HAZCON Pty Ltd

Health, Safety & Environmental Consultants

REPORT TO: Shire of Campaspe

ASSESSMENT OF AIRBORNE ROAD DUST AND POTENTIAL SILICA EXPOSURE

Report Number: 15-1313-01

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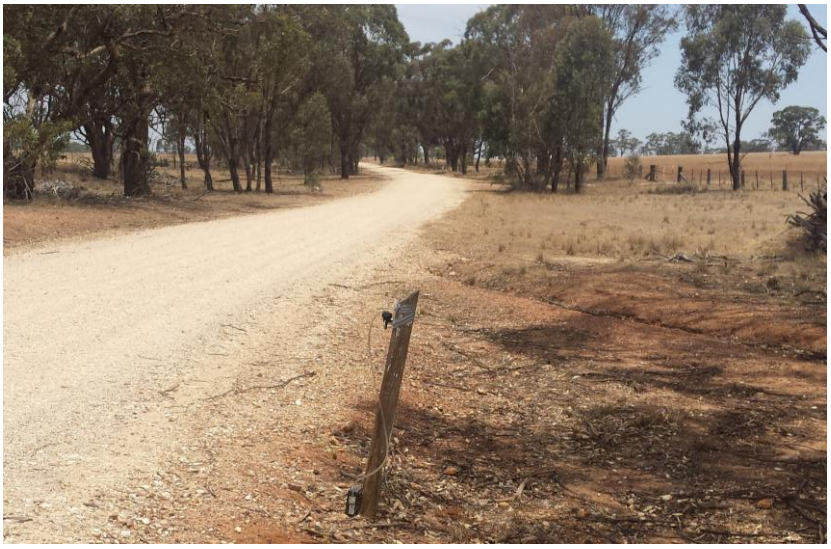

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1. EXECUTIVE SUMMARY

Introduction

Ms Christine Hartwell requested HAZCON Pty Ltd conduct a preliminary assessment of airborne road dust and potential silica exposure within the Shire of Campaspe. A consultant from HAZCON visited the Shire of Campaspe and surrounding areas to conduct specific dust monitoring on the 21st-23rd of December 2015.

This assessment was initiated due to community concern over ongoing road building and maintenance works using rock product known to contain silica. In particular, the exposure of local residents to crystalline silica from driving on and living beside these roads. The Shire of Campaspe sources the rock for road making activities from either the Shire's own quarries or external providers.

Methodology/Standards

In order to measure respirable roadside dust levels including crystalline silica content, static monitoring was conducted over a period of 4-8 hours in twenty nine (29) locations. As wind direction differed, monitoring locations were chosen to provide maximum 'exposure' to road dusts (downwind).

Whilst guidelines exist, there are currently no Australian Standards for environmental levels of respirable dust or crystalline silica. Health criteria for crystalline silica developed by other national and international agencies are based on occupational respirable crystalline silica studies, as few studies of environmental exposure to silica have been conducted.

All studies into environmental dust and silica require long term monitoring to capture the cyclic nature of dust generation (low periods during night time/wet months and high periods during the day/dry months). For the purpose of this assessment short term representative samples of worst case conditions (dry, windy, day time) were taken to identify a likely health risk or the requirement for further monitoring.

Understanding Dust

According to the Glossary of Atmospheric Chemistry Terms, dust is "Small, dry, solid particles projected into the air by natural forces, such as wind, volcanic eruption, and by mechanical or manmade processes such as crushing, grinding, milling, drilling, demolition, shovelling, conveying, screening, bagging, and sweeping. Dust particles are usually in the size range from about 1 to 100 µm in diameter, and they settle slowly under the influence of gravity."

Respirable Dust (less than 10um)

Respirable particles are the proportion of particulate matter which, when inhaled, penetrate into the uncilliated airways of the lungs, generally found to be less than 10µm in size with an average aerodynamic diameter of 3.5-5 µm. Respirable particles are normally too fine to see unless specific lighting conditions exist.

Most of the respirable dust can be removed by macrophages (white blood cells) in the lungs, the body's defence mechanism. If too much respirable dust enters the lungs, it can overwhelm these defences, and these particles can accumulate in lung tissues which over time can cause scarring, inflammation and other health issues.

Crystalline Silica

The mass of Earth's crust is 59 percent silica. Silica (silicon dioxide) is a basic component of soil, sand, granite and the main constituent of more than 95 percent of the known rocks. There are non-crystalline and crystalline forms of silicon dioxide. Crystalline silica is also known as free silica. Crystalline silica dust particles which are small enough to penetrate deep into the lungs are termed respirable. Respirable crystalline silica may cause lung damage. The non-crystalline form of silica does not cause this kind of lung damage.

Results

Thirty one (31) road sample locations were monitored. Of these sites two (2) were voided; one (1) due to obvious interference from the public (this site was re-tested) and one (1) due to a lab anomaly.

Respirable Dust

Respirable dust for all locations was generally low, not exceeding 0.36 mg/m^3. On face value, there appears to be minimal correlation between respirable dust concentrations, road material or car volume. Rather speed and road type (gravel or shoulder) contributed to dust generation.

Crystalline Silica

It was found that of the twenty nine (29) successful samples, twenty four (24) were below the level of detection for silica (0.02 mg/m^3), three (3) had low levels just above the level of detection thus subject to a 95% statistical uncertainty* and two (2) contained levels of crystalline silica at 0.08 mg/m^3 and 0.06 mg/m^3.

All samples resulting in identifiable silica content were rural gravel roads, with a speed limit of 100 km. Roads were constructed out of rock from Mt Scobie, Nanneella and Lake Cooper quarries.

** The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 50µg at 95% confidence limit (i.e. statistically the true value lies between 30-70µg / filter (60 – 140 µg/m^3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.*

Conclusion

General Dust Observations

For the purpose of this study, roads were chosen to provide a representative sample of all materials sourced and used on council roads.

Road side observations during monitoring suggest that neither Mt Scobie, Nanneella nor other rock products appeared more or less "dusty". It was noted that irrelevant of the road material, passing traffic on gravel roads all created some level of airborne dust, whilst unsealed shoulders had minimal dust release. However, given the stark whitish colour of the Mt Scobie material, the dust was more visible on these roads when both airborne or settled.

Respirable Dust/Crystalline Silica

The results indicate some levels of identifiable crystalline silica exist on unsealed roads in the Shire of Campaspe. This is not unexpected and is consistent with road making activities across Australia. Given the levels of dust and low levels of associated silica as a worst case scenario, there is little evidence to suggest that the road making material and the unsealed roads in the Shire of Campaspe pose an unacceptable health risk to people living in the Shire.

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2. INTRODUCTION

Ms Christine Hartwell of the Shire of Campaspe requested HAZCON Pty Ltd conduct a preliminary assessment of airborne road dust and potential silica exposure within the Shire of Campaspe.

A consultant from HAZCON visited the Shire to conduct specific dust monitoring on the 21st-23rd of December 2015. Council's Road Services Manger Mr Ollie McNulty was present to provide an initial site induction and to provide background on the roads and construction activity across the Shire.

3. BACKGROUND

The Shire of Campaspe is located in North Central Victoria, about 180 kilometres north of Melbourne. The Shire encompasses a total land area of about 4,500 square kilometres. Land is used mainly for agriculture, particularly dairy farming, cereal and grain growing and sheep grazing. Tourism is also an important industry. The Shire council is responsible for over 4,000 km of local roads, of which 2,100 km are gravel.

To maintain these roads the Shire of Campaspe undertakes a significant amount of on-going road building and maintenance. The product used for these road making activities comes from one of two sources:

i) Either the Shire's own quarries; or
ii) From external providers.

The assessment of road dust and potential silica exposure was initiated as a result of health concerns from members of the public and council members with regards to respirable crystalline silica. The community has raised concerns about the specific silica content of the quarry material and potential local exposure when applied to road construction. The concerns have focussed on the rock material derived from Mt Scobie quarry, which has a characteristic whitish colour.

In addition to this report, the Shire of Campaspe has produced Safety Data Sheets (SDS) for the rock products from all council quarries and conducted atmospheric monitoring within the Mt Scobie and Nanneella quarries (refer to report 15-1313-02). These studies have been conducted primarily for assessing the workplace for its employees and contractors to meet Councils Occupational Health and Safety (OHS) requirements under the OHS legislation.

4. SCOPE OF ASSESSMENT

The scope of the assessment was to determine, through static atmospheric monitoring:

i) The indicative levels of respirable roadside airborne dust; and
ii) The potential for roadside crystalline silica exposure.

5. LIMITATIONS

The assessment was undertaken in conditions of maximum levels of dust generation; samples were taken during the day when vehicle activity was generally at its highest in the summer period.

- Results were recorded over an unattended 4-8 hour period, in the case of interference results may not accurately represent the dust environment; suspected interference has been noted in discussion.
- Results were recorded as short term representative samples (4-8 hour duration), therefore results reflect the environment only at the time of monitoring; suspected variations have been noted in discussion.
- External weather conditions may influence dust measurements at the time of monitoring; suspected influencing parameters have been noted in discussion.
- For the purpose of this assessment total inhalable dust was not measured; only the respriable fraction of dust was considered, which is more likely to cause adverse health effects.

6. METHODOLOGY

The dust assessment involved static roadside monitoring over a period of 4-8 hours, in line with the Australian Standard 2985-2009. As wind direction differed, monitoring locations were chosen to provide maximum 'exposure' to road dusts (downwind). For the purpose of this assessment, respirable cyclone dust samplers which collected a 3.5-5 µm fraction were used, connected to SKC AirChek air sampling pumps. (All sampling pumps are internally calibrated every six months as per HAZCON Quality Assurance Procedure AP5.005).

The respirable dust samples were further analysed for respirable crystalline silica (α-quartz) using Fourier Transform Infrared Spectroscopy (FTIR) in accordance with NIOSH Method 7603 by MPL Laboratories, National Association of Testing Authorities (NATA) accredited laboratory.

Whilst guidelines exist there are currently no Australian Standards for environmental levels of respirable dust or crystalline silica. Health criteria for crystalline silica developed by other national and international agencies are based on occupational respirable crystalline silica studies, as few studies of environmental exposure to silica have been conducted.

All studies into environmental dust and silica require long term monitoring to capture the cyclic nature of dust generation (low periods during night time/wet months and high periods during the day/dry months). For the purpose of this assessment short term representative samples of worst case conditions were taken to indicate a likely health risk or the requirement for further monitoring.

7. UNDERSTANDING DUST AND ASSOCIATED HEALTH EFFECTS

According to the Glossary of Atmospheric Chemistry Terms, dust is "Small, dry, solid particles projected into the air by natural forces, such as wind, volcanic eruption, and by mechanical or manmade processes such as crushing, grinding, milling, drilling, demolition, shovelling, conveying, screening, bagging, and sweeping. Dust particles are usually in the size range from about 1 to 100µm in diameter, and they settle slowly under the influence of gravity."

7.1. Total Inhalable Dust (1-100um)

Inhalable dust, otherwise called “nuisance dust” is particulate matter consisting of all airborne particulates inhaled through the nose or mouth (including the respirable dust fraction). The health effects associated with airborne dust have been well documented, besides a reduction in visibility (with potential safety implications), dust in air can result in contamination in the nose and in the tubes leading to the lungs which often causes physical discomfort and irritation (runny nose, sneezing, watering eyes, coughing), in turn causing rhinitis or bronchitis.

However, generally the larger particle proportion of inhalable dust is simply filtered out in the nose and in the upper respiratory tract and cleared by the body’s natural clearance mechanisms (e.g. nasal hair, mucous membranes, coughing).

7.2. Respirable Dust (less than 10um)

Respirable particles are the proportion of particulate matter which, when inhaled, penetrates into the uncilliated airways of the lungs, generally found to be less than 10µm in size with an average aerodynamic diameter of 3.5-5 µm. These particles can enter deep into the lungs where oxygen and carbon dioxide exchange occurs.

Most of the respirable dust can be removed by macrophages (white blood cells) in the lungs, the body’s defence mechanism. If too much respirable dust enters the lungs it can overwhelm these defences, and these particles can accumulate in the lung tissues which over time may cause scarring and inflammation of the tissue in the lungs which can lead to emphysema, chronic bronchitis and Chronic Obstructive Pulmonary Disease (COPD).

Respirable particles are normally too fine to see unless specific lighting conditions exist.

7.3. Crystalline Silica

The mass of Earth's crust is 59 percent silica. Silica (or silicon dioxide) is a basic component of soil, sand, granite and the main constituent of more than 95 percent of the known rocks (Encyclopaedia Britannica, 2016). There are non-crystalline and crystalline forms of silicon dioxide. Crystalline silica is also known as free silica. Crystalline silica dust particles which are small enough to penetrate deep into the lung are termed respirable. Respirable crystalline silica may cause lung damage. The non-crystalline form of silica does not cause this kind of lung damage.

8. RESULTS

A complete record of results is located in Appendix 1.

Thirty one (31) road sample locations were monitored. Of these sites two (2) were voided; one (1) due to obvious interference from the public (this site was re-tested) and one (1) due to a lab anomaly.

8.1. Respirable Dust

Respirable dust for all locations was generally low, not exceeding 0.36 mg/m^3. On face value there appears to be minimal correlation between respirable dust concentrations, road material or car volume. Rather speed and road type (gravel or shoulder) contributed to dust generation.

8.2. Crystalline Silica

It was found that of the twenty nine (29) tested airborne samples, twenty four (24) were below the level of detection for silica (0.02 mg/m^3), three (3) had low levels just above the level of detection thus subject to a 95% statistical uncertainty*, and two (2) contained levels of crystalline silica at 0.08 mg/m^3 and 0.06 mg/m^3.

The samples that had identifiable silica content were all council rural gravel roads, with a speed limit of 100km. The roads were constructed out of rock from Mt Scobie, Nanneella and Lake Cooper quarries.

** The estimated measurement uncertainty for the laboratory analysis of Quartz is 40% at 50µg at 95% confidence limit (i.e. statistically the true value lies between 30-70µg / filter (60 – 140 µg/m^3) at 95% confidence). The estimated measurement uncertainty was determined during method validation.*

9. DISCUSSION

9.1. Observations

Weather Conditions

The following weather conditions were recorded each day of monitoring:

20/12/2016	Temp: 37.8 degrees Celsius (dry, with late thunderstorms) Wind: W 24-53km/hr Thunderstorm came over at 17:30, 0.6mm rain to 9am next morning. With storm front came significant wind and visual inhalable dust being blown off paddocks.
21/12/2016	Temp: 26 degrees Celsius (dry) Wind: NNE 13km/hr
22/12/2016	Temp: 32 degrees Celsius (dry) Wind: SE turning to NE 15-25km/hr Exceptionally dry day; 'dust devil' was observed between Lockington and Echuca approx. 50m high.
23/12/2016	Temp: 31 degrees Celsius (dry) Wind: NE 15-20km/hr

9.2. Dust

Road side observations during monitoring suggest that neither Mt Scobie, Nanneella nor other rock products appeared more or less "dusty". It was noted that irrelevant of the road material passing traffic on gravel roads all created airborne dust, whilst unsealed shoulders had minimal dust release. However, given the stark whitish colour of the Mt Scobie material, the dust was more obvious on these roads both airborne and when settled.

The dustiness of an unpaved road is dependent on a number of road and traffic related factors, providing a number of points of control for road dust:-

1) Wind speed at the road surface – wind sheer is especially important – lower vehicles with many wheels tend to cause more dust;
2) Number of vehicles using the road, or traffic volume;
3) Particle size distribution of the wearing course;
4) Restraint of road fines – related to compaction of the road surface, cohesiveness and bonding of the surface material and durability of the material;
5) The amount of spillage from trucks on the road; and
6) Climate – in particular, humidity, number of days with rain, mean daily evaporation rates and the prevailing wind speed and direction.

On the days of monitoring the respirable dust levels were believed to be indicative of a "worst case scenario". The roads and surrounding land was dry, there were suitable traffic volumes and significant wind. Given the results, it is believed that respirable dust levels within the Shire of Campaspe are consistent with gravel roads in drought prone areas, which are seen throughout Australia.

9.3. Crystalline Silica

How dust affects the health of those exposed depends on the chemical composition of the dust, the airborne concentration and the particle size. The particle size influences where in the respiratory system the dust will be deposited. There are currently no Australian standards for environmental levels of respirable crystalline silica. Health criteria for crystalline silica developed by other national and international agencies are based on occupational respirable crystalline silica studies, as few studies of environmental exposure to silica have been conducted.

The goal of this preliminary dust assessment was to provide evidence on whether the respirable crystalline silica content of the rock used for road activities in the Shire of Campaspe constitutes a legitimate health risk that requires further investigation.

The results indicate that some levels of identifiable crystalline silica exist on unsealed roads in the Shire of Campaspe. Given that silica is the main constituent of more than 95 percent of the known rocks, this is not unexpected. The following points are made in response to the results;

1) Levels of measurable crystalline silica across all monitored sites were low, below 0.08 mg/m^3, given a "worst case scenario" monitoring period.
2) Environmental dust (including crystalline silica) is cyclic in nature, and will be supressed during the night (generally with less traffic) and during the winter/wet months.
3) All locations with measurable crystalline silica were in rural areas. Few people live in close proximity to these roads and it is likely that the road dust and associated silica will dissipate before coming in contact with residences.

Given the levels of dust and low levels of associated silica as a worst case scenario, there is limited evidence to suggest that the road making material and the unsealed roads in the Shire of Campaspe pose an unacceptable health risk to people living in the Shire. The low risks are consistent with road making activities across Australia.

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DISCLAIMER

10. REFERENCES

1) Australian Institute of Occupational Hygienists (AIOH) 2009, *Respirable Crystalline Silica and Occupational Health Issues*, Victoria

2) Australian Standard 3640-2009 "*Workplace Atmospheres – Methods for Sampling and Gravimetric Determination of Inhalable Dust.*"

3) Australian Standard 2985-2009 "*Workplace Atmospheres – Method for Sampling and Gravimetric Determination of Respirable Dust.*"

4) "Silica". *Encyclopædia Britannica. Encyclopædia Britannica Online.* Encyclopædia Britannica Inc., 2016. Web. 03 Feb. 2016

5) Safe Work Australia Exposure Standards for Atmospheric Contaminants in the Occupational Environment, Guidance Note [NOHSC: 3008(1995)], National Exposure Standards [NOHSC: 1003(1995)] May 1995.

11. APPENDICES

11.1. Appendix 1 – Results

15-1313 SHIRE OF CAMPASPE DUST AND SILICA RESULTS

Item	MPL Reference	Road Name	Locality	Vehicle Volume (sample period)	Respirable Dust (mg/m3)	a-quartz (mg/m3)	Rock	Speed Limit (km/hr)	Rural - Town	Date	Sample Time (min)
S2	D15-022	Brown Rd	Echuca	85	0.01	<0.02 /filter	Nanneella	100	Rural	20/12/2015	272
G7	D14-125	Anderson Rd	Echuca	32	0.03	<0.02 /filter	Nanneella	100	Rural	20/12/2015	242
G2	D14-119	Gray Rd	Kyabram	21	0.12	**0.06**	LC / Scobie	100	Rural Urban	20/12/2015	240
G3	D15-050	Wilson Rd	Kyabram	19	0.02	**0.04***	Scobie	100	Rural	20/12/2015	240
S5	D15-046	Bolithio Rd	Kyabram	128	<0.01	<0.02 /filter	Lake Cooper	100	Rural Urban	20/12/2015	240
G6	D14-126	Thorton Rd	Timmering	6	0.02	<0.02 /filter	LC / Scobie	100	Rural	20/12/2015	240
S3	D15-038	Winter Rd	Girgarre	46	VOID- lab anomaly	VOID- lab anomaly	Scobie	100	Rural	20/12/2015	240
S4	D15-047	Blamey Rd	Stanhope	20	0.36	**0.04**	Scobie	100	Rural	20/12/2015	240
G1	D15-039	Graham Rd	Nanneella	9	0.10	**0.020**	Scobie	100	Rural	21/12/2015	449
G8	D15-037	Quarry Rd	Nanneella	50	0.14	**0.080**	Nanneella	100	Rural	21/12/2015	459
G4(a)	D15-020	Cromwell St	Rochester	22	VOID- suspected interference	VOID- suspected interference	Lake Cooper	50	Town	21/12/2015	306
S1	D15-035	Elmore Rd	Rochester	120	0.03	<0.02 /filter	Nanneella	100	Rural	21/12/2015	337
G10	D15-034	Cemetery Rd	Colbinabbin	4	0.02	<0.02 /filter	Browns	100	Rural	22/12/2015	298
L2	D15-019	Laneway	Colbinabbin	3	0.11	<0.02 /filter	Nanneella 20	50	Town	22/12/2015	299
G12	D15-017	McNamara Rd	Toolleen	6	<0.01	<0.02 /filter	Weeks	100	Rural	22/12/2015	308
G4(b)	D15-016	Cromwell St	Rochester	19	0.04	<0.02 /filter	Lake Cooper	50	Town	22/12/2015	312
L1	D14-114	Laneway	Lockington	1	0.00	<0.02 /filter	Nanneella 20	50	Town	22/12/2015	284
G5	D15-027	Echuca West School Rd	Echuca	51	0.11	<0.02 /filter	Lake Cooper	100	Rural	22/12/2015	356
G14	D14-124	Bowen St	Echuca	24	0.02	<0.02 /filter	Lake Cooper	50	Town	22/12/2015	240
S6	D14-123	Hume St	Echuca	141	0.00	<0.02 /filter	Lake Cooper	50	Town	22/12/2015	289
G15	D15-040	O'Dwyer Rd	Echuca	34	0.02	<0.02 /filter	Weeks	100	Rural	22/12/2015	355
G9	D15-048	Two Chain Rd	Runnymede	4	0.00	<0.02 /filter	Browns	100	Rural	22/12/2015	293
R1	D15-026	South St	Rushworth	2	0.00	<0.02 /filter	Mix	50	Town	23/12/2015	246
R2	D15-021	Pound Road	Rushworth	17	0.05	<0.02 /filter	S40 - Scobie	50	Town	23/12/2015	241
R3	D15-049	Old Tatura Service Rd (west side)	Rushworth	2	<0.01	<0.02 /filter	Lake Cooper	50	Town	23/12/2015	250
R4	D15-023	Perry St	Rushworth	4	0.01	<0.02 /filter	S20 - Scobie	50	Town	23/12/2015	241
R5	D14-113	Heily St	Rushworth	47	<0.01	<0.02 /filter	Scobie	50	Town	23/12/2015	275
R6	D14-117	A'Beckett St	Rushworth	27	<0.01	<0.02 /filter	Scobie	50	Town	23/12/2015	247
R7	D15-024	A'Beckett St	Rushworth	6	0.07	<0.02 /filter	Lake Cooper	50	Town	23/12/2015	252
R8	D14-115	Frenchman Rd	Rushworth	12	0.00	<0.02 /filter	Scobie 40 / LC	100	Rural	23/12/2015	273
R9	D15-018	Old Lead Rd	Rushworth	6	0.04	<0.02 /filter	Scobie 40 / LC	100	Rural	23/12/2015	243
R10	D15-043	Darby Rd	Rushworth	15	<0.01	<0.02 /filter	Weeks	80	Rural	23/12/2015	241

G- Gravel Roads
S- Shoulder Roads
L- Laneways
R- Rushworth Roads

* Anomaly due to a 95% statistical uncertainty at such low levels; realistically result would be <0.02mg/m3.