MEMORANDUM

To	KiwiRail
From	WSP
Date	23 July 2025
Subject	Respirable Crystalline Silica Assessment on the Wellington- Masterton Passenger Train Service

Please see our comments below about the above assessment.

The data collected in the Air Matters report has been undertaken using static sampling – there are monitoring devices placed in a fixed location and measure airborne concentrations in that specific space. This methodology cannot be reliably used to determine risk. The presence of respirable crystalline silica (RCS) in the static samples confirms that a **hazard** exists; this does not automatically equate to a **risk**. A risk is determined by the presence of a hazardous agent and the likelihood and extent of exposure to it.

This is because human behaviour introduces variability – people move around, interact with their environments, perform different tasks in different ways, which can either increase or decrease their exposure. For example, if a worker were to open a window in the tunnel even momentarily, they may experience a higher exposure than a worker in the same cabin who doesn't, while the static monitor in this cabin may show an average level.

Identifying a hazard is the first step in the risk assessment process, but this does not automatically mean that harm will occur. The presence of the hazard does not mean that urgent intervention is required. Instead, it signals the need for further investigation to determine whether current conditions result in exposure. This should be personal monitoring – this is where a sampling device is fixed to a person and monitors the air in their breathing zone.

This should be done in accordance with BS EN 689:2018 "Workplace exposure – Measurement of exposure by inhalation to chemical agents – Strategy for testing compliance with occupational exposure limits", or similar. Under this standard, the minimum number of data sets (monitoring rounds) required to do a statistical analysis (and make an assessment to risk) is 6. However, the more data sets you have, the conclusions are more robust.

We would typically recommend a monitoring round once a month (on days picked at random by the Occupational Hygienist), for six months. This will help account for differences between:

- Different people doing different roles (the way they interact with their environments, and the way they do their work tasks)
- Variations in workload (e.g. one return trip per day vs two)
- Variation in use of the tunnel (e.g. more trains passing through in quick succession based upon timetables, or freight, which may differ from day to day)
- Any seasonal variations

The personal monitoring should be done over the full working day and include periods where they are working and on breaks. Monitoring should be structured around Similar Exposure Groups (SEGs) such as engineers/operators, train managers etc. to ensure representative sampling across the range of roles and differing work patterns and environments.

The New Zealand Workplace Exposure Standard (NZ-WES) for silica is 0.025 mg/m^3 TWA (8-hour). New Zealand does not have Short Term Exposure Limits (STEL) or Ceiling limits for silica.

Let us know if you have any further questions/queries, or if we can help in any other way.

air matters

KiwiRail

Bunny Street, Wellington, 6011

Respirable Particulate Assessment on the Wellington-Masterton Passenger Train Service

Report P25205
Test Date 9/06/2025
Report date 27/06/2025

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Document History

No	Version	Amendments made	Issue Date
1	Draft	Internal quality checks	25/06/2025
2	Final	-	27/06/2025

Executive Summary

An investigative assessment for respirable particulate containing crystalline silica, was undertaken at KiwiRail on the Masterton-Wellington passenger train service, passing through the Remutaka Tunnel. This assessment was performed on 09 June 2025 by George Farmer of Air Matters Ltd. The assessment was requested to determine if respirable crystalline silica is present and may be a potential risk to workers operating the train.

What we did

- An investigative assessment to determine the airborne levels of respirable dust containing crystalline silica within the locomotive cab, passenger cab, and vestibule during services between Masterton and Wellington.
- We employed real time monitoring to determine respirable dust levels and possible sources throughout a return trip on the train
- We linked observations, professional judgement and measurements to determine if a risk exists.
- We provided recommendations around controls.

What we found

- Respirable dust levels were relatively low, however crystalline silica was detected in all of the measured cabins with total composition ranging from 14-20% of the total content.
- Real-time particulate monitors indicated an increase in dust levels during deceleration of the train, and increase in levels during travels through the Remutaka tunnel.
- A potential risk exists for exposure to respirable crystalline silica; the personal exposure risk can only be determined/quantified with personal exposure monitoring.

What the business can do

- Facilitate personal exposure monitoring of workers on train services that pass through the Remutaka tunnel.
- Conduct inspections and testing of train cabin seals.
- Conduct inspections on train HVAC systems, and install HEPA filters where possible.
- Increase the frequency of housekeeping within locomotive and passenger cabins to reduce the amount of accumulated dust that can become airborne.
- Continuous particulate measuring monitors may be installed in strategic points within the tunnel to ensure continuous monitoring of dust levels and assess effectiveness of control measures before and after they have been implemented.

- Static monitoring may be conducted within the Remutaka tunnel to determine the baseline levels of dust containing respirable crystalline silica.

What workers can do

- Where applicable, workers should operate with closed cabin windows and doors at all times.

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Terms and Abbreviations

Terms & Abbreviations	Explanation
ACGIH	The American Conference of Governmental Industrial Hygienists
ALARP	As low as reasonably practicable (even if a risk cannot be eliminated, practical solutions should be implemented to reduce the risk)
HEPA	High efficiency particulate arrestor
HSWA	Health and Safety at Work Act 2015, New Zealand's workplace health and safety law
HSW (GRWM)	Health and Safety at Work (General Risk and Workplace Management) Regulations 2016
mg/m^3	Milligrams per cubic metre
NMAM	NIOSH Manual of Analytical Methods
NZOHS	New Zealand Occupational Hygiene Society
MBIE	Ministry of Business, Innovation and Employment
PPE	Personal protective equipment
RCS	Respirable crystalline silica
SEG	Similar Exposure Group. A group of workers having the same general exposure profile for the agent(s) being studied because of the similarity and frequency of the tasks they perform, the materials and processes with which they work and the similarity of the way they perform the tasks (Mulhausen et al, 1998)
SOP	Standard operating procedure
TWA	Time-weighted average
WES	Workplace Exposure Standard

1. Introduction

An investigative workplace assessment for respirable crystalline silica (RCS) was undertaken onboard a train servicing the KiwiRail Wellington-Masterton Passenger Service Line. This assessment was performed on 9 June 2025 by George Farmer of Air Matters Ltd. The assessment was requested to determine if RCS poses a potential health risk to occupants. This follows reports of excessive dust generation during train movements through the Remutaka Tunnel.

KiwiRail operates the rail line that runs through Remutaka Tunnel. Remutaka Tunnel is a railway tunnel through New Zealand's Remutaka Range, between Maymorn (near Upper Hutt) and Featherston, on the Wairarapa Line. This tunnel is approximately 8.93km long.

Rail ballast in New Zealand typically consists of crushed sedimentary rock (greywacke and/or basaltic andesite, depending on the region from which it is sourced), which is known to contain crystalline silica (a hazard). Crystalline silica particles can become airborne when disturbed by rail activities, thereby increasing the likelihood of exposure that may lead to harm.

This report presents the results, conclusions and recommendations in the body, the monitoring methodology, exposure standards and additional site operation details in the appendices.

2. Objectives

- To measure the levels of airborne respirable dust in various cabin areas of passenger trains during transit to determine if RCS is present.
- To employ real time monitors during 2 trips between Wellington and Masterton to determine particulate levels during a trip, noting that each trip passes through the Remutaka Tunnel.
- Measurements will be used to assess if the hazard of RCS translates into a possible risk to health for workers operating trains passing through the Remutaka tunnel.
- To clearly report the findings of this assessment.
- Provide recommendations based on these findings.

3. Sampling strategy

Static samples represent concentrations of particulate at selected areas to gain an understanding of the operational environment, and to determine if RCS can be found, and if so, to what extent. While static concentrations cannot directly be compared to a workplace exposure standard (WES) due to the dynamic nature of workplace exposures, it serves as a reference point to determine if a hazard may translate to a risk.

High flow samples were used in the locomotive cabin, as well as the vestibule as an additional resource, to sample a higher volume of air and ensure that in the case where respirable crystalline silica was not detected on a conventional sample, that the level of detection in laboratory analysis could be reached in order to quantify RCS.

Real-time monitors were deployed to log respirable particulate levels during the measurement period to establish timeframes when particulate levels increase/decrease during the passenger service.

Sampling methodology can be found in Appendix A of this report.

The sampling plan is presented below.

Table 3-1: Sampling strategy

Location	Exposure Agent	Sample Numbers	Sample Duration
Passenger Car	Respirable dust and RCS	1x static sample	Approximately 4 hours (Return trip from Masterton-Wellington) Pump switched off while stationary at Wellington Station
Vestibule Area		1x static sample	
Locomotive Cab		1x static sample	
Locomotive Cab	RCS	1x static high flow sample	
Vestibule Area		1x static high flow sample	
Passenger Car	Respirable Dust	1x real-time sample	Approximately 2 hours per one-way trip for each location
Vestibule Area		1x real-time sample	
Locomotive cabin		1x real-time sample	

Although it was initially planned to take a sample outside the train, it was determined that it would not provide reliable results due to the movement speed of the train and the resulting pressure differences.

High flow/high volume samples were taken in the areas anticipated to have higher particulate levels to determine if it contained airborne crystalline silica.

The train services selected for sampling are shown below, and was based on worst case scenario, where prior services have already passed through the tunnel, potentially causing dust to become/remain airborne:

- Masterton to Wellington (Departure 06:47)
- Wellington-Masterton (Departure 17:30)

4. Results

The following table summarises the measured results in various cabins/locations onboard the passenger service train between Wellington and Masterton.

Table 4-4-1: Measured results and calculated exposure value from this assessment

Sample ID	Area	Train service sampled	Exposure agent	Measured value (mg/m³)	Percentage silica to dust in sample (%)
R1	Locomotive cabin	Masterton-Wellington (Scheduled departure 06:47) Train no. 1605	Respirable Dust	0.04	14
			Crystalline Silica	0.006	
R2	Vestibule (between last 2 passenger cabins)		Respirable Dust	0.06	20
			Crystalline Silica	0.011	
R3	Southern (last) passenger cabin	Wellington-Masterton (Scheduled departure 17:30) Train no. 1608	Respirable Dust	0.05	17
			Crystalline Silica	0.009	
HF3	Locomotive cabin		Crystalline Silica	0.003*	-
HF2	Vestibule (between last 2 passenger cabins)		Crystalline Silica	0.014*	-

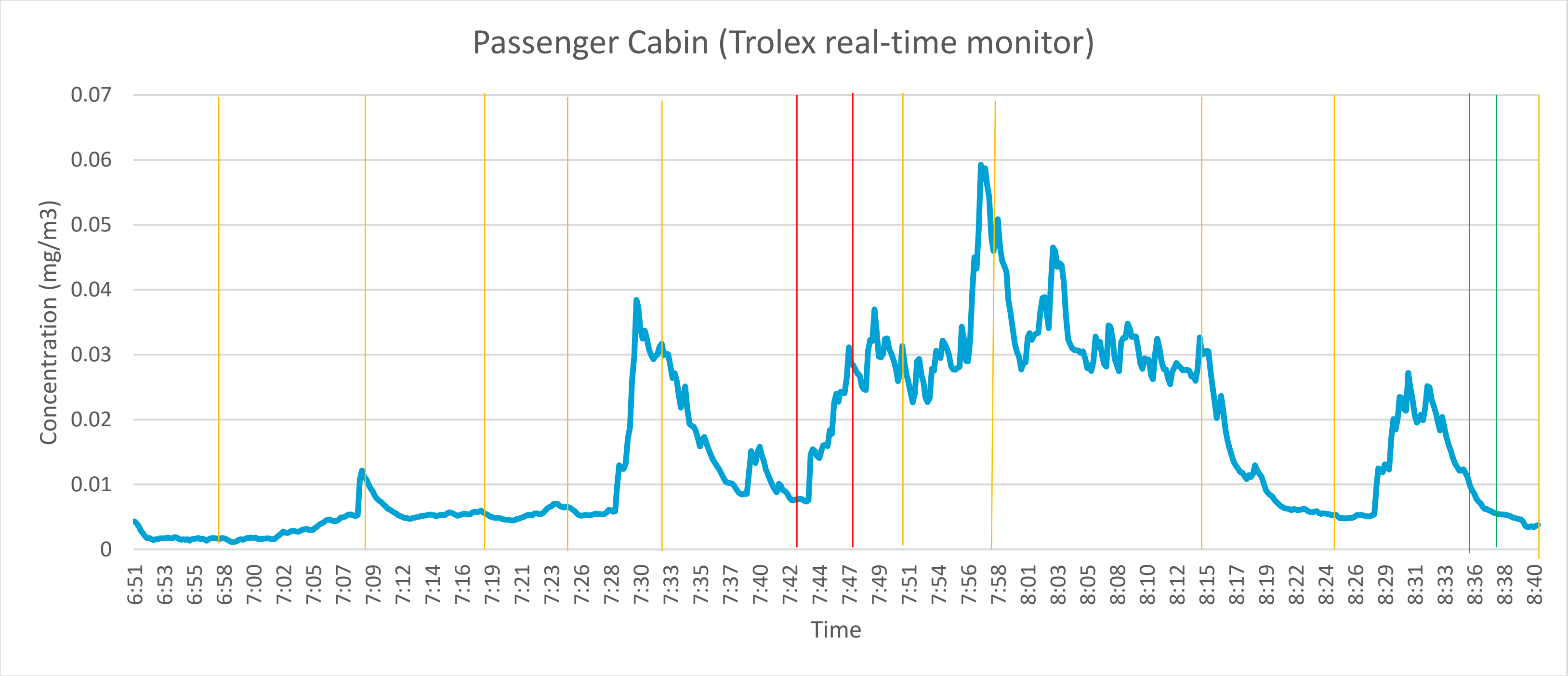
Note **Static samples cannot be compared directly to a workplace exposure standard, however are used to present conditions in the sampled area**

***** **High flow pumps used to sample maximum volume of air**

5. Realtime particulate results

The following results cannot be compared directly to the WES rather they provide an indication of the potential risk and direction as to whether personal exposure monitoring should be undertaken. Where appropriate, international best practice standards have been used. The real-time dust monitoring results do not identify what particulate type was present in the air during sampling. See the following pages for indicative graphs:

Figure 5-1: Realtime respirable particulate levels inside the passenger cab during a trip from Masterton to Wellington



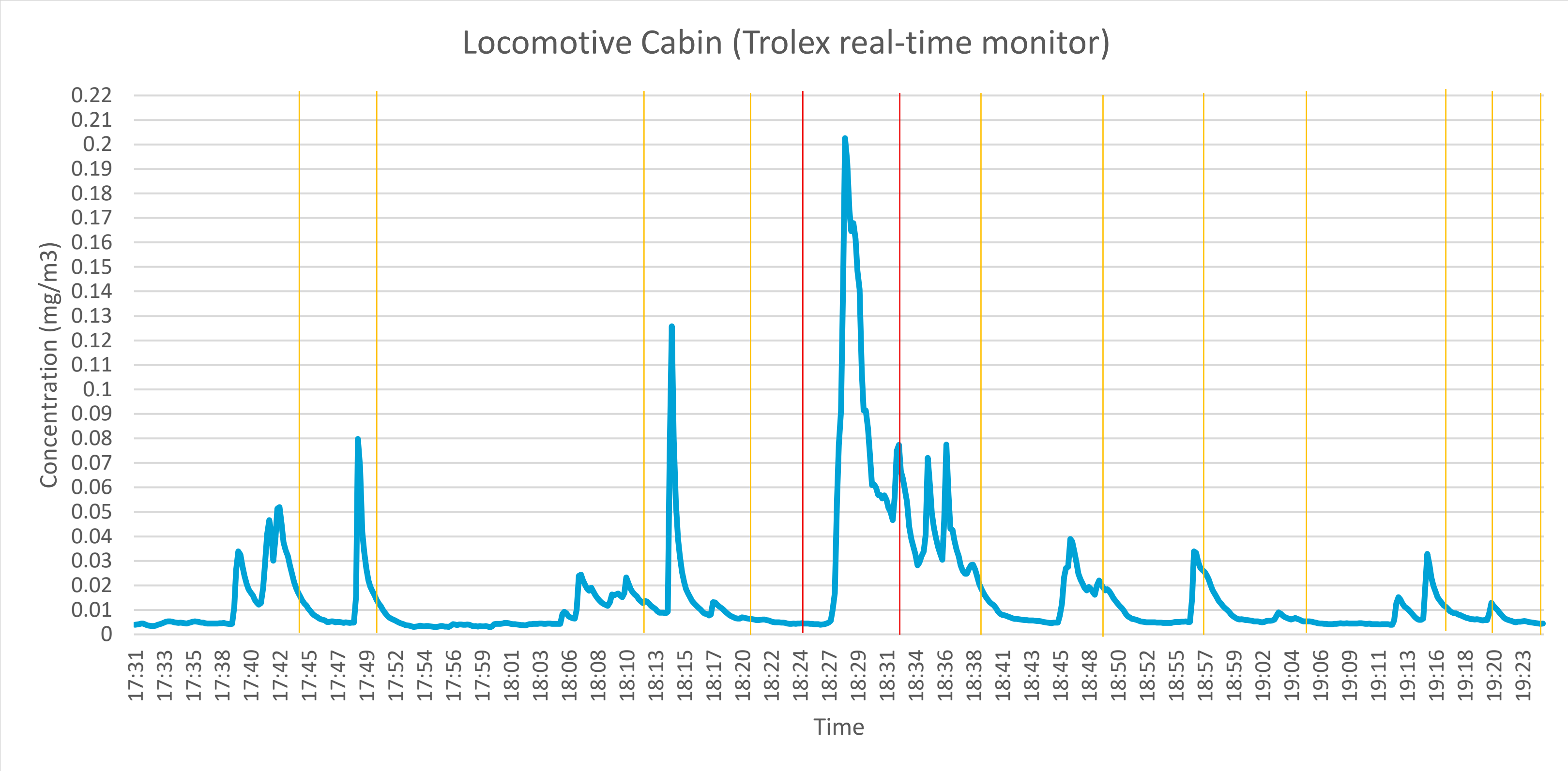
Legend:

Scheduled train station stops

Remutaka tunnel

Unscheduled stop (Waiting on vacant platform for disembarking)

Figure 5-2: Realtime respirable particulate levels inside the locomotive cab during a trip from Wellington to Masterton

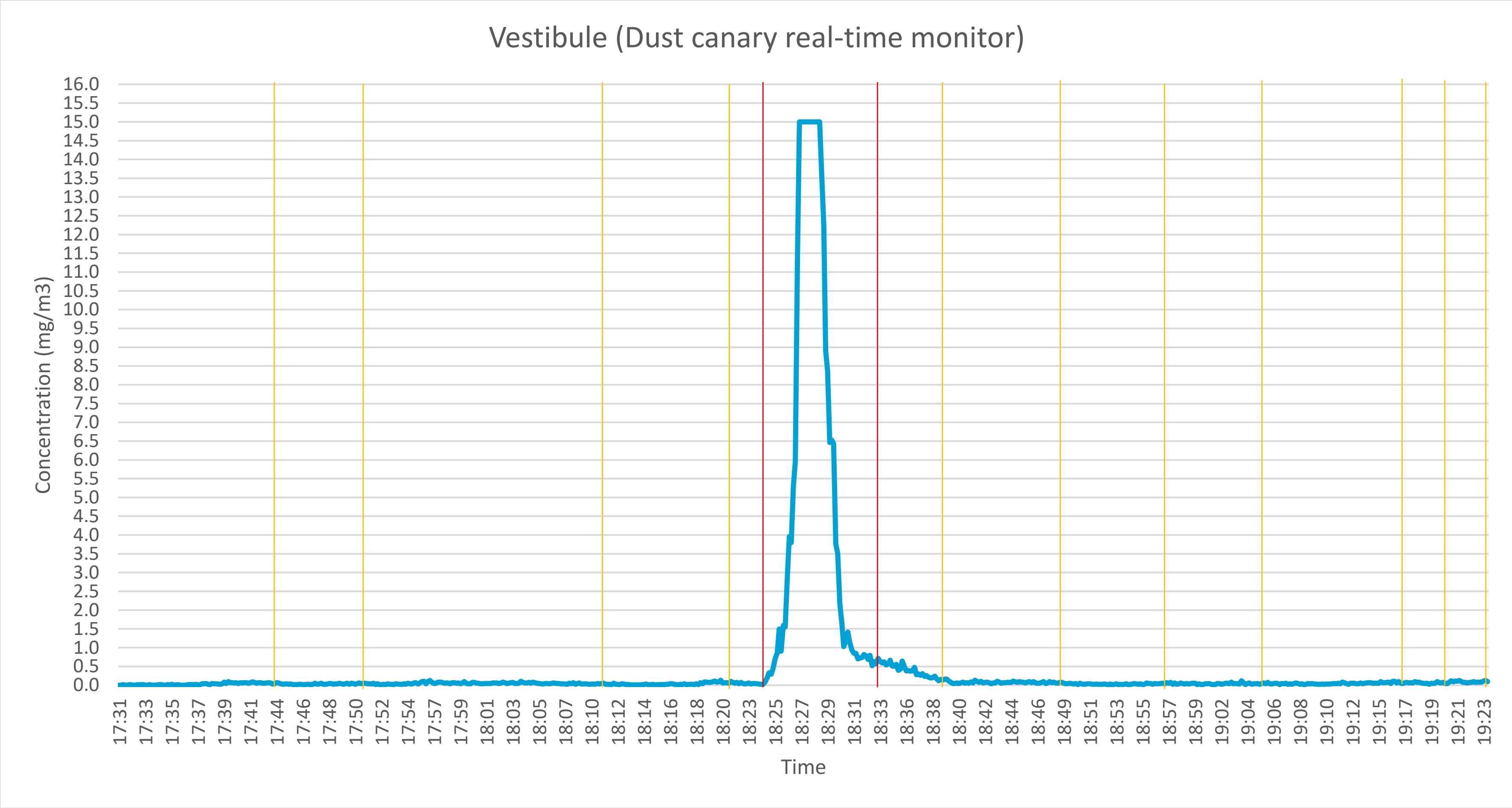


Legend:

Scheduled train station stops

Remutaka tunnel

Figure 5-3: Realtime respirable particulate levels inside the passenger cab vestibule during a trip from Wellington to Masterton



Legend:

Scheduled train station stops

Remutaka tunnel

6. Discussion

Air samplers were placed in various cabins of trains during a return trip on the Wellington/Masterton passenger service. Specific train services were sampled, Masterton-Wellington between 06:47-08:40, Train no. 1605 and Wellington-Masterton, 17:31-18:24, Train no. 1608. These services were targeted to represent worst case scenario due to prior train services passing through the tunnel, potentially causing particulates to be suspended in the air. It was reported that during maintenance activities in the immediate past, ballast has been added to the Remutaka tunnel railroad.

At the time of the assessment, the assessed cabins were found to be free from visible dust build up on surfaces, with the exception of some of the vestibule areas of cabins, where some settled dust could be observed in some corners. Due to respirable particulate sizes being less than 10 microns in diameter, it may be invisible to the naked eye, therefor highlighting the fact that it may still be present. Vestibules are typically not occupied spaces, especially whilst the train is in motion.

Passenger cars were ventilated by means of an air conditioning system, with the ability to control fresh air intake, which is used to control/dampen ingress of outside air when entering tunnels. Air conditioning systems were set to shut outside air supply during transit through the tunnel.

The locomotive cabins were enclosed and were observed to have opening windows. Locomotives are provided with a similar ventilation/air conditioning system as the passenger cabins, where air enters from air vents connected to the outside and filtered before distribution in the cabin.

Respirable dust levels were found to be low across all measured cabins, however silica was detected during laboratory analysis of the dust. The respirable dust samples were found to contain between 14-20% crystalline silica of the total composition.

Real time respirable dust monitors indicated that dust concentrations increased when the train started to decelerate before scheduled stops, this may be ascribed to resuspension of settled particles caused by airflow changes and vibrations. The change in motion disrupts airflow within the cabin, possibly causing settled dust to become airborne. The vibrations from deceleration can dislodge dust particles that have accumulated on seats, surfaces and overhead compartments. Additionally, a sharp increase in dust concentrations were observed when the train entered and remained within the Remutaka Tunnel. This may be ascribed to the pressure wave caused by the train as it travels through the tunnel, by pushing the air forward, potentially disturbing settled dust inside the tunnel and around the tracks. The pressure wave created is directly related to the trains speed through the tunnel. Typical sources of particulate inside the tunnel may originate from rail ballast, train components such as wheels, brakes and rails, as well as diesel particulate matter emitted from the locomotives. Particulate levels in the passenger cabin remained elevated for a period after travelling through the tunnel, indicating possible particulate ingress from the vestibule area and remaining suspended in the air.

Even though data from static samples cannot directly be compared to workplace exposure standards that are associated with personal air monitoring over a full work shift, an indirect comparison warrants the need for personal exposure monitoring to determine the risk of exposure to crystalline silica. Static sampling represents the conditions at a specified place, for that time sampled, and does not necessarily represent what a worker would be exposed to over a full shift due to task variability etc. During personal exposure sampling, samplers are placed within the breathing zone of the workers, and measured over a full shift to account for variations, such as time spent inside certain areas, number of trips during a shift, shift duration, and specific activities during that shift.

More information on risk assessment methodology has been provided in Appendix D of this report, and will support personal exposure assessments in the future.

Workers who are potentially exposed to RCS on train services have been divided into similar exposure groups (SEG) for personal exposure sampling to be carried out. This list is not exhaustive; however, these were the immediate groups that were identified:

Locomotive Engineer, Rail Operator, Rail Control Operator, Train Manager.

Due to the variability in the number of trips and shifts per roster/schedule of workers, personal exposure monitoring is recommended.

7. Conclusion

An investigative assessment for RCS was undertaken onboard the KiwiRail Wellington-Masterton Passenger Service Line. This assessment was performed on 9 June 2025 by George Farmer of Air Matters Ltd. The assessment was requested to determine if RCS poses a potential health risk to occupants. This follows reports of excessive dust generation during train movements through the Remutaka Tunnel.

RCS was detected in all of the measured cabins (Locomotive cabin, passenger car, as well as the vestibule section of the passenger car). The respirable dust concentration was relatively low, however it was found that silica content ranged from 14-20% of the total content. Thus, it can be concluded that the hazard has been translated to a risk and should be investigated further.

Static sampling and real-time monitoring results cannot directly be compared to workplace exposure standards (WES) as they only reflect the conditions of that area, however results indicated the need for personal exposure monitoring to determine the overall risk over a full work shift.

8. Recommendations

Exposure to workplace health hazards must be kept as low as reasonably practicable. There is an expectation in the Health and Safety at Work Act 2015 that risks are eliminated and if this is not practicable, the employer shall ensure the exposure risk is minimised by implementing controls as per the hierarchy of controls (HoC). Personal protective equipment (PPE) is often easy to implement but should only be an interim measure until effective long-term controls are in place. The use of exposure controls further up in the hierarchy often results in long-term savings, higher productivity, and greater worker retention.

The recommendations presented in Table 8-8-1 are suggestions based on the information gathered and processes observed as part of this assessment. The recommended actions are priority ordered and have the hierarchy control levels identified alongside them. This is not an exhaustive list of potential exposure controls but those determined to be most impactful by the author. The recommended controls need to be fully assessed by KiwiRail to determine if they are reasonably practicable and this evaluation needs to be documented. The review and implementation of controls should include consultation with all stakeholders. A single control measure will rarely achieve effective results and so a combination of exposure controls is often required to adequately manage workplace exposure risk.

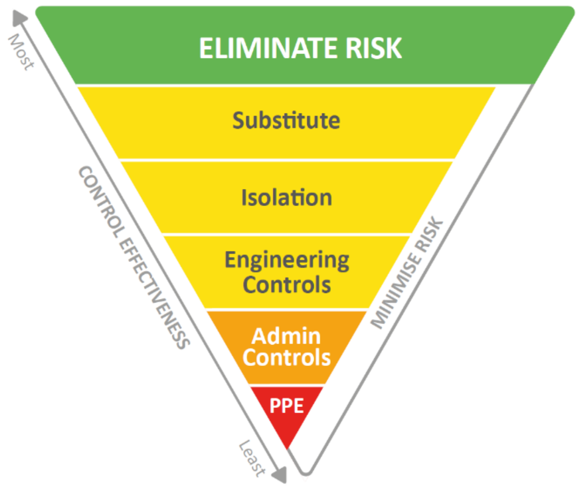


Figure 8-1: Hierarchy of Controls

Table 8-8-1: Recommended actions

Corresponding HoC	Recommended Actions
ADMINISTRATIVE/ENGINEERING	Conduct visual inspections on all cabin seals, the integrity can be verified by means of visual smoke tests to determine if leaks are present.
	HVAC systems on all train cabins should be inspected, and where possible, HEPA filters fitted.
	The Remutaka tunnel ballast may be sealed by applying a spray applicated sealant, binding fine dust particles together, preventing them from becoming airborne. Sealants may assist in binding of these particulates.
ADMINISTRATIVE	Personal air monitoring should be conducted on personnel operating trains that travel through the Remutaka tunnel to determine their exposure levels to respirable crystalline silica. Static monitoring may be conducted within the Remutaka tunnel to determine the baseline levels of dust containing silica.
	Continuous particulate measuring monitors may be installed in strategic points within the tunnel to ensure continuous monitoring of dust levels and assess effectiveness of control measures before and after they have been implemented.
	The frequency of housekeeping within train cabins should be increased to reduce the amount of accumulated dust from becoming airborne. Where a vacuum cleaner is used, it should be fitted with HEPA filters, otherwise small particulates may not be captured effectively by conventional filters, thereby facilitating the particles becoming airborne. Dry sweeping or compressed air should not be used for removing dust.
	Train speeds may be decreased as an interim measure when travelling through the tunnel, this may assist in decreasing pressure levels as the train passes through, possibly resulting in lower airborne levels of dust. This may be implemented until other controls can be established.

9. Limitations

- Static samples cannot be directly compared to workplace exposure standards and are not representative of personal exposure, however they represent the conditions for a specified area, for that time duration.
- The number of sampling days was limited, thus the results represent conditions for only the one sample day and do not take into consideration variations, such as the number of trains passing through the tunnel per day, size/number of carriages, cargo, meteorological conditions etc.

10. References

- AIOH, June 2020, Simplified Occupational Hygiene Risk Management Strategies, Second Edition.
- New Zealand Government. Health and Safety at Work Act, 2015.
- AS2985-2009 - Workplace atmospheres - Method for sampling and gravimetric determination of respirable dust.
- MULHAUSEN J., DAMIANO J. (2015) Chapter 4, *Establishing Similar Exposed Groups. In A strategy for assessing and managing occupational exposures*, 4th Edition, Jahn, Bullock and Ignacio, Eds. American Industrial Hygiene Association, Falls Church, VA 22042, USA.

Appendices

Appendix A Methodology

Respirable Dust containing Crystalline Silica

Static respirable dust and respirable crystalline silica samples were collected per OSHA ID-142 (modified). The samplers were placed in the cabins, with the inlets located at a height that would typically represent the same height as the breathing zones of occupants. Workplace air was drawn through an SKC disposable parallel particle impactor (PPI) loaded with a 37-millimeter PVC filter (5-micron pore size) and backing pad, using pulsation-dampening air sampling pumps calibrated/flow checked at 4 litres per minute (pre & post sampling). The samples were collected over a return trip between Masterton-Wellington and is only representative of that (Sampling pumps were only switched on during the stated passenger services). The samples were gravimetrically weighed and thereafter analysed for quartz (crystalline silica) using infrared spectroscopy. This analysis was undertaken by Envirolab Services.

Crystalline Silica (High flow sampling)

Static respirable dust and crystalline silica samples were collected per OSHA ID-142 (modified). The samplers were placed in the cabins, with the inlets located at a height that would typically represent the same height as the breathing zones of occupants. Workplace air was drawn through an Aluminium cyclone loaded with a 47-millimeter PVC filter (5-micron pore size) and backing pad, using pulsation-dampening air sampling pumps calibrated/flow checked at 9 litres per minute (pre & post sampling). The samples were collected over a return trip between Masterton-Wellington and is only representative of that (Sampling pumps were only switched on during the stated passenger services). The samples were analysed for quartz (crystalline silica) using infrared spectroscopy. This analysis was undertaken by Envirolab Services.

Real time dust monitoring

Real-time area dust levels were monitored using a Dust Canary and a Trolex XD-1 Particulate Monitor. Different brands of monitors were used due to availability. The particulate monitors display a real-time digital log of dust concentration using a laser photometer which was set up to measure respirable particulate fractions. The unit takes a reading every second and was set to data log 10 second averages. The monitors were deployed inside the locomotive cabin, passenger cabin and within the vestibule between the last 2 train carts. The height was approximately 800mm above the seat plane, the same height as the breathing zone for seated persons (more or less).

Monitor	Serial number	Dust fractions
Dust Canary	DC564014	Respirable
Trolex XD-1	IG01146	Respirable

Appendix B Raw Data

Sample No	Analyte	Work Area	Sampling Date	Pump Used	Cassette Used	Start and End Time	Official Total Time (min)	Pre-cal flow (L/min)	Post-cal flow (L/min)	±5% of flow (L/min)	Final flow (L/min)	Sample Volume (m3)	Mass Value (mg)	Measured concentration (mg/m^3)
R1	Respirable Dust	Locomotive Cabin	9/06/2025	GAP 50	PPI 09747	(6:27-8:57) & (17:15-19:30)	285	3.954	3.921	**0.83%**	3.94	1.122	0.05	**0.04**
R2	Respirable Dust	Vestibule	9/06/2025	GAP 51	PPI 09594	(6:35-8:51) & (17:20-19:26)	262	4.051	4.04	**0.27%**	4.05	1.060	0.06	**0.06**
R3	Respirable Dust	Passenger Cab	9/06/2025	GAP 52	PPI 09531	(6:47-8:51) & (17:25-19:24)	238	4.048	4.041	**0.17%**	4.04	0.963	0.05	**0.05**
R1	Crystalline Silica	Locomotive Cabin	9/06/2025	GAP 50	PPI 09747	(6:27-8:57) & (17:15-19:30)	285	3.954	3.921	**0.83%**	3.94	1.122	0.0072	**0.0064**
R2	Crystalline Silica	Vestibule	9/06/2025	GAP 51	PPI 09594	(6:35-8:51) & (17:20-19:26)	262	4.051	4.04	**0.27%**	4.05	1.060	0.0120	**0.0113**
R3	Crystalline Silica	Passenger Cab	9/06/2025	GAP 52	PPI 09531	(6:47-8:51) & (17:25-19:24)	238	4.048	4.041	**0.17%**	4.04	0.963	0.0086	**0.0089**

Sample No	Analyte	Work Area	Sampling Date	Pump Used	Cassette Used	Start and End Time	Official Total Time (min)	Pre-cal flow (L/min)	Post-cal flow (L/min)	±5% of flow (L/min)	Final flow (L/min)	Sample Volume (m3)	Mass Value (mg)	Measured concentration (mg/m^3)
HF3	Crystalline Silica	Locomotive Cabin	9/06/2025	G12-01	Cyclone	(6:27-8:57) & (17:15-19:30)	285	8.9	8.892	**0.09%**	8.90	2.535	0.0085	**0.0034**
HF2	Crystalline Silica	Vestibule	9/06/2025	G12-02	Cyclone	(6:35-8:51) & (17:20-19:26)	262	8.906	8.888	**0.20%**	8.90	2.331	0.0320	**0.0137**

Appendix C Health Effects

The health effects of exposure agents referred to in this assessment are presented in the table below.

Table C-1: Health effects

Substance	Health Effects
Particulates not otherwise classified (respirable dust)	
Worsen or contribute to chronic obstructive pulmonary disease (COPD), occupational asthma and fibrosis	
Crystalline silica	
Silicosis (fibrosis of the lung), lung cancer (confirmed human carcinogen), renal toxicity, increased risk of tuberculosis and autoimmune diseases Epidemiological studies of occupational populations have shown that silicosis occurs at the lowest estimated cumulative exposure levels reported, thus a “no-observed-effect level” (NOAEL) has not been defined. Best practice dictates to reduce levels to as low as reasonably practicable (ALARP)	

Table C-2: Workplace exposure standards to be incorporated for future personal exposure sampling

Exposure Agent	Exposure standard (8-hr TWA)
Respirable Dust – Particulates not otherwise classified (PNOC)	3 mg/m^3 (r)
Respirable Crystalline Silica	0.025 mg/m^3 (r)

Appendix D Additional Information on Risk Assessment

The following three tables provide additional information on the categories used to determine overall health risk determination. These tables provide context on how health consequences, likelihood and risk is determined.

Health effects categories

Table: Appendix D-1: AIOH health consequence categories

Scale Rating	Consequence	Description
5	Severe	Can potentially cause fatality, cancer or reproductive / genetic health effects to one or more people resulting from chemical, physical or biological agent exposures.
4	Major	Can potentially cause irreversible health effects or disabling illness to one or more people resulting from chemical, physical or biological agent exposures.
3	Moderate	Can cause severe, reversible health effects of concern - could result in a lost time illness.
2	Minor	Can cause reversible health effects of concern that would typically result in a medical treatment with no lost time.
1	Negligible	Can cause reversible health effects of little concern (e.g. temporary discomfort), requiring first aid treatment at most.

Exposure rating categories

The likelihood of exposure is a descriptor of the probability / frequency of exposure leading to the consequence that is associated with the hazard under consideration. In determining likelihood, it is necessary to consider the exposure to a hazard and the probability that harm will occur following that exposure. Exposure may be viewed in terms of frequency or time, that is, how often or how long one is exposed, and the concentration, or the level, of the contaminant or agent. For this assessment the following tables describe how the likelihood is estimated for airborne contaminants.

Table Appendix D-2: AIOH health exposure rating categories

Likelihood		Description
A	Almost certain	regular contact with the potential hazard at very high levels
B	Likely	periodic contact with the potential hazard at very high levels or regular contact with the potential hazard at high levels
C	Possible	periodic contact with the potential hazard at high levels or regular contact with the potential hazard at moderate levels
D	Unlikely	periodic contact with the potential hazard at moderate levels or regular contact with the potential hazard at low levels
E	Rare	periodic contact with the potential hazard at low levels

Health Risk Assessment Criteria

The main goal of a health risk assessment in the workplace is to evaluate overall risk by considering identified health consequences and exposure levels. This type of assessment helps determine if control measures are needed to safeguard worker health.

Air Matters utilises the most appropriate international guidance in its risk assessment process, such as that produced by Australian Institute of Occupational Hygiene (AIOH) (AIOH, 2020). The AIOH sets out a framework for health risk management along with matrices to be used in decision-making around the combination of health effect and exposure ratings.

Table D-3 below shows the 'AIOH Health Risk Matrix' which can be used to assess the initial estimated overall health risk and to help inform the further actions that are required. This matrix uses the consequence rating (reflecting health consequences) and the likelihood rating (indicating a likelihood of exposure) to derive an overall health risk rating.

Table Appendix D-3: AIOH health risk matrix

Likelihood Rating (exposure)		Consequence Rating				
		1 Negligible	**2** Minor	**3** Moderate	**4** Major	**5** Severe
A	Almost Certain	Medium	High	High	Extreme	Extreme
B	Likely	Medium	Medium	High	High	Extreme
C	Possible	Low	Medium	Medium	High	High
D	Unlikely	Low	Low	Medium	Medium	High
E	Rare	Low	Low	Low	Medium	Medium

The outcome of applying this matrix is to inform decision priorities and overall risk levels based on the health effect and exposure rating inputs. It helps determine where to focus controls in order to minimise exposure. The results section of this report presents a summary table of the health risk, exposure risk and overall risk category for each similar exposure group (SEG).

Appendix E Analytical Reports

Envirolab Services (WA) Pty Ltd trading as MPL Laboratories
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Certificate of Analysis PGF0917

Client Details

Client	Air Matters Ltd
Contact	George Farmer
Address	587B Mt Eden Rd,, AUCKLAND, NEW ZEALAND, 1342

Sample Details

Your Reference	P25205 - KiwiRail Wellington
Number of Samples	9 Filter
Date Samples Received	13/06/2025
Date Instructions Received	13/06/2025

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for soils and on an as received basis for other matrices.

Report Details

Date Final Results Expected	20/06/2025
Date of Issue	20/06/2025

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Authorisation Details

Airborne Dust Approved By	Shirleen Goh
Results Approved By	Shirleen Goh, OH Lab Analyst
Laboratory Manager	Michael Kubiak

Certificate of Analysis PGF0917

Respirable Dust (Filter)

Envirolab ID	Units	PQL	PGF0917-01	PGF0917-02	PGF0917-03	PGF0917-04	PGF0917-05
Your Reference			R1 ANZ 55 - 09747	R2 ANZ 60 - 09594	R3 ANZ 57 - 09531	R4 ANZ 58 - 09440	R5 ANZ 59 - 09474
Date Sampled			09/06/2025	09/06/2025	09/06/2025	09/06/2025	09/06/2025
Dust	mg	0.040	0.050	0.060	0.050	<0.040	0.040

Envirolab ID	Units	PQL	PGF0917-06
Your Reference			R6 ANZ 56 - 09654
Date Sampled			09/06/2025
Dust	mg	0.040	<0.040

Certificate of Analysis PGF0917

Respirable Crystalline Silica (Filter)

Envirolab ID	Units	PQL	PGF0917-01	PGF0917-02	PGF0917-03	PGF0917-04	PGF0917-05
Your Reference			R1 ANZ 55 - 09747	R2 ANZ 60 - 09594	R3 ANZ 57 - 09531	R4 ANZ 58 - 09440	R5 ANZ 59 - 09474
Date Sampled			09/06/2025	09/06/2025	09/06/2025	09/06/2025	09/06/2025
a-Quartz	µg/sample	5.0	7.2	12	8.6	<5.0	<5.0

Envirolab ID	Units	PQL	PGF0917-06	PGF0917-07	PGF0917-08	PGF0917-09
Your Reference			R6 ANZ 56 - 09654	HF 1 HFR 1	HF 2 HFR 2	HF 3 HFR 3
Date Sampled			09/06/2025	09/06/2025	09/06/2025	09/06/2025
a-Quartz	µg/sample	5.0	<5.0	<5.0	32	8.5

Certificate of Analysis PGF0917

Method Summary

Method ID	Methodology Summary
DUST-004_QTZ	Respirable Quartz (and/or Cristobalite) is determined after ashing, redeposition and FTIR determination. The Quartz exposure standard is 50µg/m3, therefore where sampling follows MDHS 101 guidelines and at least 500L of air is sampled, this is equivalent to a dust weight of 25µg/filter. The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 25µg at 95% confidence limit (i.e. statistically the true value lies between 15-35µg / filter (30 – 70 µg/m3) at 95% confidence). The estimated measurement uncertainty was determined during method validation. NSW Resources Regulator have licenced (MLA0017505) Envirolab/MPL for the Analysis of Inhalable & Respirable Dust and Respirable Crystaline Silica.
INORG-100_RESP	Gravimetric determination of Respirable dust as pre AS2985. NSW Resources Regulator have licenced (MLA0017505) Envirolab/MPL for the Analysis of Inhalable & Respirable Dust and Respirable Crystaline Silica.

Data Quality Assessment Summary PGF0917

Client Details

Client	Air Matters Ltd
Your Reference	P25205 - KiwiRail Wellington
Date Issued	20/06/2025

Recommended Holding Time Compliance

No recommended holding time exceedances

Quality Control and QC Frequency

QC Type	Compliant	Details
Blank	Yes	No Outliers
LCS	Yes	No Outliers
Duplicates	Yes	No Outliers
Matrix Spike	Yes	No Outliers
Surrogates / Extracted Internal Standards	Yes	No Outliers
QC Frequency	Yes	No Outliers

Surrogates/Extracted Internal Standards, Duplicates and/or Matrix Spikes are not always relevant/applicable to certain analyses and matrices. Therefore, said QC measures are deemed compliant in these situations by default. See Laboratory Acceptance Criteria for more information