration or air quality (including dust) effects located within 200 m of the option during construction and operation activities?</i></p>	<p><i>Activities sensitive to noise, vibration and air quality include medical sites, rest homes, schools, childcare sites, residential properties, marae, community facilities, horticultural use or ecological receivers.</i></p> <p><i>Zoning of adjacent property (under the district plan or unitary plan) may help identify land uses that may be sensitive to air quality health and amenity effects (e.g., residential zones). In general, the greater the number of potential receivers, and the closer the option is to highly sensitive (HSRs), the higher the risk of the option.</i></p>	<p>There are multiple HSRs located within 200 m of the Project Site. These are discussed in Section 4.</p>
<p><i>Human health: What are the design, management or mitigation opportunities to address noise, vibration or air quality (including dust) issues?</i></p>	<p><i>It is important to consider at the earliest stages of project development whether there are high level opportunities to minimise the exposure of people and/or reduce the emissions from the project so that these can be considered in the multi criteria analysis (MCA) of options at the indicative business case stage and incorporated into key into the design philosophy statement at the detailed business case stage.</i></p> <p><i>If proposed construction methods include high risk dust generating activities, such as crushing and/or screening or concrete batching, this should be identified as these have specific characteristics that need to be considered.</i></p>	<p>Opportunities to manage and mitigate potential air quality issues and effects are discussed in Section 6.4 below.</p>

Question	Considerations	Evaluation																
<p><i>Human health: Is the area designated as a polluted airshed and/or is the background concentration of NO₂, PM₁₀, or PM_{2.5} higher than 90 % of the guidelines set out in the following table.</i></p> <table border="1" data-bbox="210 488 584 791"> <thead> <tr> <th>Air Pollutant</th> <th>Guideline Value</th> <th>Averaging time</th> </tr> </thead> <tbody> <tr> <td>NO₂</td> <td>40µg/m³</td> <td>Annual</td> </tr> <tr> <td rowspan="2">PM_{2.5}</td> <td>25µg/m³</td> <td>24 hours</td> </tr> <tr> <td>10µg/m³</td> <td>Annual</td> </tr> <tr> <td rowspan="2">PM₁₀</td> <td>50 µg/m³</td> <td>24 hours</td> </tr> <tr> <td>20µg/m³</td> <td>Annual</td> </tr> </tbody> </table>	Air Pollutant	Guideline Value	Averaging time	NO ₂	40µg/m ³	Annual	PM _{2.5}	25µg/m ³	24 hours	10µg/m ³	Annual	PM ₁₀	50 µg/m ³	24 hours	20µg/m ³	Annual	<p><i>Polluted airsheds are areas identified in accordance with the National Environmental Standards for Air Quality (NESAQ) as being polluted with respect to ambient PM₁₀ concentrations. The regional council or unitary authority can advise if a location is within a polluted airshed.</i></p> <p><i>Background concentrations of NO₂, PM₁₀, and PM_{2.5} are published on the NZTA website in spreadsheet and map format. The data is presented by census area unit (CAU). In these areas where the background concentration is greater than 90 % of the values shown in the table, there is a greater risk that the incremental effect of additional vehicle movements may cause human health effects and also make it more difficult to meet air quality standards.</i></p>	<p>As discussed in Section 3, coarse particulate matter (dust) is the main discharge to air associated with construction activities in relation to the Project.</p> <p>A small portion of the dust discharge is expected to comprise PM₁₀. However, mitigation measures used to control dust discharges will also control PM₁₀ discharges.</p> <p>The Project will involve upgrading of existing sections of SH1 that bisect the Kaiapoi Airshed, which as noted in Section 4.5 is classified as ‘polluted’ under the NESAQ.</p> <p>Vehicle combustion will give rise to emissions of nitrogen oxides (NO_x that can impact on NO₂ concentration, (in addition to PM₁₀, and PM_{2.5}). As discussed in Section 3.1, the overall proportion of combustion emissions from construction vehicles associated with the Project is considered negligible.</p> <p>Notwithstanding this, NZTA background air quality estimates (NZTA 2020) for the census area units traversed by the designation indicate that ambient NO₂ concentrations are unlikely to exceed the specified criterion.</p>
Air Pollutant	Guideline Value	Averaging time																
NO ₂	40µg/m ³	Annual																
PM _{2.5}	25µg/m ³	24 hours																
	10µg/m ³	Annual																
PM ₁₀	50 µg/m ³	24 hours																
	20µg/m ³	Annual																

Question	Considerations	Evaluation
<p><i>Technical assessment requirements: list technical assessments or further information required for the option to help understand risks and opportunities or to support the development of the detailed business case.</i></p>	<p><i>The environmental screen will specifically identify that an air quality technical assessment is required.</i></p> <p><i>The presence of potential activities sensitive to air quality effects located within 200 m of the option indicates that a preliminary air quality technical assessment may also need to be considered. This will depend on the nature and scale of the project and the extent to which there are design, management or mitigation opportunities to address air quality issues.</i></p> <p><i>As the environmental screen is a high-level tool, it may not identify all cases where air quality issues may create a project consenting risk and/or risk to the reputation of NZTA. Where there is uncertainty, it is recommended that a preliminary air quality technical assessment is undertaken.</i></p>	<p>This report documents a technical assessment of air quality impacts that can enable an understanding of the air quality related risks and opportunities of the Project.</p>

Table 5.3: Construction air quality risk assessment checklist

Topic	Key Question	Evaluation
Scale of earthworks	Is the total site area > 10,000 m ² or the total volume of material to be moved > 100,000 m ³ ?	The overall earthworks will be greater than 10,000 m ² in area and 100,000 m ³ in volume.
Proximity to highly sensitive receivers	Are there more than 50 High Sensitivity Receptors (HSRs) within 200 m?	More than 50 HSRs are located within 200 m.
Anticipated truck movements	Will there be more than 50 outward truck movements per day?	Outward truck movements are anticipated to exceed 50 movements per day at times.

5.2.2 Dust Risk Index

The DRI set out in Appendix B of the NZTA AQA Guide has been used to evaluate the risk of dust impacts on nearby receptors for construction works. The DRI is calculated as follows:

$$DRI = (E + P + T + WS + D + A) * M * WD$$

Where:

E = surface exposure

P = exposure period

T = time of year

WS = wind speed

D = distance to nearest receiver

A = construction activity

M = mitigation

WD = wind direction

The input values for each parameter are provided in Appendix B of NZTA AQA Guide and reproduced in Appendix A Table 1.

For surface exposure (E), the NZTA AQA Guide provides values for less than 1 hectare, between 1 and 5 hectares, and greater than 10 hectares. No value is provided for between 5 and 10 hectares. It is assumed that the construction works will be done in a staged approach and that exposed surface areas are most likely to be between 5 to 10 ha at any given time (at least within the same constructability zone of the Project). Exposed ground in different constructability zone may occur concurrently (e.g., Kaiapoi to Cam and Woodend Beach Bridge) but providing the exposed ground areas are not adjacent the dust discharges are unlikely to have a cumulative effect on individual receptors. Consequently, the average of the values for between 1 to 5 ha (5) and greater than 10 ha (10) has been used for surface exposure.

For wind direction (WS), the NZTA AQA Guide assigns a value of 1 to the prevailing wind direction and a value of 0 when the prevailing wind is blowing away from the nearest sensitive receptors. As discussed in Section 4.4, the prevailing wind direction is from the east. As this assessment categorises receptors into the four cardinal and four intercardinal directions (northeast, southeast, southwest, and northwest), wind direction values reflect the following ratio:

$$WD = \frac{\% \text{ of winds } (> 5 \text{ m/s}) \text{ blowing from the cardinal or intercardinal direction}}{\% \text{ of winds } (> 5 \text{ m/s}) \text{ blowing from the prevailing wind direction (east)}}$$

All other parameters reflect the recommended values provided in Appendix B of the NZTA AQA Guide. Selection of the input parameters is discussed in Table 5.4.

Table 5.4: Evaluation of DRI input parameters

Input parameter	Selected parameter (NZTA assigned value)	Evaluation
Surface Exposure (E)	7.5, reflecting the average of values for between 1 to 5 ha (5) and greater than 10 ha (10)	See discussion above.
Exposure Period (P)	More than 1 year (20)	Construction works are expected to occur over 3-4 years.
Time of year (T)	December to March (50)	Selected to be conservative as construction works will occur throughout the 3-4 year construction period.
Wind speed (WS)	Exposed to prevailing winds (100)	Selected for receptors located west of the Project Site as winds prevail from the east.
	Moderately exposed location (50)	Selected for all other locations.
Distance (D)	Receptor dependent	0-50 m evaluated initially, where the DRI was high or moderate, distances further away were evaluated – see Appendix A Table 3.
Construction Activity (A)	Haul operations (100)	Selected due to having the highest value of all of the proposed construction activities.
Mitigation (M)	Controls 50 % or more dust (0.8)	Most conservative value where mitigation is applied (proposed dust mitigation measures are discussed in in Section 6.4 below).
Wind direction (WD)	Calculated per equation above.	

Note: NZTA recommended input parameters have been reproduced in Appendix A Table 1.

DRI values for the Project are calculated in Appendix B Table 3 from which the dust risk is categorised according to Table 5.5.

Table 5.5: Conversion values for DRI to Dust Risk (NZTA, 2025a)

DRI Value	Risk
0 to 100	Low
100 to 200	Moderate
200 to 300	High

5.3 IAQM dust risk assessment approach

The IAQM Construction guidance details a method for classifying the risk of dust impacts during the *preparation of land (e.g. demolition, land clearing, and earth moving), and during construction*. The dust risk classification allows *mitigation measures commensurate with that risk to be Identified*.

The dust risk classification takes into account the following aspects of the activity:

- The magnitude of potential dust emissions from proposed demolition, earthworks, construction and vehicle movements/track-out activities.
- The sensitivity of the surrounding area to dust soiling, human health or ecological effects.

The identified dust risk (categorised as “negligible”, “low”, “medium” or “high”) is then used to inform an identification of dust management and mitigation requirements for the activity.

The potential magnitude of emissions is categorised as “small”, “medium” or “large” based on the nature and scale of the activities proposed.

The sensitivity of the surrounding area is determined in relation to three aspects as follows:

- The sensitivity of the surrounding area to dust soiling is categorised as “low”, “medium” or “high” based on the number of high, medium and low sensitivity receptors located within distances of 20 m, 50 m and 100 m of the dust proposed sources⁶.
- The sensitivity of the surrounding area to human health effects is calculated in a similar fashion with additional consideration of annual average PM₁₀ concentrations in the area. Separate classifications for air quality are provided for Scotland and the rest of the UK in the IAQM Construction guidance. For the purposes of this assessment, the air quality classifications for Scotland have been considered more appropriate than the other overall classification, which encompasses areas of dense urban development in the cities of England.
- The sensitivity of the area to ecological impacts is based on the number of ecologically sensitive receptors within distances of 20 m and 50 m.

5.4 Evaluation of dust mitigation and monitoring

Available measures to manage and monitor potential dust emissions and associated air quality effects are evaluated against guidance published in IAQM Construction guidance and MfE GPG Dust.

5.5 MfE GPG Dust and FIDOL evaluation

Nuisance effects of dust are commonly assessed in New Zealand using a framework that considers the frequency, duration and intensity of dust exposure, the offensiveness or character of the dust, and the sensitivity of the location where the exposure occurs. These factors are referred to as the FIDOL⁷ factors and are set out by the MfE GPG Dust and defined in Table 5.6 below. The same factors are described in Schedule 2 (items 2 to 6 of the criteria for assessing offensive or objectionable dust) of the CARP.

⁶ Frequency, Intensity, Duration, Offensiveness, Location.

Table 5.6: Definition of each FIDOL factor (MfE, 2016a)

FIDOL factor	Explanation of each factor
Frequency:	The frequency of exposure to dust impacts experienced at a given location. This depends on both the frequency of discharges and the frequency of weather conditions that could transport a discharge towards a sensitive location.
Intensity:	The intensity of dust impacts depends on the degree to which dust sources are controlled but also the separation distance between a source and the receptor.
Duration:	The duration of dust impacts depends on both the duration of the discharge and how long a sensitive location is continuously downwind of the dust source.
Offensiveness:	The offensiveness of the dust relates to both the character of dust and the degree of how pleasant or unpleasant the dust is. For example, some dust types such as coal dust have a greater potential for soiling.
Location:	The location factor relates to the sensitivity of the location being assessed, and is typically expressed as low, medium or high. Residential dwellings are considered to have a high sensitivity, whereas rural/pastoral land is considered to have a low sensitivity.

As described in Table 5.6, the Frequency and Duration factors depend on the strong winds blowing towards a given receptor. IAQM (2016) has been used as a basis to categorise the frequency of strong winds according to Table 5.7. Although this guidance is intended for assessment of mineral dust specifically, the wind exposure frequency guidance is considered appropriate for use for evaluating potential wind exposure to emissions from Project dust sources.

As it relates directly to activities associated with the Construction Works, IAQM Construction guidance has been used as a basis to categorise the intensity of emissions at source in the evaluation of the Intensity factor. A combination of the IAQM (2016) and NZTA AQA Guide has been used to categorise the proximity of receptors for evaluation of potential intensity of dust exposure, as set out in Table 5.8.

Neither the Ministry for the Environment (MfE, 2016a) or Schedule 2 of the CARP provide specific guidance on how the FIDOL factors should be collectively evaluated, with the factors typically being assessed using professional judgement.

Table 5.7: Categorisation of frequency of potentially dusty winds

% of time strong winds (> 5 m/s) are blowing towards a receptor	Category
Less than 1 %	Very infrequent
1 % to 5 %	Infrequent
5 % to 12 %	Moderately frequent
12 % to 20 %	Frequently
Greater than 20 %	Very frequent

Table 5.8: Categorisation of receptor distance from activities

Distance between source and receptor (NZTA 2025a)	Category
0 – 50 m	Very close
51 – 100 m	Close
101 – 150 m	Intermediate
151 – 200 m	Far
> 200 m	Distant

6 Assessment of effects

6.1 Overview

This section provides an assessment of the actual and potential effects of discharges to air from the Construction Works associated with the Project on amenity (dust nuisance). As described in Section 5, the assessment comprises an initial screen of 'at risk' receptors using the DRI detailed in the NZTA AQA Guide (Section 6.2). Receptors identified as 'high' or 'moderate' risk from the DRI are further evaluated using the FIDOL factor in Section 6.4.

6.2 Dust Risk Index

Table 6.1 summarises the dust risk at adjacent receptor based on DRI calculations (see Appendix A).

Table 6.1: DRI (dust risk) calculated in accordance with the NZTA AQA Guide

Direction from Project Site	Distance from Project Site	DRI risk category
West	Any distance	High
Northeast, southwest	Less than 50 m	Moderate
	Greater than 50 m	Low
North, east, southeast, south, northwest	Any distance	Low

6.3 IAQM dust risk

6.3.1 Potential dust emission magnitude

The potential magnitude of dust emissions from the Project activities have been evaluated against the example definitions outlined in section 7.2 of the IAQM Construction guidance (which are summarised in Appendix B Table 1) below:

- Demolition:** There are a small number of dwellings (approximately eight) and other small structures (e.g., sheds, in the order of ten) that are situated within the Project Site and will need to be relocated or demolished. At the time of writing the building volume to be demolished is unknown but given that the buildings are single story the heights are likely to be less than 6 m. In addition, no on-site crushing or screening of demolition material is proposed. Given this, the magnitude of dust emissions from demolition is assessed as being 'small'.
- Earthworks:** While the total Project Site is greater than 110,000 m², it is considered that active earthworks areas, at any given time, are likely to fall within the 'medium' category of IAQM Construction guidance, i.e., 50,000 m² to 100,000 m². Bunds resulting from stockpiled material, or constructed for noise protection, are expected to be less than 6 m in height. It is expected that the number of heavy vehicles at any given time (within non-adjacent constructability zones) will also be 'medium' (i.e., between 5 and 10). Consequently, the magnitude of dust emissions from earthworks is assessed as being 'medium'.
- Construction:** The proposal is for construction of roading infrastructure rather than buildings and the building volume is likely to be low. As a result, the magnitude of dust emissions from construction is assessed as falling within the 'small' category of IAQM Construction guidance.

- **Vehicle movements (referred to as ‘track-out’ in IAQM Construction guidance):** The frequency of heavy vehicle movements associated with the Construction Works is unknown at the time of writing, but it is expected to be greater than 50 per day. Unpaved road length is also unknown but is likely to be greater than 100 m. Consequently, the magnitude of dust emissions from vehicle movements is conservatively assessed as being ‘**large**’.

6.3.1.1 Sensitivity of area to dust soiling effects

Figure 6.1 to Figure 6.3 illustrate the area located within distances of 20 m, 50 m and 100 m of the Project Site for the purposes of determining sensitivity.

As detailed in Section 4.1, except for urban areas of Kaiapoi and Woodend traversed by the Project, the majority of the Project is located within rural land. Where the Project passes through these urban areas the alignment adjoins a reasonably high density of residential dwellings (which under the IAQM Construction guidance are classed as high sensitivity receptors). Within the rural area surrounding the rest of the Project sensitivity is generally low. However, the area is also interspersed with activities that would be classified as high sensitivity activities, such as rural dwellings, a cemetery, a church, and recreational areas (see Figure 6.1 to Figure 6.3).

Given the differences between the rural and urban environmental settings of the Project, they have been evaluated in terms of sensitivity under the IAQM Construction guidance framework separately as follows:

- In relation to the urban environmental settings at Kaiapoi and Woodend, given the number of adjoining dwellings within 50 m, the area is assessed as having a ‘**high**’ sensitivity to dust soiling effects.
- In relation to the rural remainder of the alignment, as there is between 1 and 10 high sensitivity receptors within 20 m of the alignment, this area is assessed as having a ‘**medium**’ sensitivity to dust soiling effects.

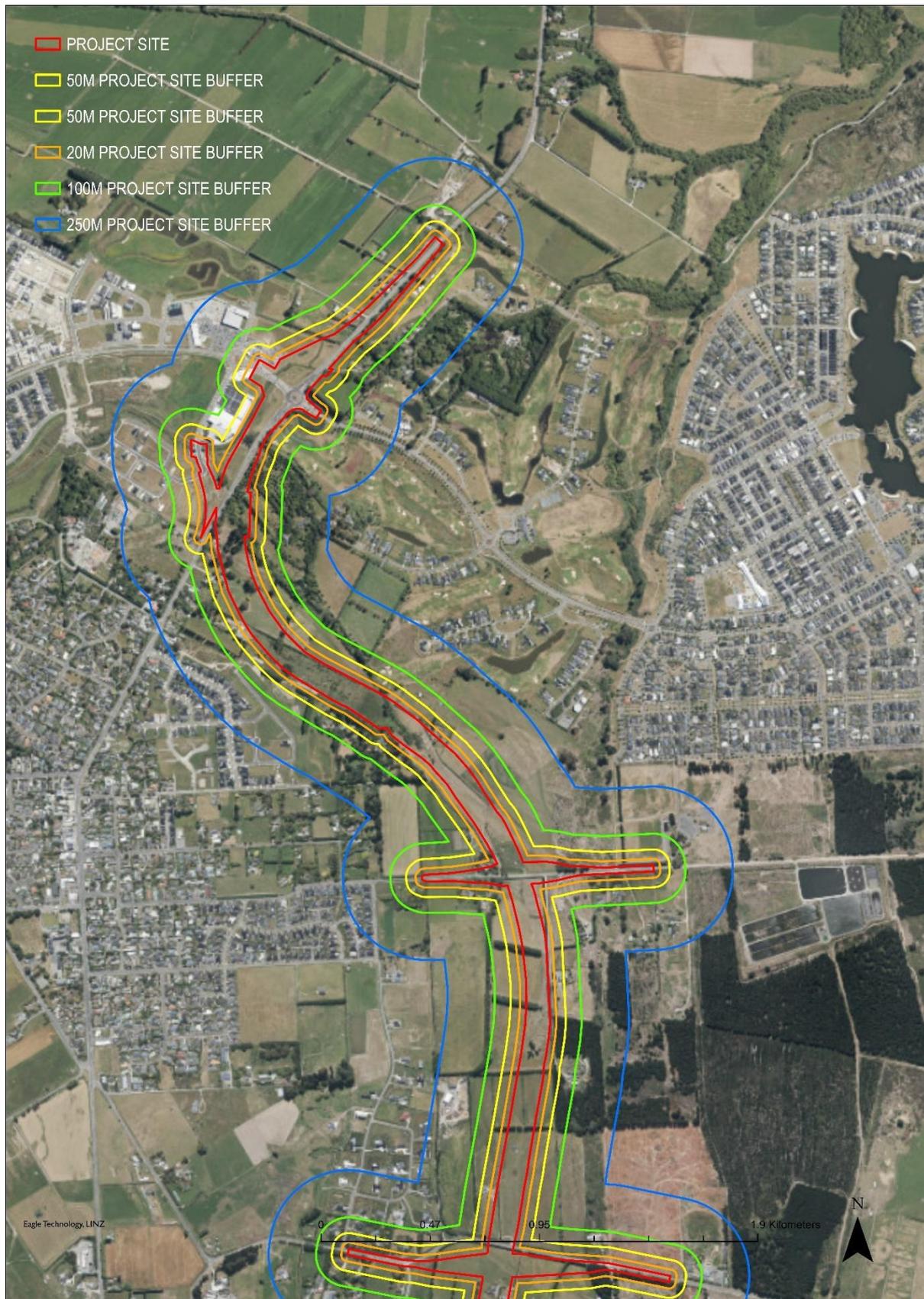


Figure 6.1: Area within 20 m, 50 m and 100 m of the Project Site (northern end).

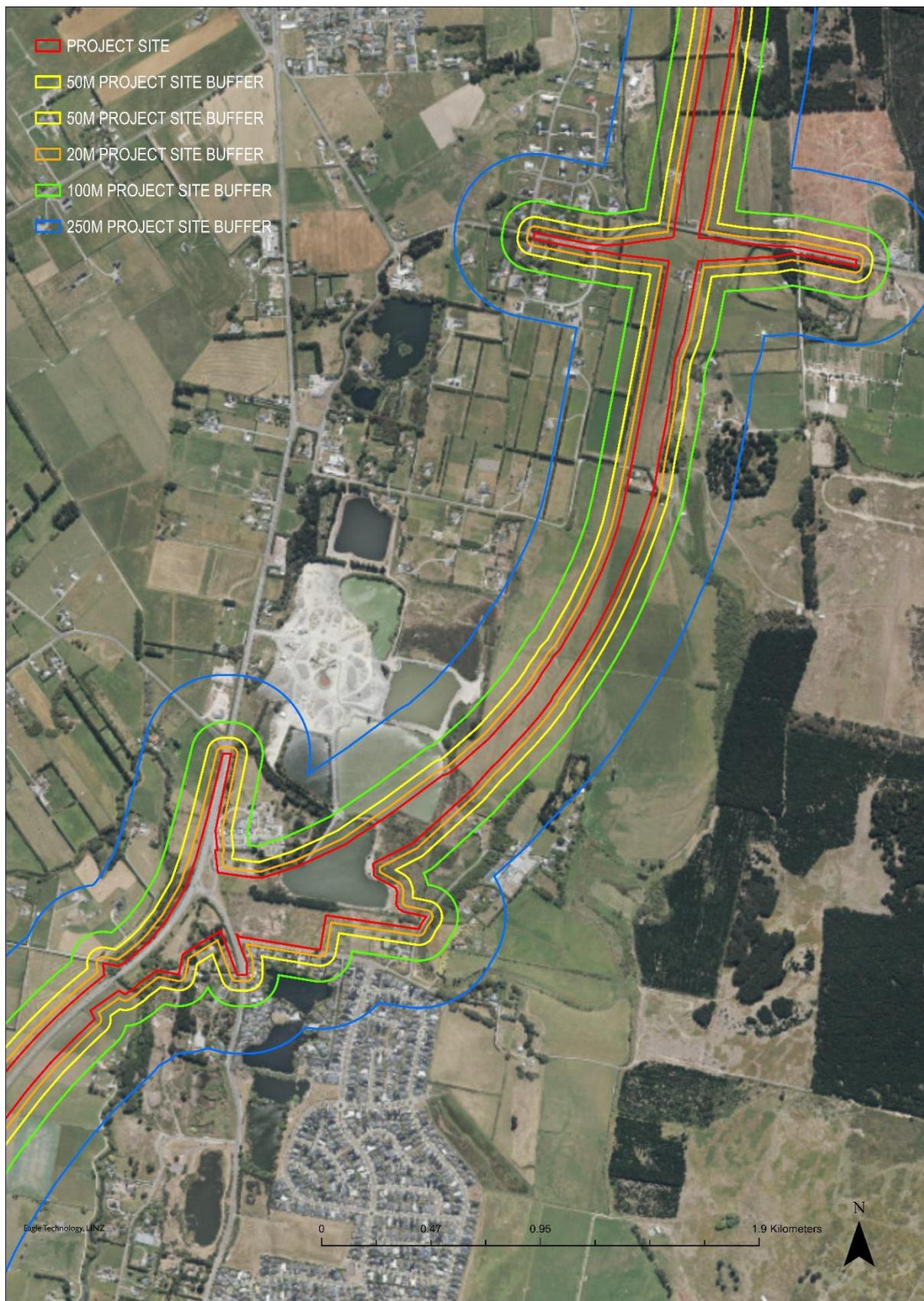


Figure 6.2: Area within 20 m, 50 m and 100 m of the Project Site (central area).



Figure 6.3: Area within 20 m, 50 m and 100 m of the Project Site (southern end).

6.3.1.2 Sensitivity of area to the health effects of PM₁₀

In relation to the sensitivity of adjacent areas to the health effects of PM₁₀, this has been assessed using background PM₁₀ concentration estimates published by NZTA for the census area units (CAUs) traversed by the Project.

The sensitivity to the health effects of PM₁₀ in the rural and urban environmental settings of the Project (discussed in Section 6.3.1.1 above) are assessed separately as follows:

- In relation to urban environments, NZTA estimates indicate that annual average PM₁₀ concentration in CAUs encompassing the urban areas of Kaiapoi lie in the 16 to 18 µg/m³ range. Taking account of the relatively high number of adjoining dwellings within 50 m of the designation, sensitivity to the health effects of PM₁₀ is assessed as being a 'high'. Despite this classification, it is of note that it is based on PM₁₀ concentrations occurring in urban areas over winter periods. Dust from construction activities over winter periods are likely to be minimal due to high moisture levels in surface and stockpiled materials. There is little potential for coincident cumulative impacts between Project dust emissions and high particulate pollution levels in these urban areas.
- In relation to the rural remainder of the Project Site, NZTA estimates indicate that annual average PM₁₀ concentrations are likely to be less than 14 µg/m³ (typically below 10 µg/m³). Given the relatively low number of high sensitivity receptors within 50 m, this area is assessed as having a 'low' sensitivity the health effects of PM₁₀.

6.3.1.3 Sensitivity of area to ecological effects

The Project is predominately located in a rural environment, which contains a mix of ecological receptors including streams, wetlands, native fish, birds, and lizards. These receptors have been assessed in the Ecological Impact Assessment (SAR, Volume 3I) and Wildlife Approval Assessment (SAR Volume 3J) reports and are evaluated as having a 'low' risk to dust impacts from the Construction Works of the Project.

6.3.2 Overall risk of dust impacts

Table 6.2 summarises the dust emission magnitude and sensitivity of surrounding area inputs to the IAQM dust risk evaluation (IAQM, 2024).

Table 6.2: Summary of inputs to IAQM dust risk evaluation

Activity	Potential magnitude of dust emissions	Sensitivity of surrounding area		
		To dust soiling	To human health effects	To ecological effects
Demolition	Small	High for urban environments	High for urban environments	Low across the Project
Earthworks	Medium			
Construction	Small	Medium for rural environments	Low for rural environments	
Vehicle movements/track-out	Large			

Based on the potential dust emission magnitude and the sensitivity of the area the overall risk of dust impacts for each activity can be determined. The risk calculated under the IAQM Construction guidance framework for each activity is summarised in Table 6.3. The relative level of dust impact risk of the various proposal activities has been used to inform the consideration of dust mitigation measures in Section 6.4.

Overall, the IAQM (2024) dust risk evaluation indicates:

- Sensitivity to dust impacts will be higher in the urban settings traversed by the Project at Kaiapoi and Woodend, sensitivity within the rural remainder of the Project setting is generally 'medium'.
- Due to the travel volumes and likely length of unsealed haul roads, vehicle movements over unsealed surfaces present the highest risk of dust effects (in both rural and urban settings).
- A medium dust risk of soiling and human health effects is attributed to earthworks across the project.
- Medium risks are assessed in urban settings during the demolition and construction works and low risks for these activities in rural settings.
- Ecological dust risks are assessed low or negligible throughout the Project Site.

Table 6.3: Summary assessment of dust risk to inform dust mitigation evaluation

Potential impact	Risk			
	Demolition	Earthworks	Construction	Vehicle movements, track-out
Dust soiling	Medium for urban environments	Medium	Low	High for urban environments
	Low for rural environments			Medium for rural environments
Human health	Medium for urban environments	Medium	Low	High for urban environments*
	Low for rural environments			Low for rural environments
Ecological	Negligible	Low	Negligible	Low

* As discussed above, despite the high risk rating there is little potential for coincident cumulative impacts of dust emissions from the Project and poor urban air quality events associated with winter-time domestic heating emissions.

6.4 Dust mitigation measures and monitoring

6.4.1 Dust mitigation

Recommendations are made below for measures to be employed to manage dust emissions from the construction of the Project and to mitigate dust effects based on the assessment of dust provided in Sections 6.1 to 6.3 and the recommendations of the IAQM Construction guidance (refer Appendix C) and the MfE GPG Dust.

The recommended mitigation measures will also be detailed in a Construction Air Quality Management Plan (CAQMP) which will be prepared for the Project following granting of resource consent and appointment of a contractor, prior to commencement of Enabling Works and Construction Works. The CAQMP will be prepared in accordance with Schedule 2 of the CARP to satisfy the requirements of condition 2 of Rule 7.32 of the CARP for the discharges to air from *land development and unsealed surfaces*.

As noted in Section 6.3, a higher level of mitigation may be required where dust generating activities are undertaken within 250 m of urban residential zones or areas at Kaiapoi and Woodend. Additional mitigation measures are recommended below for activities within 250 m these areas as well as within 100 m of other (rural) sensitive receptors.

Demolition

Specific measures for works within 250 m of urban residential zones or areas or within 100 m of other sensitive receptors:

- Maintain demolition materials in damp condition for all demolition activities, concrete breaking and cutting.

Earthworks (including material stockpiling and handling)

General measures for all areas:

- Minimise drop heights when handling material (e.g., from loader buckets or conveyors).
- Locate stockpiles and other potential sources of dust to maximise separation from sensitive receptors and/or minimise dust exposure as far as practicable.
- Minimise heights of outdoor, uncovered stockpiles (below 5 m in height) as far as practicable to reduce wind entrainment.
- Stabilise or cover inactive stockpiles (e.g. through hydroseeding or application of temporary stabilising agents).
- Minimise the extent of excavation areas open at any time as far as practicable.
- Stabilise disturbed areas as soon as practicable (e.g. through hydroseeding, metalling or application of temporary stabilising agents).
- Remove materials that have a potential to produce dust from site as soon as practicable, unless being re-used on site.

Specific additional measures for works within 250 m of urban residential zones or areas or within 100 m of other sensitive receptors:

- Further minimise heights of outdoor, uncovered stockpiles (below 3 m in height) as far as practicable to reduce wind entrainment.
- Erect solid screens or barriers around stockpiles.
- Use wet suppression for excavation or handling of dry material in prolonged dry conditions.

Construction

Specific additional measures for works within 250 m of urban residential zones or areas or within 100 m of other sensitive receptors:

- Where practicable, store sand and fine aggregate materials in banded areas and maintain in damp condition.
- Keep any bagged material sealed, especially if it contains a high percentage of fine material.

Vehicle movements

General measures for all areas:

- Apply road metal to haul roads to reduce dust from vehicle movements.
- Utilise wet suppression to suppress dust from haul roads in dry conditions.
- Where reasonably practicable, implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud) at each entry/exit point to public roads for vehicles leaving the site.
- Cover vehicle loads of fine or dusty material (i.e., particles less than 100 µm).
- Use a suction/vacuum sweeper truck to remove visible material tracked off-site.

Specific additional measures for works within 250 m of urban residential zones or areas or within 100 m of other sensitive receptors other sensitive receptors:

- Limit vehicle speeds on haul roads to 20 km/hr. (e)(v).

6.4.2 Monitoring

To monitor the effectiveness of the mitigation measures the following monitoring is proposed:

General monitoring measures for all areas

- Undertake daily visual checks to identify whether any of the following have occurred:
 - Accumulation of material at site entry/exit points.
 - Visible tracking of material onto adjoining public roads.
 - Visible dust emitted from Project activities (including vehicle movements on haul roads) that is propagating beyond the Project Site and has the potential to cause a nuisance effect on neighbours.
- Implement continuous instrumental weather monitoring. Continuous monitoring of wind speed and direction and rainfall should be installed at one location within the Project Site (at a minimum). Trigger levels for measured weather conditions associated with an elevated risk of dust emissions or impacts (i.e., wind speed) should be determined and automated alerts of trigger exceedances should be provided to staff to initiate investigation and potential implementation of dust management modifications.

Specific monitoring measures for works within 250 m of urban residential zones:

- Implement continuous instrumental monitoring of dust. Continuous instrumental dust/particulate matter monitoring is recommended at locations downwind of haul roads and dust generating earthworks activities within 250 m of urban residential zones to provide instantaneous feedback on dust management. This should include determination of trigger levels for measured particulate matter concentrations with automated trigger exceedance alerts communicated to staff to initiate investigation and dust management responses. Given that the prevailing winds are easterly, monitoring is most likely to be effective at locations west of the active works at a distance that is representative of the nearest receptor at the time. It is recommended that mobile continuous dust monitor(s) are used so that monitors can be moved as construction progresses.
- Increase frequency of visual checks in prolonged dry conditions when winds above 5 m/s are forecast.

6.4.3 Water availability

Water will be required for dust control as well as to facilitate for enabling bulk fill compaction of fill embankments and pavements. This demand will peak in summer to control dust during strong northwest winds and is expected to be in the order of up to 2,000 m³ of water per day. Construction water is proposed to be sourced from surface water from the quarry lakes, which will be able to recharge naturally from groundwater (**Hydrogeology Assessment, SAR, Volume 3K**).

6.4.4 Summary

A range of dust mitigation and monitoring measures are proposed, which take account of the nature of dust generating and sensitivity of the environments adjoining the Project and risk of potential dust impacts. The recommended mitigation and monitoring regime is intended to enable avoidance of offensive or objectionable dust effects from the construction phase of the Project. The recommended mitigation measures will also be detailed in the proposed CAQMP.

6.5 FIDOL assessment

6.5.1 Overview

A FIDOL assessment has been used to assess the potential effects of dust from the Project. Due to the number of the receptors surrounding the Project Site, the FIDOL assessment has separately considered dust effects on receptors identified as having a 'high' or 'moderate' sensitivity (refer Section 4.2) located in the urban and rural environmental settings discussed in Section 6.3.

6.5.2 Frequency

The frequency of exposure to dust discharge depends on the following:

- The frequency of the discharge from the source.
- The frequency of human occupation at a receptor location.
- The frequency of wind conditions that are conducive to transport the dust discharge to the receptor.

Frequency of discharge at the source

The majority of activities associated with construction of the Project will occur within the proposed hours of operations, 7:00 a.m. to 7:00 p.m. Monday to Saturday. However, some night works or extended hours are also expected to occur.

Dust discharges from construction of the Project are likely to be associated primarily with vehicle movements over unsealed haul roads and excavation and handling of materials (each of which occur during operating hours). Dust from these processes is generated regardless of wind conditions but generally requires moderate to strong winds to transport the discharges receptor locations.

Dust discharges can also occur from wind erosion of exposed surfaces (including ground surfaces and stockpiles). However, these dust discharges require strong winds (i.e., greater than 5 m/s) to raise and transport the material. Dust discharges from wind erosion have the potential to occur outside of operating hours if the material is dry, and winds are strong.

The mitigation measures recommended in Section 6.4 will likely reduce the frequency of exposure either by:

- Reducing the frequency of emissions that occur in conditions conducive to transporting dust to receptor locations (i.e., reducing the frequency of dry conditions).
- Reducing the frequency that the intensity of dust is perceptible (by reducing the overall intensity of emissions).

Frequency of human occupation at a receptor location

In terms of the frequency of sensitive activities occupying or occurring at the receptor location, it is assumed that residential and commercial locations will be occupied relatively frequently. Recreational locations may also be visited frequently during daylight hours e.g., for sport or daily walks. Occupation of community facilities such as the Church and the Cemetery are likely to be occupied intermittently. However, it is expected that these locations will have a high sensitivity to soiling of property and therefore frequency is considered to be high as well.

Frequency of wind conditions that are conducive to transport the dust discharge to the receptor.

In terms of downwind exposure to dust from Project activities, the frequency of strong winds in each direction from the Project (based on Bromley EWS wind data) is classified according to IAQM (2016) guidance in Table 6.2. This indicates that receptors located west of the Project Site are considered to be exposed to construction dust discharges 'frequently' and receptors located northeast or southwest of the Project Site are expected to have a 'moderately frequent' exposure to strong winds from the direction of the Project.

Table 6.4: Frequency (%) of strong winds

Direction from Project Site	Frequency of time receptor is downwind of strong winds*	IAQM (2016) categorisation
North	1 %	Infrequent
Northeast	6 %	Moderately frequent
East	3 %	Infrequent
Southeast	2.3 %	Infrequent
South	1.9 %	Infrequent
Southwest	5 %	Moderately frequent
West	14 %	Frequently
Northwest	1 %	Very infrequent

*Strong winds are wind speeds greater than 5 m/s. Frequency has been calculated from measurements recorded at the Bromley EWS meteorological station for years 2020 – 2021 (inclusive).

6.5.3 Intensity

The intensity of dust observed at a sensitive receptor depends on:

- Emission strength at the source.
- The separation distance between the source and receptor and the degree of meteorological dispersion. In general, with increasing distance, the concentration of dust will reduce as the plume disperses and dilutes.

Emission strength at the source

In terms of the intensity of dust at the source the IAQM (2024) dust risk evaluation in Section 6.3 assesses the dust emission magnitude' of Project activities as follows:

- Demolition: Small.
- Earthworks: Medium.
- Construction: Small.
- Vehicle movement/track-out: Large.

The intensity or strength of emissions will be reduced by mitigation measures recommended in Section 6.4. Additional mitigation measures are recommended for urban areas where dust risks have been evaluated as being higher, which will further reduce the intensity of emissions near these areas.

Separation distance to receptors

Under the categories set out in Table 5.8 receptors located within 100 m of construction works are classified as 'very close' or 'close' and the opportunity for dust plumes to disperse and dilute is reduced over this type of distance. Dust exposure intensity will reduce further with distance (i.e., beyond 100 m).

As highlighted in Figure 6.1 to Figure 6.3, there are a number of dwellings and other sensitive receptors located within 100 m of the designation, particularly in urban residential areas at Kaiapoi and Woodend.

6.5.4 Duration

Duration of exposure depends on similar conditions to frequency, that is:

- The duration of the discharge at the source.
- The likely duration a receptor location may be occupied.
- The likely duration that the receptor would be downwind of a discharge.

Receptors visiting the recreational areas, or the Cemetery are not expected to be at those locations for prolonged periods. However, as discussed in Section 6.5.2, people at the Cemetery are likely to have high amenity expectations in regard to soiling of property. People at the recreational areas identified in Section 4.2 are likely to be present for reasonably short durations. The duration of occupation at commercial and residential receptor locations is expected to be long.

The mitigation measures recommended in Section 6.4 are likely to reduce both the frequency of discharge and the intensity of discharge thereby reducing the duration of dust emissions (at the source).

Overall, it is considered that duration of dust experienced at receptor locations is likely to be short in most cases, considering the factors above.

6.5.5 Offensiveness

The offensiveness of dust relates to its characteristics in relation to visibly soiled surfaces. These characteristics might include colour or texture. For example, a material such as coal dust with a dark brown to black colour has a high potential for soiling and would be considered relatively offensive.

As discussed in Section 3.2, it is expected that dust generated from the Enabling Works and Construction Works will be derived primarily from soil/crustal and aggregate material, which is likely to be inert and have a neutral colour and character.

6.5.1 Location

The sensitivity of nearby receptors is discussed in Table 4.1. While the sensitivity to dust is generally low over the rural setting of much the Project, this FIDOL assessment has focused on locations that have moderate to high sensitivity, which are predominantly located in areas of urban development. Table 6.5 summarises the sensitivity of the receptors.

As noted in Sections 4.2 and 6.3 the majority of receptors of this nature are located in the urban areas of Kaiapoi and Woodend. Additional dust monitoring and mitigation measures are recommended in Section 6.4 in response to the heightened sensitivity and risk of potential dust impacts in these areas.

Table 6.5: Sensitivity of receptors

Receptor type	Location sensitivity
Residential (urban)	High
Residential (rural)	Moderate to high
Recreational	Moderate to high (while in occupation)
Community	High (while in occupation)
Commercial	Moderate to high

6.5.2 Summary of FIDOL factor assessment

Potential exposure to dust emissions from the construction phase of the Project in the environment has been evaluated against the individual FIDOL factors in sections 6.5.2 to 6.5.1, taking the implementation of the recommended mitigation and monitoring measures in Section 6.4 into consideration. In summary of the FIDOL evaluation:

- Dust emitted from the Project construction activities is likely to be comprised primarily of coarse particles of concrete, aggregate and soil/crustal material. These dust emissions are likely to be inert and are considered to have a neutral colour and character.
- While the sensitivity to dust is generally low over the rural setting of much the Project, there are a number of high and moderate sensitivity receptors located adjacent to the Project. The majority of these receptors are located in urban residential areas at Kaiapoi and Woodend.
- A range of dust generating activities are proposed, each of which will vary in terms of scale and intensity of dust emissions. Vehicle movements over haul roads and other unsealed surfaces are identified as the largest intensity dust source, the proposed scale of earthworks is identified as have medium intensity emissions and demolition and construction activities are associated with small intensity emissions. The mitigation and monitoring measures recommended in Section 6.4 are likely to reduce the intensity of emissions from these activities.
- The intensity of dust exposure will also relate to distance from construction activities. Within the urban areas adjoining the Project there is a reasonably high density of residential properties and other sensitive receptors within 100 m of the designation. Given the close proximity of these receptors, the opportunity for dust plumes to disperse and dilute is reduced. Consequently, additional mitigation and monitoring measures are recommended in these areas to reduce the intensity of dust emissions (and the resulting intensity of exposure). With these mitigation and monitoring measures in place, the intensity of dust exposure should be low despite the limited opportunity for dust dispersal.

- In terms of the frequency and duration of exposure, strong winds blowing towards the west of the Project occur relatively 'frequently' and towards the northeast or southwest of the Project on a 'moderately frequent' basis. Wind exposure to Project construction works at receptors located in other directions is likely to be infrequent.

Overall, the FIDOL analysis indicates that, provided the mitigation measures recommended in Section 6.4 are implemented, the anticipated intensity, frequency, and duration of exposure to dust from the construction works is unlikely to result in offensive or objectionable dust impacts in the surrounding environment.

6.6 Cumulative effects

In relation to the potential for cumulative dust impacts with emissions from the Project with background emissions from the North End Quarry, the key dust generating activities associated with the North End Quarry (i.e., screening and processing of aggregate and stockpiling of material) are located within the 'main processing area' which is located at least 310 m from the Project Site (GHD 2022). This is a relatively large separation distance for quarries without blasting (GHD 2022, IAQM 2016).

Consequently, cumulative effects from the construction of the Project and the nearby quarry activities are expected to be negligible.

7 Conclusion

NZTA is proposing to construct, operate, and maintain an approximate 11 km extension of the Christchurch Northern Motorway (SH1), connecting Belfast to Pegasus and bypassing Woodend.

NZTA is applying for a resource consent for discharges to air that are associated with the construction phase of the Project.

This report assesses the actual and potential effects of the discharges to air from *outdoor storage of bulk solids material*. The report also evaluates whether discharges to air are likely to be offensive or objectionable in order to demonstrate compliance with Rule 7.32 of the CARP (*land development and unsealed surfaces*).

The assessment has conservatively assumed that construction works (which could give rise to discharges to air) will occur anywhere within the Project Site. While this is unlikely to occur, the exact extent of construction works will not be confirmed until completion of detailed design and a contractor is appointed.

Dust is the main discharge to air associated with the Project. Dust effects have been evaluated in accordance with the following guidance:

- The NZ Transport Agency Waka Kotahi *Guide to assessing air quality impacts from road transport projects* (NZTA 2025a).
- The Institute of Air Quality Management (IAQM) *Guidance on the assessment of dust from demolition and construction* (IAQM 2024).
- The Ministry for the Environment (MfE) *Good Practice Guide for Assessing and Managing Dust* (MfE 2016).

The above assessments assess the risk of dust effects as being variable across the Project, depending on the nature of the dust generating activities and adjacent receptor activities. The risk of dust impacts associated with Project construction activities is identified to be highest where construction occurs in and around the urban residential areas of Kaiapoi and Woodend.

Consequently, a variety of mitigation and monitoring measures have been recommended to reduce dust impacts from the construction phase of the Project (Section 6.4), with additional measures recommended to respond to the heightened risk near urban residential areas. These mitigation measures will also be detailed in a CAQMP which will be prepared for the Project following granting of resource consent and appointment of a contractor, prior to Enabling Works and Construction Works.

Provided the recommended mitigation and monitoring measures are adopted and implemented in accordance with the CAQMP, it is considered that:

- The effects of the emissions to air from the construction of the Project will be appropriately mitigated or avoided.
- Offensive or objectionable effects beyond the Project Site are unlikely to occur as a result the construction emissions (including from associated *land development and unsealed surfaces* and from *outdoor storage of bulk solids material*).

8 References

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9 Applicability

This report has been prepared for the exclusive use of our client Aurecon NZ Ltd and New Zealand Transport Agency Waka Kotahi, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that NZTA will submit this report as part of an application under the Fast-Track Approvals Act 2024 and the appointed panel will use this report for the purpose of assessing that application.

This report has been prepared in accordance with our sub consultancy agreement to “Belfast to Pegasus Motorway & Woodend Bypass pre-implementation & MSQA Professional services contract number 11320”, dated 20 May 2025.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:

Report reviewed by:



Environmental Consultant

Principal Environmental Engineer

Authorised for Tonkin & Taylor Ltd by:



Chris Perks
Project Director

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Appendix A Further information on the DRI

A1 DRI Input parameters

The NZTA (2025) recommended DRI input parameters, set out in Appendix B of the NZTA AQA Guide, have been reproduced in Appendix A Table 1, below.

Appendix A Table 1: NZTA recommended input values for the DRI (reproduced from the NZTA AQA Guide)

DRI Input parameter	Category	Assigned value
Surface Exposure (E)	Less than 1 hectare	1
	Between 1 and 5 hectares	5
	Greater than 10 hectares	10
Exposure Period (P)	Less than 1 month	1
	Between 1 and 5 months	5
	Up to 1 year	10
	More than 1 year	20
Time of year (T)	June to September	0
	April, May, October, and November	20
	December to March	50
	Unknown/Default	10
Wind speed (WS)	Exposed to prevailing winds (100)	100
	Moderately exposed location (50)	50
	Sheltered location (10)	10
	Unknown/Default (100)	100
Distance (D)	0-50 m	100
	51-100 m	50
	101-150 m	10
	151-200 m	5
	>200 m	0
Construction Activity (A)	Vegetation removal	5
	Piling operations	5
	Excavator cutting and shaping of natural ground	20
	Pavement construction	20
	Fill shaping and compaction - bulldozer	50

A2 DRI calculations

To identify receptors that might have an elevated risk to dust impacts from the construction of the Project, DRIs have been calculated for each of the four cardinal (north, east, south, and west) and intercardinal (northeast, southeast, southwest, and northwest) wind directions. Calculations were initially done for the most conservative distance category (0 – 50 m) and if this gave rise to a 'high' or 'moderate' risk (for the relevant wind direction) then additional calculations were for the next conservative distance category (51 – 100 m) until the DRI risk was 'low' or all receptor distance categorised were analysed. These calculations are shown in Appendix A Table 3 and the results summarised in Section 6.2.

The direction from the Project was categorised according to Appendix A Table 2.

Appendix A Table 2: Assigned direction to modulo angle

Receptor direction	Modulo angle
East	337.5 to 22.5
Northeast	22.5 to 67.5
North	67.5 to 112.5
Northwest	112.5 to 157.5
West	157.5 to 202.5
Southwest	202.5 to 247.5
South	247.5 to 292.5
Southeast	292.5 to 337.5
East	337.5 to 382.5
East	337.5 to 22.5
Northeast	22.5 to 67.5

Appendix A Table 3: Dust Risk Index (RDI) and corresponding dust risk associated with receptors for the Project Site

Receptor direction from Project Site	Risk	DRI Value	Input parameters (associated value)							
			Distance (D)*	Surface Exposure (E)	Exposure Period (P)	Time of year (T)	Wind speed (WS)	Construction Activity (A)	Mitigation (M)	Wind direction
North	LOW	21.7	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	South (0.1)
Northeast	MODERATE	106.5	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Southwest (0.4)
Northeast	LOW	90.2	51-100 m (50)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Southwest (0.4)
East	LOW	58.5	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	West (0.2)
Southeast	LOW	44.4	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Northwest (0.2)
South	LOW	36.3	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	North (0.1)
Southwest	MODERATE	105.6	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Northeast (0.4)
Southwest	LOW	89.5	51-100 m (50)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Northeast (0.4)

Receptor direction from Project Site	RISK	DRI Value	Input parameters (associated value)							
			Distance (D)*	Surface Exposure (E)	Exposure Period (P)	Time of year (T)	Wind speed (WS)	Construction Activity (A)	Mitigation (M)	Wind direction
West	HIGH	302.0	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Exposed to prevailing winds (100)	Haul operations (100)	Controls 50 % or more dust (0.8)	East (1)
West	HIGH	262.0	51-100 m (50)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Exposed to prevailing winds (100)	Haul operations (100)	Controls 50 % or more dust (0.8)	East (1)
West	HIGH	230.0	101-150 m (10)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Exposed to prevailing winds (100)	Haul operations (100)	Controls 50 % or more dust (0.8)	East (1)
West	HIGH	226.0	151-200 m (5)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Exposed to prevailing winds (100)	Haul operations (100)	Controls 50 % or more dust (0.8)	East (1)
West	HIGH	222.0	>200 m (0)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Exposed to prevailing winds (100)	Haul operations (100)	Controls 50 % or more dust (0.8)	East (1)
Northwest	LOW	10.6	0-50 m (100)	Between 5 and 10 hectares (7.5)	More than 1 year (20)	December to March (50)	Moderately exposed location (50)	Haul operations (100)	Controls 50 % or more dust (0.8)	Southeast (0.0)

*Represents distance from Project Site.

Appendix B IAQM Construction guidance matrices

Appendix B Table 1: Example ‘Potential Dust Emission Magnitude’ (reproduced from section 7.2 of IAQM 2024)

A: Dust emission magnitude	Examples		
	Small	Medium	Large
A1. Demolition			
Total building volume m ³	<12,000	12,000 - 75,000	>75, 000
Height above ground level m	<6	6 – 12	>12
A2. Earthworks			
Total site area m ²	<18,000	18,000 - 110,000	>110,000
Bund height m	<3	3 – 6	>6
Heavy vehicle limit	<5	5 – 10	>10
A3. Construction			
Total building volume m ³	<12,000	12,000 - 75,000	>75, 000
A4. Trackout (Access Track)			
Heavy Duty Vehicle numbers	<20	20 – 50	>50
Unpaved track length m	<50	50 – 100	>100

Appendix B Table 2: Sensitivity to dust soiling effects on people and property (reproduced from Table 2 of IAQM 2024)

Receptor Sensitivity	Number of Receptors	Distance from the Source (m) ^c			
		<20	<50	<100	<250
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Appendix B Table 3: Sensitivity to human health impacts of PM₁₀ (reproduced from Table 3 of IAQM 2024)

Receptor Sensitivity	Annual Mean PM ₁₀ concentration ^c	Number of Receptors	Distance from the Source (m) ^c			
			<20	<50	<100	<250
High	>32 µg/m ³ (>18 µg/m ³ in Scotland)	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28-32 µg/m ³ (16-18 µg/m ³ in Scotland)	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24-28 µg/m ³ (14-16 µg/m ³ in Scotland)	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m ³ (<14 µg/m ³ in Scotland)	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32 µg/m ³ (>18 µg/m ³ in Scotland)	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	28-32 µg/m ³ (16-18 µg/m ³ in Scotland)	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	24-28 µg/m ³ (14-16 µg/m ³ in Scotland)	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 µg/m ³ (<14 µg/m ³ in Scotland)	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low

Appendix B Table 4: Sensitivity of the area to ecological impacts of PM₁₀ (reproduced from Table 4 of IAQM 2024)

Receptor Sensitivity	Distance from the Source (m) ^c	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Appendix B Table 5: Risk of dust impacts – demolition (reproduced from Table 6 of IAQM 2024)

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Appendix B Table 6: Risk of dust impacts – earthworks (reproduced from Table 7 of IAQM 2024)

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Appendix B Table 7: Risk of dust impacts – construction (reproduced from Table 8 of IAQM 2024)

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Appendix B Table 8: Risk of dust impacts – track out (reproduced from Table 9 of IAQM 2024)

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

**Appendix C Evaluation of dust mitigation and
monitoring measures against IAQM
2024 recommendations**

Appendix C Table 1: Evaluation of dust mitigation and monitoring measures against IAQM mitigation recommendations⁸

Note: Classification of Activity Dust Risk highlighted by colour separately for **urban areas**, **rural areas** and **all of Project** in table.

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
Communications	<i>1. Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.</i>	H	H	H	N/A – Stakeholder and community engagement addressed elsewhere in application.
	<i>2. Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.</i>	H	H	H	To be confirmed prior to construction.
	<i>3. Display the head or regional office contact information.</i>	H	H	H	
	<i>4. Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. In London additional measures may be required to ensure compliance with the Mayor of London’s guidance. The DMP may include monitoring of dust deposition, dust flux, realtime PM10 continuous monitoring and/or visual inspections.</i>	D	H	H	A CAQMP to be developed prior to construction in accordance with Schedule 2 of the CARP and MFE Dust guidance.

⁸ IAQM. 2024 “Guidance on the assessment of dust from demolition and construction”. Version 2.2. Section 8.2.

⁹ **Key to recommendation:**

H: Highly recommended.

D: Desirable.

N: Not required.

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
Site Management	<i>5. Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.</i>	H	H	H	Recommended to be incorporated in CAQMP.
	<i>6. Make the complaints log available to the local authority when asked.</i>	H	H	H	Recommended to be incorporated in CAQMP.
	<i>7. Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.</i>	H	H	H	Recommended to be incorporated in CAQMP.
	<i>8. Hold regular liaison meetings with other high risk construction sites within 250 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.</i>	N	N	H	N/A – Stakeholder and community engagement addressed elsewhere in application.
Monitoring	<i>9. Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100 m of site boundary, with cleaning to be provided if necessary.</i>	D	D	H	Daily on-site and boundary inspections downwind of works are recommended. This is discussed in Section 6.4.2 and is recommended to be incorporated into the CAQMP.
	<i>10. Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.</i>	H	H	H	

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
	<i>11. Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.</i>	H	H	H	Increased frequency of inspections recommended within 250 m of urban residential areas and within 100 m of other sensitive receptors. This is discussed in Section 6.4.2 and is recommended to be incorporated into the CAQMP.
	<i>12. Agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.</i>	H	H	H	Continuous PM ₁₀ monitoring is recommend adjacent to works in and around urban areas is recommended to provide ongoing feedback on dust levels at these sensitive locations and efficacy of dust management measures. This is discussed in Section 6.4.2 and should be incorporated into the CAQMP.
Preparing and maintaining the site	<i>13. Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.</i>	H	H	H	Recommended to be incorporated in CAQMP.
	<i>14. Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.</i>	H	H	H	Recommended within 250 m of urban residential areas and within 100 m of sensitive receptors.
	<i>15. Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.</i>	D	H	H	N/A – Project involves progressive construction of linear infrastructure.
	<i>16. Avoid site runoff of water or mud.</i>	H	H	H	N/A to dust emissions.
	<i>17. Keep site fencing, barriers and scaffolding clean using wet methods.</i>	D	H	H	Not recommended - measure unlikely to have discernible impact on dust emissions (value of measure is largely aesthetic).

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
	<i>18. Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.</i>	D	H	H	Recommended, see Section 6.4.1.
	<i>19. Cover, seed or fence stockpiles to prevent wind whipping.</i>	D	H	H	Recommended, see Section 6.4.1.
Operating vehicle/machinery and sustainable travel	<i>20. Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NRMM standards, where applicable.</i>	H	H	H	N/A – specified requirements are not applicable in NZ.
	<i>21. Ensure all vehicles switch off engines when stationary - no idling vehicles.</i>	H	H	H	Recommended.
	<i>22. Avoid the use of diesel or petrol powered generators and use mains electricity or battery .</i>	H	H	H	N/A – given the rural nature of much of the Project main electricity is likely to be unavailable.
	<i>23. Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).</i>	D	D	H	A speed limit of 20 km/h on unsealed haul roads is recommended in urban areas and within 250 m of sensitive receptors, see Section 6.4.1.
	<i>24. Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.</i>	N	N	H	N/A
	<i>25. Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).</i>	N	D	H	N/A
Operations	<i>26. Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.</i>	H	H	H	Recommended within 250 m of urban residential areas and within 100 m of other sensitive receptors, see Section 6.4.1..

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
	<i>27. Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate</i>	H	H	H	Water availability discussed in Section 6.4.3.
	<i>28. Use enclosed chutes and conveyors and covered skips.</i>	H	H	H	Not recommended - Demolition of relatively small scale.
	<i>29. Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.</i>	H	H	H	Recommended, see Section 6.4.1.
	<i>30. Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.</i>	D	H	H	A sweeper truck is recommended for removing dust from hard surfaces, see Section 6.4.1.
Waste management	<i>31. Avoid bonfires and burning of waste materials.</i>	H	H	H	N/A - Burning of waste not proposed.
Demolition	<i>32. Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).</i>	D	D	H	Not recommended - demolition of relatively small scale.
	<i>33. Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.</i>	H	H	H	Recommended within 250 m of urban residential areas and within 100 m of sensitive receptors, see Section 6.4.1.
	<i>34. Avoid explosive blasting, using appropriate manual or mechanical alternatives.</i>	H	H	H	N/A – Blasting not proposed.

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
	<i>35. Bag and remove any biological debris or damp down such material before demolition.</i>	H	H	H	Contaminated material is to be handled in accordance with the Contamination Site Management Plan.
Earthworks	<i>36. Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.</i>	N	D	H	Recommended, see Section 6.4.1.
	<i>37. Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.</i>	N	D	H	Use of alternative stabilisation methods recommended, see Section 6.4.1.
	<i>38. Only remove the cover in small areas during work and not all at once.</i>	N	D	H	Minimisation of exposed area to the extent practicable is recommended, see Section 6.4.1.
Construction	<i>39. Avoid scabbling (roughening of concrete surfaces) if possible.</i>	D	D	H	N/A – Not proposed.
	<i>40. Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.</i>	D	H	H	Recommended within 250 m of urban residential areas and within 100 m of other sensitive receptors.
	<i>41. Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.</i>	N	D	H	N/A – On-site concrete batching not proposed.
	<i>42. For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.</i>	N	D	D	Recommended.
Vehicle track-out	<i>43. Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.</i>	D	H	H	Recommended. Continuous use unlikely to be required if wheel wash facilities are effective.
	<i>44. Avoid dry sweeping of large areas.</i>	D	H	H	Suction sweeping recommended and should be incorporated into the CAQMP.

Activity	IAQM Recommended Mitigation Measure	Implementation Recommendation by Activity Dust Risk ⁹			Evaluation of proposed measures
		Low	Medium	High	
	<i>45. Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.</i>	D	H	H	Recommended for fine materials only, see Section 6.4.1.
	<i>46. Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.</i>	N	H	H	Visual inspections recommended in Section 6.4.2 focus on dust emissions from roads rather than road integrity.
	<i>47. Record all inspections of haul routes and any subsequent action in a site log book.</i>	D	H	H	Recommended to be incorporated into CAQMP.
	<i>48. Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.</i>	N	H	H	Not recommended given temporary nature of the works.
	<i>49. Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).</i>	D	H	H	Recommended, see Section 6.4.1.
	<i>50. Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.</i>	N	H	H	Access wheel wash locations are to be determined prior to construction.
	<i>51. Access gates to be located at least 10 m from receptors where possible.</i>	N	H	H	Access locations are to be determined prior to construction.

Note: classification of Activity Dust Risk highlighted by colour separately for urban areas, rural areas and all of Project in table.

⁹Key to recommendation:

H: Highly recommended.

D: Desirable.

N: Not required.

