26th July 2020

For the attention:
Hoagy Moscrop-Allison
Senior Planner – Major Assessment
City Development Branch
Council of City of Gold Coast

Dear **Hoagy Moscrop-Allison,**

Objection submission COM/2019/81 - Respirable Silica Dust

Please find below further information that I think should be considered re this development Application and its Environmental Submission and the non-conformance to the silica limits it claims to meet.

DA Section 3.3.6 Dust Modelling results, Respirable Crystalline Silica (RCS)

'Section 3.3.6 Dust Modelling results' of the Noise and Dust assessment (Attachment A1).

This section says standards are based on "the Vic EPA (SEPP AQM) Mining and Extractive Industries objective for respirable crystalline silica at all surrounding residences. The highest predicted annual average crystalline silica (as PM2.5) concentration at a sensitive receptor is less than 15% of the adopted Victorian PEM objective. The Victorian PEM objective is based upon the Californian Office of Environmental Health Assessment determination of **"an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level".** On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community".

However, the 'Air quality objective' (or 'Maximum Acceptable Concentration' as it is more correctly referred to) adopted by this development application for silica ($PM_{2.5}$) is 3µg/m³ (Attachment A2). Whereas the Vic EPA (SEPP AWM) standard referenced is 0.00033mg/m³ (0.33µg/m³) measured as $PM_{2.5}$ (Attachment A3).

Therefore, the 'Maximum Acceptable Concentration' used is out by a factor of 10 and should be '0.33µg/m³' NOT '3µg/m³' (based on the Vic EPA (SEPP AQM) objective as quoted in the development application).

It goes on to say: "The Victorian PEM objective is based upon the Californian Office of Environmental Health Assessment determination of **"an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level"** ". However, the Californian exposure limit (Attachment A4) is PM4 (i.e. Particles 4 microns or less) not PM2.5 (Particles 2.5 microns or less) that this development application has used. Therefore, the statement **"an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level"** is incorrectly applied in this context as this is based on completely different limits.

It should also be pointed out that the quoted statement: "an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level" is taken from the Californian Environmental Protection Agency, Office of Environment Health Hazard Assessment (OEHHA) standard that states: "The Chronic Reference exposure Level (REL). A chronic REL is 'an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level' ". i.e. This is not a safe level. But instead the safest level before it should be considered that it could pose significant health risk. This is, in my opinion, taken out of context to appear safer than it should.

It then goes on to say: "On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community". However, as shown above this cannot be safely stated. Both the 'Vic EPA' standards and the 'Californian Office of Environmental Health Assessment' limits have been incorrectly referenced. And, very importantly, all these figures are based **on occupational exposure**. No non-occupational limits have been discussed. **Therefore, this cannot be specified in the context of the local community.**

The dust analysis submission for this development application is clearly deficient, especially given the proposed reduction of separation buffers to within 220m of residential homes, but making no allowance for non-occupational dust exposure,. This is, I believe, is negligent and their statement: "On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community" is highly culpable and is based on false assumptions.

Is the Victoria EPA a safe guideline?

It should also be realised this Victoria EPA standard was devised back in December 2001. The dangers associated with respirable crystalline silica (RCS) are only now coming to light so even this level should not be considered safe as it was established nineteen years ago.

The safety of using this adopted standard should be questioned when it is realised that this is only concerned with particles $PM_{2.5}$ and below. However, Respirable particles are particles up to an approximate size of PM_{10} (As emphasised in a letter from the Compliance delivery Manager for the department of Environment and Heritage Protection, Attachment B1). This is also confirmed by the Australian Institute (Attachment B2). And further confirmed by the Australian Governments National Pollutant Inventory and Safe Work Australia (Attachment B3).

Also, this Victoria EPA standard is also only relevant for industrial premises: "These criteria are to be used in the assessment of the design of new or expanded sources of emissions such as industrial premises" (Attachment A3). **Therefore, again, this cannot be applied to the local community.** Thus the development application statement: "On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community" is highly misleading and culpably negligent in my opinion.

Clearly, a separate standard is required for the non-occupational exposure. This unfortunately, despite separation buffers to sensitive receptors reduced far below DES guidelines has not been submitted and/or considered by this development application. Therefore, in no way can this development application specify: ”On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community”.

Is the Californian Limit a Safe Guideline?

Even the Californian enhanced level of silica dust protection has been criticized. The Environmental Working Group (EWG) concluded that the silica exposure limits adopted by California are insufficient to protect children and other vulnerable populations for several reasons:

- The exposure limits are based on epidemiologic studies of adult male miners (a population of typically healthy and robust workers).
- No studies included children or vulnerable populations
- Exacerbation of asthma (more severe in children than adults) is a known response to some respiratory irritants.

The agency added (Attachment A4): “Since children have smaller airways than adults and breathe more air on a body weight basis, penetration and deposition of particles in the airways and alveoli in children is likely greater than in adults exposed to the same concentration”.

Therefore, even the more stringent Californian limit of 3µg/m³ at PM4 is unacceptable as it does not represent the more vulnerable, non-occupational limits that should be clearly considered.

Respirable Crystalline Silica in the Atmosphere (PM10)

Table 10 (Attachment A2) shows how the Maximum 24-hour average for the Eastern receptor group for PM10 (respirable fraction) is 37.8 µg/m³ (unfortunately this modelled result fails to include both the cumulative effect of surrounding Industrial activities and also blasting effects), apparently below the ‘Maximum Acceptable concentration’ of 50µg/m³.

However, this fails to calculate the silica content of this. Bearing in mind the Silica PM2.5 Annual average is daily limit is 3µg/m³ (or 0.33µg/m³ Vic EPA standard). What level is the Silica PM10 Maximum 24-hour average µg/m³ ‘Maximum acceptable Concentration’? Why is this omitted from the table? I would suggest that with the PM10 limits for particulate exposure so close to the ‘Maximum Acceptable concentration’ that the silica content will be approximately 49% of these figures and therefore will not meet the ‘‘Maximum Acceptable concentration’ for Silica dust at PM10 for the 24-hour average.

From Airborne Silica and Regulations (Attachment D1): “Agencies use a rough estimate for the composition of particles they expect to be in any give sample. They estimate that 10% of particulate matter is silica, which includes respirable crystalline silica and other forms of particulate silica. However , it is acknowledged that the percentage of total silica, and the percentage of respirable crystalline silica, varies by location and nearby activities. At sand mining operations where silica can constitute 95-99% of the mined sand, the percentage of PM10 that is total silica is likely to be higher than the assumed 10%. If the respirable crystalline silica percentage of PM2.5 near industrial sand mines is more than 3% the area could be in compliance with the ambient air limit of 12ug/m3 PM2.5, but still exceed a chronic exposure level for crystalline silica”.

From this, given than the Nucrush quarry is up to 57% Silica (Attachment D2) then the estimate of 10% particulate matter is silica will be higher. Thus for a PM2.5 limit of 8ug/m3 (Attachment A2) for the Western receptor it is modelled 5.3µg/m³ total if the constitute part is 57% silica then the silica limit of 3ug/m3 would be exceeded. Despite the ambient air limit being within the 8ug/m3.

However, it should be remembered this 3µg/m³ (which is much higher than both the Vic EPA standard and the Californian standards quoted) is also TWA (Time Weighted Average) occupational exposure and is therefore based on an 8 hour exposure per day and based on adult health young male quarry workers. It is not the 24/7 exposure limit (subjected to families including children, elderly and infirm) that will have clearly been surpassed.

Non-Occupational-Exposure to respirable silica dust

From Airborne Silica and Regulations (Attachment D1): "Converting between occupational and non-occupational exposures requires accounting for both exposure time and exposure risk. Occupational exposure is assumed to be 40 hours per week, while ambient, chronic exposure time is a full week of 168 hours. Workers who are protected by the OSHA laws, are also assumed to be healthier than vulnerable segments of the general population, such as children and the elderly. Therefore, a margin of safety (usually a factor of 30 to 100) must be built into chronic exposure limits to account for risks to these vulnerable populations".

Thus, an occupational exposure $PM_{2.5}$ limit of 3 µg/m³ should have a more appropriate corresponding chronic exposure limit for non-occupational limit of around 0.06 µg/m³.

From the submitted modelled data (Attachment A2) it can be clearly seen that the Annual average daily Silica is modelled to be 0.09 µg/m³ (Eastern Receptor Group). This is 50% higher than the assumed non-occupational silica limit.

However, even this value of 50% over the non-occupational exposure limit is highly debatable and belies far higher chronic exposure to non-occupational respirable silica that local residents and their families will be subjected to.

Firstly, this is only allowing for PM2.5 not the respirable factor of approximately PM5 and/or the inhalable/respirable fraction up to PM10.

Secondly, there is considerable doubt as to the fraction of respirable silica within the modelled data submitted. i.e. For Eastern receptors the PM2.5 annual average daily exposure is 4.9 µg/m³ (Attachment A2). However, the claimed silica (0.09 µg/m³) fraction of this is only 1.84% of this. Attachment D1 (Airborne Silica and Regulations by Gretchen Gehrke) shows how for any given sample of particulate matter agencies assume an estimated 10% of this will be silica (which includes respirable silica). However, the total silica varies by location and nearby activities. Therefore, with quarrying activities where silica constitutes up to 57% of the product, the percentage of PM10 that is total silica will be far higher. Therefore, if the respirable crystalline silica is more than 3% the area could be in compliance for $PM_{2.5}$ dust at 8µg/m³, but will readily exceed the chronic exposure risk level for respirable crystalline silica (up to PM_5).

PM10, PM5 compared to PM2.5 monitoring

The modelled data only reports on occupational exposure of silica at PM2.5. However, it is abundantly clear that particle sizes up to PM5 and PM10 are respirable and highly dangerous (Attachment D3).

From the Particle Size distribution (from the Noise and Dust assessment within the DA, reproduced in Attachment E1) It can be seen that the PM2.5 content of PM5 makes up for 26.5% of the total. Therefore, 73.5% of the respirable crystalline silica is ignored (or 85% of all inhalable/respirable dust up to PM10).

Therefore, the modelled data should be analysing the PM10 or at the very least PM5 respirable crystalline silica content not just the PM2.5 which is more likely to be made up of fine particle levels such as carbon (from cars, trucks heavy equipment), nitrates (from Cars, trucks and power generation), sulfates (power generation) with only the approximately 10% remainder crustal (Suspended soil, metallurgical and rock particulates). See Attachment D1.

So, in total of the respirable crystalline silica within PM10, only 15% is considered by this DA (85% ignored yet still dangerous and respirable), and of this 15% only an expected 10% (1.5%) will be expected to be quarry material. Therefore, an inexcusably, 85% of the respirable crystalline silica dust has simply been ignored in the development application submitted analysis.

Attachment B4 further describes the make up of PM10 (Coarse Particles) and PM2.5 (Fine particles). This clearly shows how the larger (yet still fully respirable) particles are made up of earth crust materials and dust from roads and industries and mainly produced by the mechanical break-up of even larger solid particles (describing the quarry function precisely) unlike PM2.5 which is more likely to be fumes and gases (as discussed above). Therefore, to measure silica in just the PM2.5 portion of the respirable dust would seem utterly ridiculous and is setting a highly dangerous precedent.

Workplace Exposure standards for airborne contaminants

As from the 1st July 2020 the Work Health and Safety (WHS) laws for respirable crystalline silica was reduced to $0.05 mg/m^3$ ($50 \mu g/m^3$) for TWA (Attachment C1). This is for all airborne particulates i.e. Total suspended particulates (TSP). It is of concern the silica content of the TSP has not been modelled (or has not been submitted) as this would be a valuable factor in analysing if the quarry is capable of meeting its crystalline silica limit for TSP.

As it has not been made available we must assume it cannot until proven otherwise.

Monitored Locations and cumulative totals

The cumulative impact on the Environment must be considered within any development application.

In Section 3.3, Assessment Criteria of the Vic EPA (SEPP AQM) standard referenced (Attachment H1) it says "The assessment of emissions from the area sources must consider local air quality (i.e. existing air quality) in the vicinity of the mining or extractive operations. The assessment criteria are used to assess the total concentration of background plus emissions arising from activities on the site. Emissions from the mine or quarry must be managed to ensure the cumulative impacts of all sources (including the mine or quarry) in the local area do not pose a risk to the health and amenity of local residents and that the beneficial uses specified in the SEPP (AQM) are protected".

The monitoring locations used by the DA are shown in Attachment F1. The modelled result for the Stage 1 Northern Haul Route are reproduced as Attachment F2.

Firstly, it is unfortunate to note there is no air quality analysis provided to the North where there are lots of additional sensitive receptor albeit hidden from view in Attachment F1. Also, it is unfortunate that despite five monitoring locations identified as part of the Western receptor group two of these seem to have been disregarded (R19 and R20) from the Receptor list in the table of results.

The failure to include the cumulative air quality analysis can easily be demonstrated by examining the remaining three receptors in the Western receptor group:

If you look at the Silica column it can be seen that the closest receptors to the 'JGI Quarry' and the 'Holcim concrete bathing facility' (i.e. 'R17' to the North and 'R16' to the South) are modelled at 0.18 ug/m3 and 0.09 respectively. Whereas 'R18' is 0.30 ug/m3. Therefore, the two receptors straddling the 'JGI quarry' and the 'Holcim batching facility' are reading lower values than the further north receptor despite their closer proximity to a significantly industrialised dusty environment. This is obviously incorrect (the location of the Bullrin JGI quarry and the Holcim baching plant are identified in Attachment N2).

The exact same results can be observed for the PM10 columns the PM2.5 columns, TSP and Dust Deposition column.

Clearly, these two significant dust sources have been completely ignored in the dust modelling. Dust modelling for the development application required cumulative analysis to ensure the air quality for the area as a whole is of sufficient quality. By ignoring this sites the dust analysis is clearly deficient and does not reflect the air quality that will be prevalent.

Sensitive Receptors

The Victorian EPA standard states: "The results of the modelling must be reported for sensitive locations including houses, schools, kindergartens, recreation areas and sporting ovals. Any proposed developments, such as new housing developments, and identified future eland uses (including zoning requirements) must be taken into account to ensure that developments planned closer to the sites than the current situation are considered for the assessment of potential impacts" (Attachment I1).

'Attachment I2' shows future potential areas that should have been included overlayed on the receptor locations considered.

Sensitive Receptors 'A3' and 'A4' are zoned Emerging community, yet have been ignored in the dust analysis.

Similarly sensitive receptors 'A1', 'A5', 'A6', 'A7', 'A8' and 'A9' are all zoned open space and are all closer than the sensitive receptors used.

Sensitive receptor 'A2' Is the Oxenford Freshwater supply Water Tank. This is closer than any of the sensitive receptors modelled on the Eastern side yet is a most sensitive receptor bearing in mind its function i.e. supplying freshwater to residents throughout Oxenford.

Also, 'A10' is open space zoned Lot that has not been modelled in the dust analysis.

Clearly the dust analysis has NOT modelled the most sensitive receptors but instead has merely used the closest homes and completely ignoring: "The results of the modelling must be reported for sensitive locations including houses, schools, kindergartens, recreation areas and sporting ovals. Any proposed developments, such as new housing developments, and identified future land uses (including zoning requirements) must be taken into account to ensure that developments planned closer to the sites than the current situation are considered for the assessment of potential impacts".

The consideration of future planning with respect to possible new emerging sensitive receptors has clearly not been considered.

Safe work Australia

The Safe Work Australia analysis of the 'Potential health effects following exposure to crystalline silica' (Attachment B5) highlights that the exposure to crystalline silica is via inhalation. Can cause Lung failure (e.g. Silicosis - acute, accelerated, chronic, primary myelofibrosis, Lung cancer, chronic obstructive pulmonary disease and tuberculosis), Kidney failure and autoimmune issues (e.g. Scleroderma, Rheumatoid arthritis, systemic lupus erythematosus, sarcoidosis).

Silicosis is irreversible and a progressive condition.

There is no known safe level for silica exposure.

Air Quality Objective

It should also be noted that the 'Air Quality Objective' (Attachment A2) is not an 'Air Quality Objective' it is actually a 'Maximum acceptable concentration' (See Attachment J1). It is worrying that the DA does not make this distinction. It is even more worrying that this 'Maximum acceptable concentration' was defined in 2005 and has not been updated since.

Dust Deposition

It should also be noted that the Dust Deposition column in Tables 10, 11, 12, 13 14 and 15 of the Noise and Dust section of the Development application is incorrectly stating the limit is 120µg/m^3 however the limit is actually 120mg/m^2 (per day averaged over one month), as shown in Attachment K1.

Again, reflecting the lack of care and attention, in my opinion, to highly important aspects of this development application that have seemingly been glossed over and trivialised.

Modelled Data

It is of great concern to me that the submitted data is only based on 'modelled data'.

Firstly, because have been a functioning quarry for I believe, the last 27 years, it would seem appropriate to submit data based on its past performance, especially bearing in mind its claim (albeit incorrect) that it is not increasing production but just continuing as per it has in the past. It attempts to assure us of compliancy below the 'Maximum Acceptable concentration (albeit occupational), with no consideration for non-occupational exposure despite reducing separation buffers far below DES guidelines (Attachment L1). Lack of 'Real' data, although readily available, is highly concerning.

Secondly, because 'real' data has not been made available, it is even more important that the input data is modelled correctly. However, the modelled input data falls far below satisfactorily requirements (as per my 'Modelled Dust Submission results are culpably misleading, incorrect and highly dangerous' dated 17th July 2020). Summarised as follows: Wind erosion has not be satisfactorily accounted for as incorrect stockpile areas has been used, also it appears 40% less haulage trucks have been modelled, it also fails to include any considerations for blasting.

Thirdly, the 'Dust Modelling Methodology' (Section 3.3.1 of the 'Noise and Dust' submission, reproduced in Attachment M1) advises that: "The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were added to the ambient concentrations presented in Table 8 [Attachment M2] to assess the cumulative dust exposure at surrounding receptors". However, this is incorrect. For instance the annual average ambient PM2.5 at Springwood of 4.9 µg/m³ (Attachment M2) is higher than many of the modelled receptor results (Attachment F2 shows modelled receptor data at 4.8µg/m³). Therefore, the ambient data has obviously not been correctly included as part of the modelled data, otherwise the receptor values would not be below the ambient values. This is highly worrying aspect of the modelled results and their accuracy. Therefore the statement: "The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were **added** to the ambient concentrations presented in Table 8 to assess the cumulative dust exposure at surrounding receptors". Is clearly and culpably incorrect.

Finally, the cumulative dust exposure has been modelled (albeit incorrectly) by adding to the ambient values found at Springwood. However, absolutely no attempt has been made to include the localised industrial activities namely the Bullrin Quarry run by JGI Quarry Pty Ltd (approximately 400 metres to the West), or the Holcim Concrete batching facility (approximately 150 metres to the West), or the 'JJ Richards recycling centre adjoining the quarry to the North (Attachment N2). The first two, for example, are major dust generators located between modelled receptors R16, R17 and R18 yet there is absolutely no signs of elevated dust at these receptors in the modelled results. This modelled data would be farcical if the dangers associated with underestimating dust in the local environment wasn't such a major health and safety consideration.

Attachment N2 shows the Submitted receptor location map with the surrounding area added and the 1000m separation buffer also. It can be clearly seen that Receptors R16, 17 and 18 are in the midst of a dust storm (Attachment N3 and N4). Yet no elevated dust levels whatsoever for these receptors (Attachment F2). Similarly, the 'JJ Richards Site' adjacent to the Nucrush quarry (Another highly dusty environment - Attachment N5) between receptors R1 and R18. Yet no elevated dust levels. The modelled data has obviously not been modelled correctly.

It is also particularly interesting to compare the submitted Receptor location map, Attachment N1 with the extended version Attachment N2. It can be clearly seen that the submitted map fails to show either the 'Oxenford state school' (NE) the Gaven state school (SE) or the Retirement community to the West. Was the Receptor Location map constrained to not show sensitive areas within the 1000m separation buffer? It appears to have been so.

It also fails to show any of the local community to the North. Clearly there should have been a Northern Receptor group also. This has been ignored in dust analysis.

The modelled data, although fundamentally incorrect, also falls well short of a thorough analysis of the surrounding area.

Conclusion

Given the significantly reduced separation buffers from the Queensland DES standard required of 1000m (down to a proposed 220m) for this quarry's extractive boundary to sensitive receptors it is particularly important to assure that the dust levels, especially the respirable crystalline silica, are not going to be above a safe limit.

However, the adopted levels in this development application needs to be investigated as it is has clearly NOT based it's 'Air Quality Objective' (Attachment A1): "upon the Californian Office of Environmental Health assessment determination of "an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level" " as claimed, otherwise its limit would be 3µg/m³ for PM4 not PM2.5 (Attachment A4). Similarly, it is also not using the Vic EPA (SEPP AQM) Mining and extractive Industries objective it would be 0.33µg/m³ (Attachment A3).

It is instead attempting to justify a PM2.5 respirable crystalline silica level of 3µg/m³ which is not supported by the standards it attempts to justify itself against.

It is also only considering the PM2.5 aspects for silica and completely ignoring the PM10 which is the respirable factor. It is therefore ignoring a vast swathes of respirable silica dust in its analysis (between 10 microns and 2.5 microns is completely ignored).

Further, there is no non-occupational allowance for residents despite the ridiculously small separation buffers proposed. Resulting in occupational TWA limits within a non-occupational chronic exposure environment (24/7 exposure to local residents including children, vulnerable people and the elderly).

It also fails to include any blast dust analysis. This should be a highly significant factor as it typically effects residents for a number of days after with tangible elevated dust in the atmosphere. It is also imperative given that the worst case scenario that should have be adopted.

It also fails to include the cumulative effect of any of the highly dusty industrial activity surrounding it i.e. the Holcim concrete batching facility (185m from extractive boundary), the 'JGI Bullrin Quarry' (360m), the 'JJ Richards' recycling centre (265m) and the Nucrush Hart Street batching facility (1250m). All of these industrial sites will add to the cumulative total that the development application have failed to include, as should have been within their environmental analysis.

It is of course noted that despite up to 57% of the rock being silica that the highly dusty process of crushing the product produces only a claimed 1.84% silica (98.16% undisclosed) of the respirable PM2.5 I find this highly questionable and I urge the decision makers to investigate these seemingly unacceptable claims. However, more importantly it is the PM10 figures, the respirable aspects, that require investigation as this is where it would seem the most harm will be caused.

Please remember all figures produced in the development application relating to respirable crystalline silica are purportedly based on standards which have been incorrectly referenced. Thus, the standards they are attempting to adopt are not the Vic EPA (SEPP AQM) Mining and Extractive standard or the Californian Office of Environmental Health they are their own produced standard that are well below industrial standards referenced and are further completely incompatible with non-occupational exposure which should be a fraction of the occupational exposure.

It is important to note, that no non-occupational considerations have been included in this development application, despite a proposed vast reduction in separation buffers. This would seem highly callous and unfair and a potentially highly dangerous health time bomb in the making.

I therefore conclude this development application cannot be accepted as there is nowhere near enough due diligence shown as to the highly important and proven dangerous respirable crystalline silica. The constitution of the rock they are crushing is made up of up to 57% silica (specified in the DA, Attachment D2) failing to make adequate provision for the respirable part of the silica dust generated of between PM10 and PM2.5 is, I believe, bordering on criminal given the inherent and proven dangers surrounding this material at respirable levels.

Please remember there is no safe level for respirable silica dust.

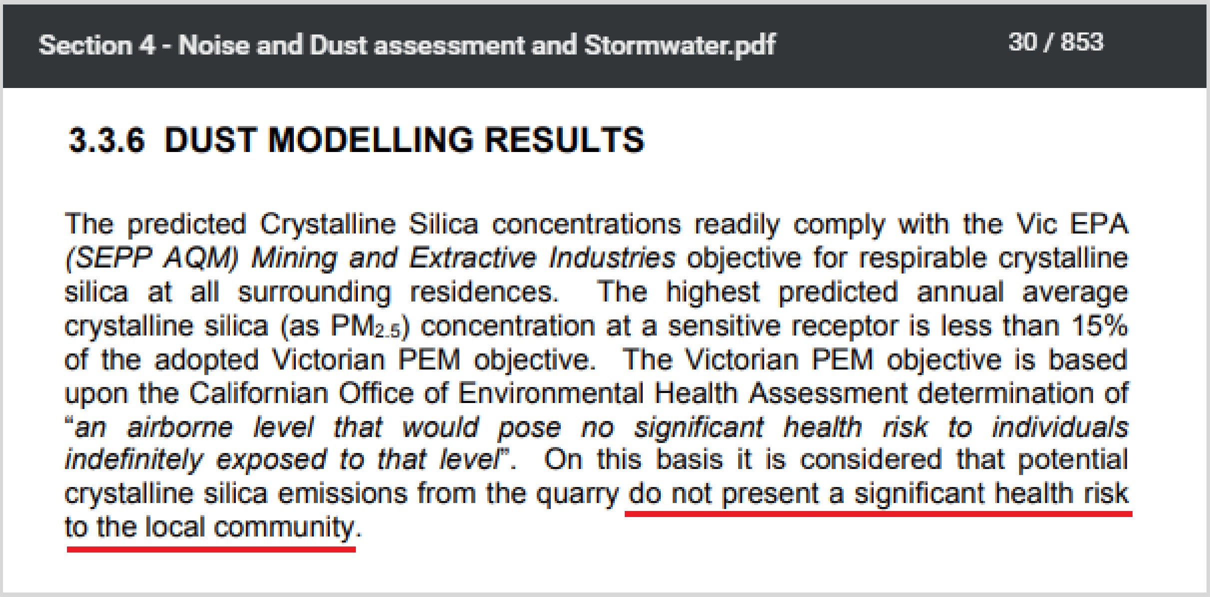
Thank you for considering my objection,

Kind regards

Tony Potter

* Disclaimer. Please note my findings are believed correct and are to the best of my ability. However, there may be errors and assumptions I have made that are incorrect. I do not believe this to be the case, but, realise with the vast amounted of submitted data from the applicant, errors and assumptions on my part may occur. Hopefully this is not the case, but please accept my apologises if this is so. Thank you.

Attachment A1 - Dust modelling results



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3.3.6 DUST MODELLING RESULTS

The predicted Crystalline Silica concentrations readily comply with the Vic EPA *(SEPP AQM) Mining and Extractive Industries* objective for respirable crystalline silica at all surrounding residences. The highest predicted annual average crystalline silica (as $PM_{2.5}$) concentration at a sensitive receptor is less than 15% of the adopted Victorian PEM objective. The Victorian PEM objective is based upon the Californian Office of Environmental Health Assessment determination of "*an airborne level that would pose no significant health risk to individuals indefinitely exposed to that level*". On this basis it is considered that potential crystalline silica emissions from the quarry do not present a significant health risk to the local community.

Attachment A2 - Submitted Modelled data

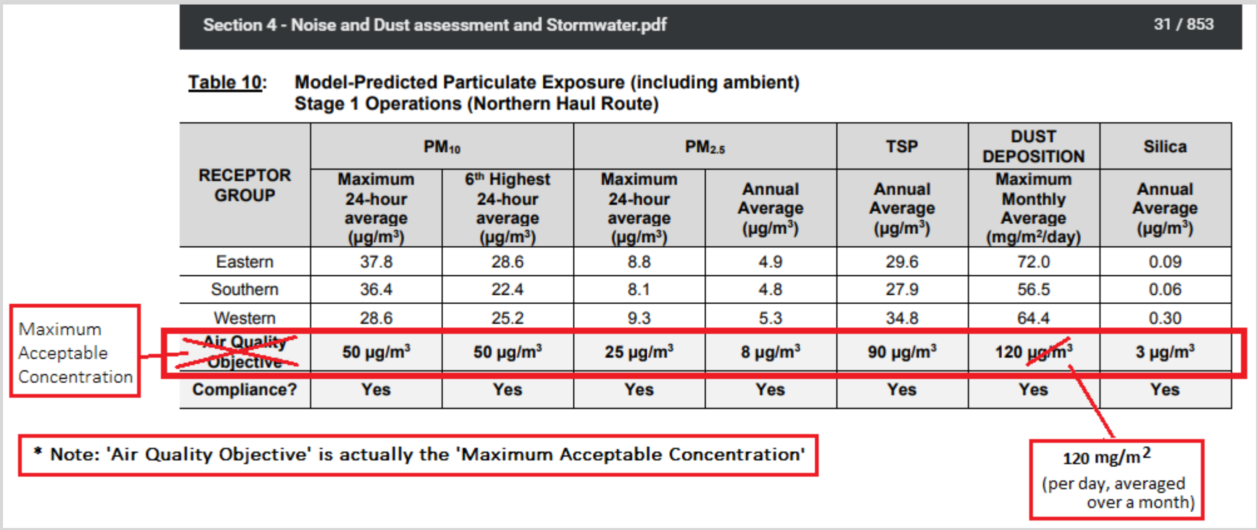

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Table 10: **Model-Predicted Particulate Exposure (including ambient)**
Stage 1 Operations (Northern Haul Route)

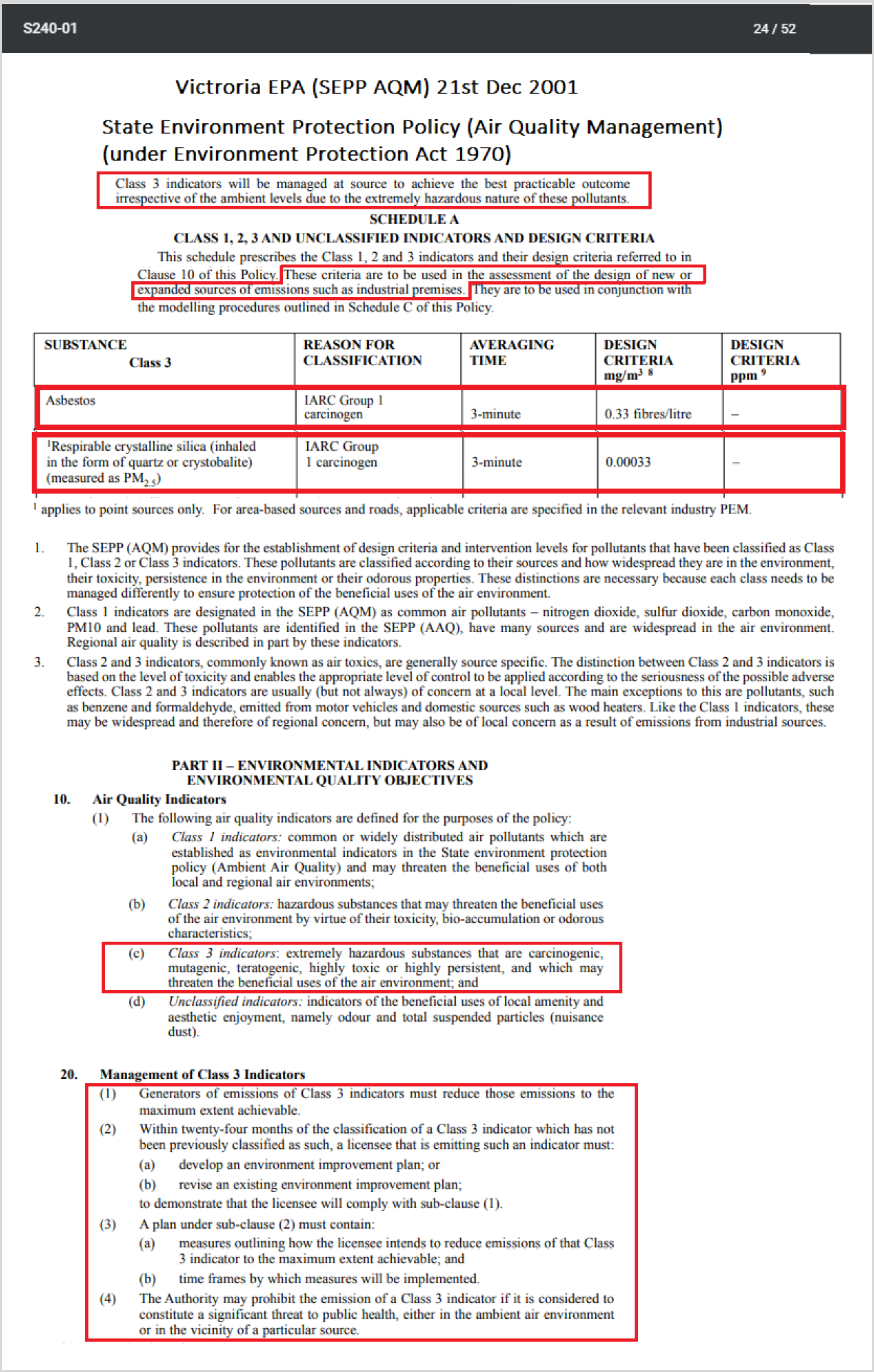
RECEPTOR GROUP	PM_{10}		$PM_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	37.8	28.6	8.8	4.9	29.6	72.0	0.09
Southern	36.4	22.4	8.1	4.8	27.9	56.5	0.06
Western	28.6	25.2	9.3	5.3	34.8	64.4	0.30
~~Air Quality Objective~~	50 µg/m^3	50 µg/m^3	25 µg/m^3	8 µg/m^3	90 µg/m^3	120 ~~µg/m~~^{3}	3 µg/m^3
Compliance?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Maximum
Acceptable
Concentration

120 mg/m^2
(per day, averaged over a month)

* Note: 'Air Quality Objective' is actually the 'Maximum Acceptable Concentration'

Attachment A3 - Vic EPA Respirable Silica 0.00033mg/m^3



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Victroria EPA (SEPP AQM) 21st Dec 2001

State Environment Protection Policy (Air Quality Management) (under Environment Protection Act 1970)

Class 3 indicators will be managed at source to achieve the best practicable outcome irrespective of the ambient levels due to the extremely hazardous nature of these pollutants.

SCHEDULE A

CLASS 1, 2, 3 AND UNCLASSIFIED INDICATORS AND DESIGN CRITERIA

This schedule prescribes the Class 1, 2 and 3 indicators and their design criteria referred to in Clause 10 of this Policy. These criteria are to be used in the assessment of the design of new or expanded sources of emissions such as industrial premises. They are to be used in conjunction with the modelling procedures outlined in Schedule C of this Policy.

SUBSTANCE Class 3	REASON FOR CLASSIFICATION	AVERAGING TIME	DESIGN CRITERIA mg/m^3 [8]	DESIGN CRITERIA ppm [9]
Asbestos	IARC Group 1 carcinogen	3-minute	0.33 fibres/litre	–
[1]Respirable crystalline silica (inhaled in the form of quartz or crystobalite) (measured as PM$_{2.5}$)	IARC Group 1 carcinogen	3-minute	0.00033	–

[1] applies to point sources only. For area-based sources and roads, applicable criteria are specified in the relevant industry PEM.

1. The SEPP (AQM) provides for the establishment of design criteria and intervention levels for pollutants that have been classified as Class 1, Class 2 or Class 3 indicators. These pollutants are classified according to their sources and how widespread they are in the environment, their toxicity, persistence in the environment or their odorous properties. These distinctions are necessary because each class needs to be managed differently to ensure protection of the beneficial uses of the air environment.
2. Class 1 indicators are designated in the SEPP (AQM) as common air pollutants – nitrogen dioxide, sulfur dioxide, carbon monoxide, PM10 and lead. These pollutants are identified in the SEPP (AAQ), have many sources and are widespread in the air environment. Regional air quality is described in part by these indicators.
3. Class 2 and 3 indicators, commonly known as air toxics, are generally source specific. The distinction between Class 2 and 3 indicators is based on the level of toxicity and enables the appropriate level of control to be applied according to the seriousness of the possible adverse effects. Class 2 and 3 indicators are usually (but not always) of concern at a local level. The main exceptions to this are pollutants, such as benzene and formaldehyde, emitted from motor vehicles and domestic sources such as wood heaters. Like the Class 1 indicators, these may be widespread and therefore of regional concern, but may also be of local concern as a result of emissions from industrial sources.

PART II – ENVIRONMENTAL INDICATORS AND ENVIRONMENTAL QUALITY OBJECTIVES

10. Air Quality Indicators

(1) The following air quality indicators are defined for the purposes of the policy:

(a) *Class 1 indicators:* common or widely distributed air pollutants which are established as environmental indicators in the State environment protection policy (Ambient Air Quality) and may threaten the beneficial uses of both local and regional air environments;

(b) *Class 2 indicators:* hazardous substances that may threaten the beneficial uses of the air environment by virtue of their toxicity, bio-accumulation or odorous characteristics;

(c) *Class 3 indicators*: extremely hazardous substances that are carcinogenic, mutagenic, teratogenic, highly toxic or highly persistent, and which may threaten the beneficial uses of the air environment; and

(d) *Unclassified indicators:* indicators of the beneficial uses of local amenity and aesthetic enjoyment, namely odour and total suspended particles (nuisance dust).

20. Management of Class 3 Indicators

(1) Generators of emissions of Class 3 indicators must reduce those emissions to the maximum extent achievable.

(2) Within twenty-four months of the classification of a Class 3 indicator which has not been previously classified as such, a licensee that is emitting such an indicator must:

(a) develop an environment improvement plan; or

(b) revise an existing environment improvement plan;

to demonstrate that the licensee will comply with sub-clause (1).

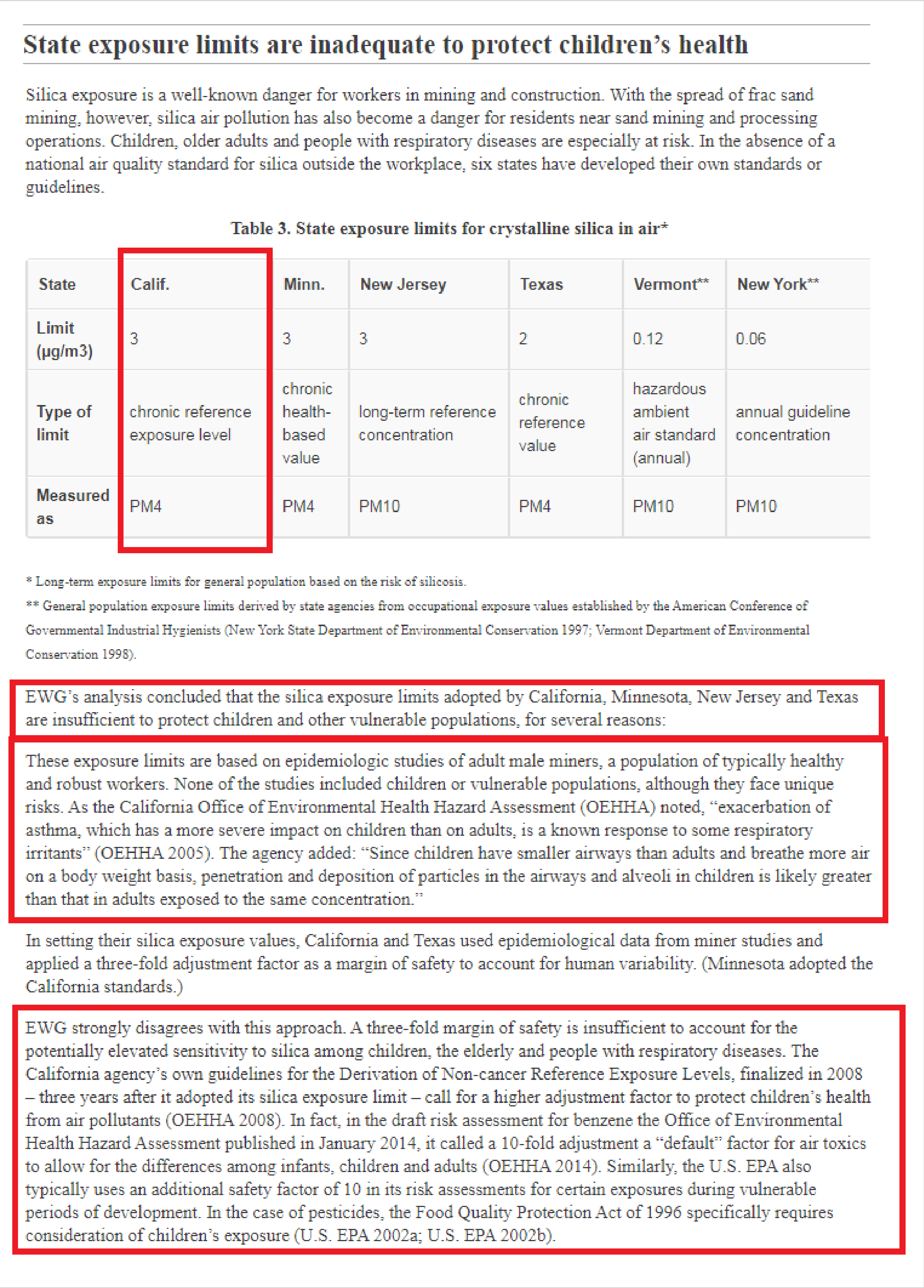
(3) A plan under sub-clause (2) must contain:

(a) measures outlining how the licensee intends to reduce emissions of that Class 3 indicator to the maximum extent achievable; and

(b) time frames by which measures will be implemented.

(4) The Authority may prohibit the emission of a Class 3 indicator if it is considered to constitute a significant threat to public health, either in the ambient air environment or in the vicinity of a particular source.

Attachment A4 - Californian Standards



State exposure limits are inadequate to protect children's health

Silica exposure is a well-known danger for workers in mining and construction. With the spread of frac sand mining, however, silica air pollution has also become a danger for residents near sand mining and processing operations. Children, older adults and people with respiratory diseases are especially at risk. In the absence of a national air quality standard for silica outside the workplace, six states have developed their own standards or guidelines.

Table 3. State exposure limits for crystalline silica in air*

State	Calif.	Minn.	New Jersey	Texas	Vermont**	New York**
Limit (µg/m3)	3	3	3	2	0.12	0.06
Type of limit	chronic reference exposure level	chronic health-based value	long-term reference concentration	chronic reference value	hazardous ambient air standard (annual)	annual guideline concentration
Measured as	PM4	PM4	PM10	PM4	PM10	PM10

* Long-term exposure limits for general population based on the risk of silicosis.

** General population exposure limits derived by state agencies from occupational exposure values established by the American Conference of Governmental Industrial Hygienists (New York State Department of Environmental Conservation 1997; Vermont Department of Environmental Conservation 1998).

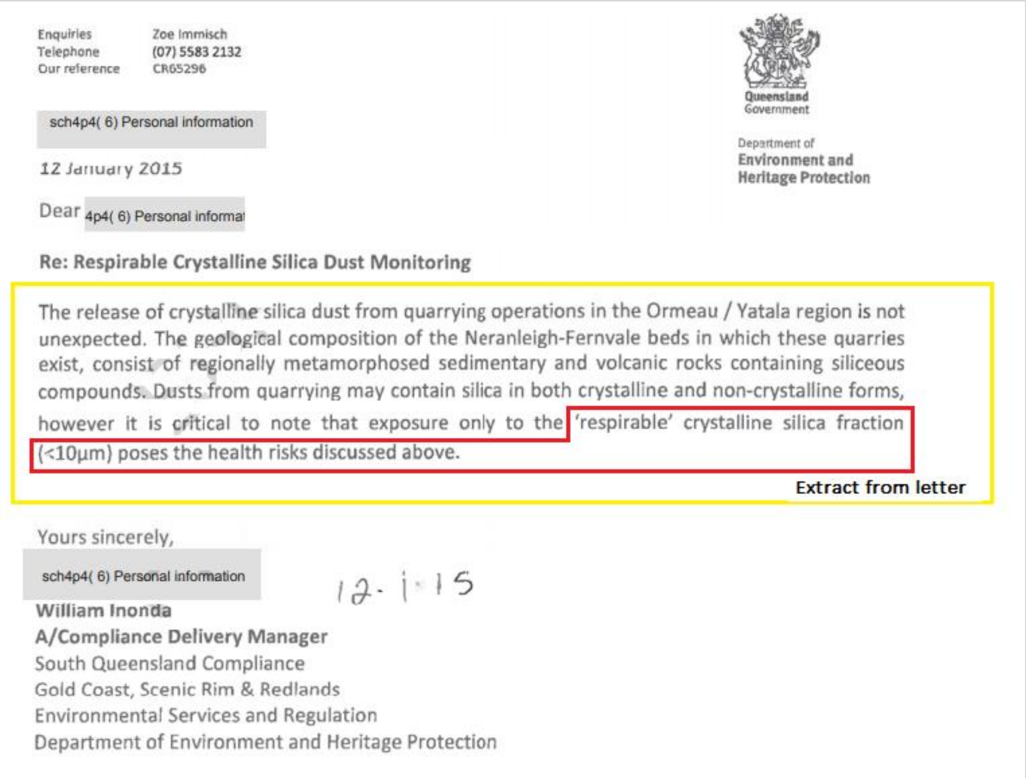
EWG's analysis concluded that the silica exposure limits adopted by California, Minnesota, New Jersey and Texas are insufficient to protect children and other vulnerable populations, for several reasons:

These exposure limits are based on epidemiologic studies of adult male miners, a population of typically healthy and robust workers. None of the studies included children or vulnerable populations, although they face unique risks. As the California Office of Environmental Health Hazard Assessment (OEHHA) noted, "exacerbation of asthma, which has a more severe impact on children than on adults, is a known response to some respiratory irritants" (OEHHA 2005). The agency added: "Since children have smaller airways than adults and breathe more air on a body weight basis, penetration and deposition of particles in the airways and alveoli in children is likely greater than that in adults exposed to the same concentration."

In setting their silica exposure values, California and Texas used epidemiological data from miner studies and applied a three-fold adjustment factor as a margin of safety to account for human variability. (Minnesota adopted the California standards.)

EWG strongly disagrees with this approach. A three-fold margin of safety is insufficient to account for the potentially elevated sensitivity to silica among children, the elderly and people with respiratory diseases. The California agency's own guidelines for the Derivation of Non-cancer Reference Exposure Levels, finalized in 2008 – three years after it adopted its silica exposure limit – call for a higher adjustment factor to protect children's health from air pollutants (OEHHA 2008). In fact, in the draft risk assessment for benzene the Office of Environmental Health Hazard Assessment published in January 2014, it called a 10-fold adjustment a "default" factor for air toxics to allow for the differences among infants, children and adults (OEHHA 2014). Similarly, the U.S. EPA also typically uses an additional safety factor of 10 in its risk assessments for certain exposures during vulnerable periods of development. In the case of pesticides, the Food Quality Protection Act of 1996 specifically requires consideration of children's exposure (U.S. EPA 2002a; U.S. EPA 2002b).

Attachment B1 - Respirable silica dust up to PM10



Enquiries Zoe Immisch
Telephone (07) 5583 2132
Our reference CR65296

Queensland Government

Department of
Environment and Heritage Protection

sch4p4(6) Personal information

12 January 2015

Dear 4p4(6) Personal informat

Re: Respirable Crystalline Silica Dust Monitoring

The release of crystalline silica dust from quarrying operations in the Ormeau / Yatala region is not unexpected. The geological composition of the Neranleigh-Fernvale beds in which these quarries exist, consist of regionally metamorphosed sedimentary and volcanic rocks containing siliceous compounds. Dusts from quarrying may contain silica in both crystalline and non-crystalline forms, however it is critical to note that exposure only to the 'respirable' crystalline silica fraction (<10µm) poses the health risks discussed above.

Extract from letter

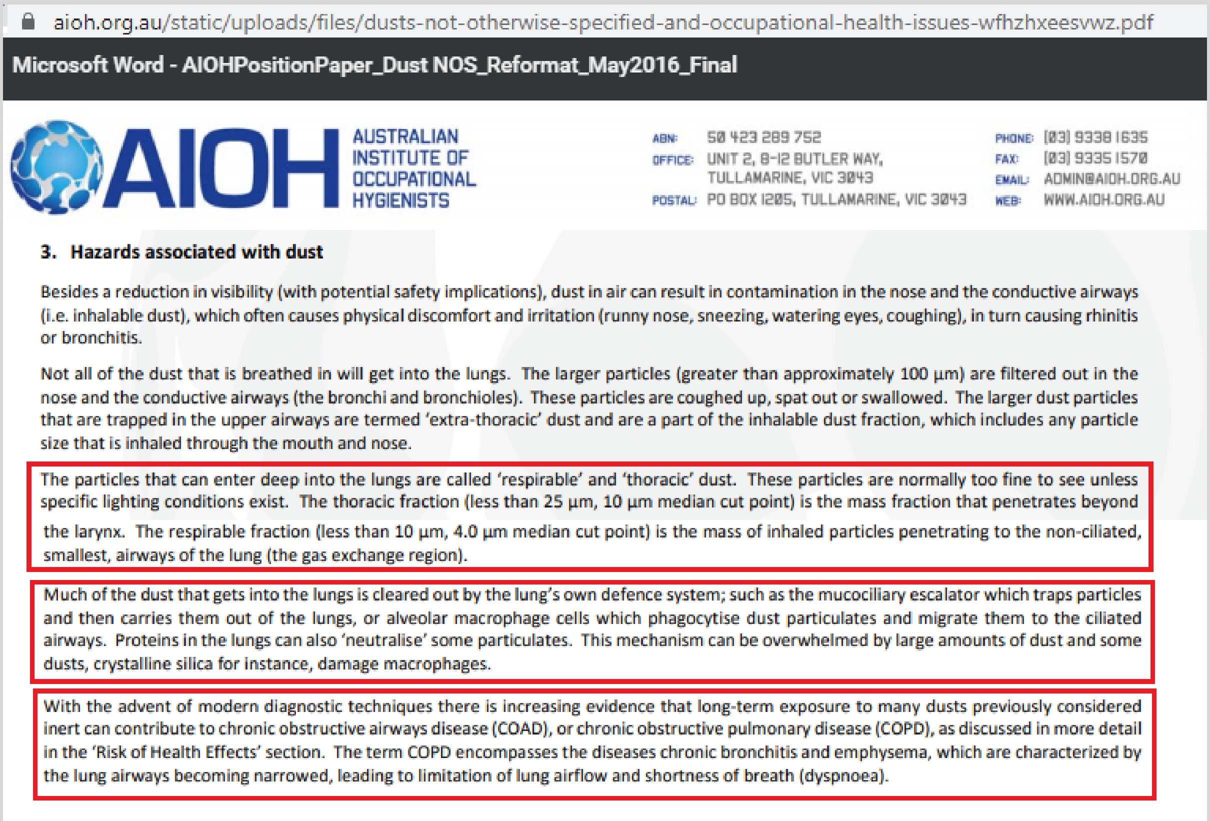
Yours sincerely,

sch4p4(6) Personal information

12.1.15

William Inonda
A/Compliance Delivery Manager
South Queensland Compliance
Gold Coast, Scenic Rim & Redlands
Environmental Services and Regulation
Department of Environment and Heritage Protection

Attachment B2 - Respirable PM10



aioh.org.au/static/uploads/files/dusts-not-otherwise-specified-and-occupational-health-issues-wfhzhxeesvwz.pdf

Microsoft Word - AIOHPositionPaper_Dust NOS_Reformat_May2016_Final

AIOH AUSTRALIAN INSTITUTE OF OCCUPATIONAL HYGIENISTS

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3. Hazards associated with dust

Besides a reduction in visibility (with potential safety implications), dust in air can result in contamination in the nose and the conductive airways (i.e. inhalable dust), which often causes physical discomfort and irritation (runny nose, sneezing, watering eyes, coughing), in turn causing rhinitis or bronchitis.

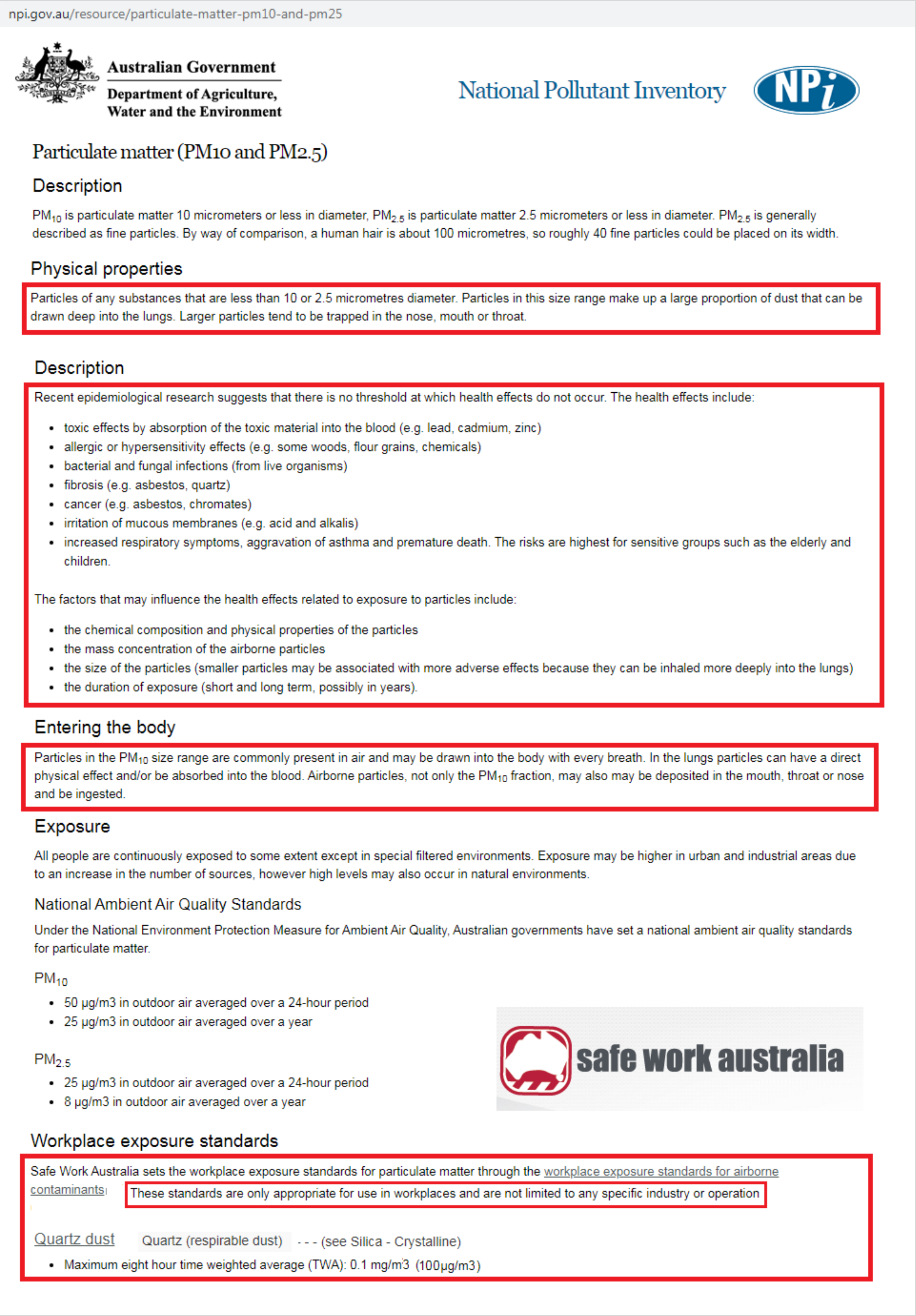
Not all of the dust that is breathed in will get into the lungs. The larger particles (greater than approximately 100 µm) are filtered out in the nose and the conductive airways (the bronchi and bronchioles). These particles are coughed up, spat out or swallowed. The larger dust particles that are trapped in the upper airways are termed 'extra-thoracic' dust and are a part of the inhalable dust fraction, which includes any particle size that is inhaled through the mouth and nose.

The particles that can enter deep into the lungs are called 'respirable' and 'thoracic' dust. These particles are normally too fine to see unless specific lighting conditions exist. The thoracic fraction (less than 25 µm, 10 µm median cut point) is the mass fraction that penetrates beyond the larynx. The respirable fraction (less than 10 µm, 4.0 µm median cut point) is the mass of inhaled particles penetrating to the non-ciliated, smallest, airways of the lung (the gas exchange region).

Much of the dust that gets into the lungs is cleared out by the lung's own defence system; such as the mucociliary escalator which traps particles and then carries them out of the lungs, or alveolar macrophage cells which phagocytise dust particulates and migrate them to the ciliated airways. Proteins in the lungs can also 'neutralise' some particulates. This mechanism can be overwhelmed by large amounts of dust and some dusts, crystalline silica for instance, damage macrophages.

With the advent of modern diagnostic techniques there is increasing evidence that long-term exposure to many dusts previously considered inert can contribute to chronic obstructive airways disease (COAD), or chronic obstructive pulmonary disease (COPD), as discussed in more detail in the 'Risk of Health Effects' section. The term COPD encompasses the diseases chronic bronchitis and emphysema, which are characterized by the lung airways becoming narrowed, leading to limitation of lung airflow and shortness of breath (dyspnoea).

Attachment B3 - Australian Government - Respirable silica dust up to PM10



npi.gov.au/resource/particulate-matter-pm10-and-pm25

Australian Government
Department of Agriculture, Water and the Environment

National Pollutant Inventory

Particulate matter (PM10 and PM2.5)

Description

PM$_{10}$ is particulate matter 10 micrometers or less in diameter, PM$_{2.5}$ is particulate matter 2.5 micrometers or less in diameter. PM$_{2.5}$ is generally described as fine particles. By way of comparison, a human hair is about 100 micrometres, so roughly 40 fine particles could be placed on its width.

Physical properties

Particles of any substances that are less than 10 or 2.5 micrometres diameter. Particles in this size range make up a large proportion of dust that can be drawn deep into the lungs. Larger particles tend to be trapped in the nose, mouth or throat.

Description

Recent epidemiological research suggests that there is no threshold at which health effects do not occur. The health effects include:

- toxic effects by absorption of the toxic material into the blood (e.g. lead, cadmium, zinc)
- allergic or hypersensitivity effects (e.g. some woods, flour grains, chemicals)
- bacterial and fungal infections (from live organisms)
- fibrosis (e.g. asbestos, quartz)
- cancer (e.g. asbestos, chromates)
- irritation of mucous membranes (e.g. acid and alkalis)
- increased respiratory symptoms, aggravation of asthma and premature death. The risks are highest for sensitive groups such as the elderly and children.

The factors that may influence the health effects related to exposure to particles include:

- the chemical composition and physical properties of the particles
- the mass concentration of the airborne particles
- the size of the particles (smaller particles may be associated with more adverse effects because they can be inhaled more deeply into the lungs)
- the duration of exposure (short and long term, possibly in years).

Entering the body

Particles in the PM$_{10}$ size range are commonly present in air and may be drawn into the body with every breath. In the lungs particles can have a direct physical effect and/or be absorbed into the blood. Airborne particles, not only the PM$_{10}$ fraction, may also may be deposited in the mouth, throat or nose and be ingested.

Exposure

All people are continuously exposed to some extent except in special filtered environments. Exposure may be higher in urban and industrial areas due to an increase in the number of sources, however high levels may also occur in natural environments.

National Ambient Air Quality Standards

Under the National Environment Protection Measure for Ambient Air Quality, Australian governments have set a national ambient air quality standards for particulate matter.

PM$_{10}$

- 50 µg/m3 in outdoor air averaged over a 24-hour period
- 25 µg/m3 in outdoor air averaged over a year

PM$_{2.5}$

- 25 µg/m3 in outdoor air averaged over a 24-hour period
- 8 µg/m3 in outdoor air averaged over a year

safe work australia

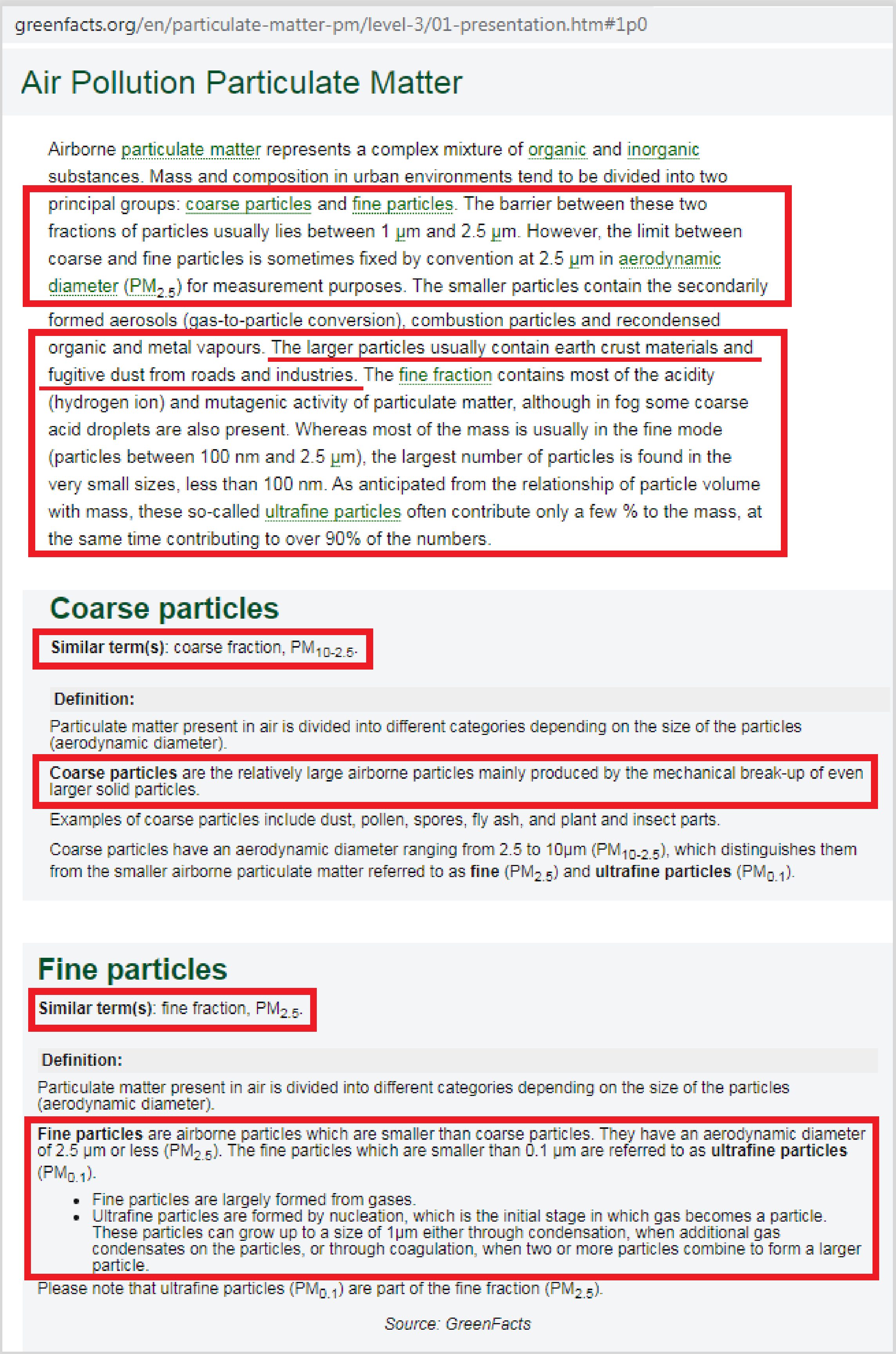
Workplace exposure standards

Safe Work Australia sets the workplace exposure standards for particulate matter through the workplace exposure standards for airborne contaminants. These standards are only appropriate for use in workplaces and are not limited to any specific industry or operation

Quartz dust   Quartz (respirable dust)   - - - (see Silica - Crystalline)

- Maximum eight hour time weighted average (TWA): 0.1 mg/m3 (100µg/m3)

Attachment B4 - Coarse (Silica Dust)and Fine Particles (Fumes)



greenfacts.org/en/particulate-matter-pm/level-3/01-presentation.htm#1p0

Air Pollution Particulate Matter

Airborne particulate matter represents a complex mixture of organic and inorganic substances. Mass and composition in urban environments tend to be divided into two principal groups: coarse particles and fine particles. The barrier between these two fractions of particles usually lies between 1 µm and 2.5 µm. However, the limit between coarse and fine particles is sometimes fixed by convention at 2.5 µm in aerodynamic diameter ($PM_{2.5}$) for measurement purposes. The smaller particles contain the secondarily formed aerosols (gas-to-particle conversion), combustion particles and recondensed organic and metal vapours. The larger particles usually contain earth crust materials and fugitive dust from roads and industries. The fine fraction contains most of the acidity (hydrogen ion) and mutagenic activity of particulate matter, although in fog some coarse acid droplets are also present. Whereas most of the mass is usually in the fine mode (particles between 100 nm and 2.5 µm), the largest number of particles is found in the very small sizes, less than 100 nm. As anticipated from the relationship of particle volume with mass, these so-called ultrafine particles often contribute only a few % to the mass, at the same time contributing to over 90% of the numbers.

Coarse particles

Similar term(s): coarse fraction, $PM_{10-2.5}$.

Definition:

Particulate matter present in air is divided into different categories depending on the size of the particles (aerodynamic diameter).

Coarse particles are the relatively large airborne particles mainly produced by the mechanical break-up of even larger solid particles.

Examples of coarse particles include dust, pollen, spores, fly ash, and plant and insect parts.

Coarse particles have an aerodynamic diameter ranging from 2.5 to 10µm ($PM_{10-2.5}$), which distinguishes them from the smaller airborne particulate matter referred to as **fine** ($PM_{2.5}$) and **ultrafine particles** ($PM_{0.1}$).

Fine particles

Similar term(s): fine fraction, $PM_{2.5}$.

Definition:

Particulate matter present in air is divided into different categories depending on the size of the particles (aerodynamic diameter).

Fine particles are airborne particles which are smaller than coarse particles. They have an aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$). The fine particles which are smaller than 0.1 µm are referred to as **ultrafine particles** ($PM_{0.1}$).

- Fine particles are largely formed from gases.
- Ultrafine particles are formed by nucleation, which is the initial stage in which gas becomes a particle. These particles can grow up to a size of 1µm either through condensation, when additional gas condensates on the particles, or through coagulation, when two or more particles combine to form a larger particle.

Please note that ultrafine particles ($PM_{0.1}$) are part of the fine fraction ($PM_{2.5}$).

Source: GreenFacts

Attachment B5 - Health Effects of exposure to crystalline silica

safeworkaustralia.gov.au/book/potential-health-effects-following-exposure-crystalline-silica

Potential health effects following exposure to crystalline silica

Route of occupational exposure

The primary route of crystalline silica exposure is via inhalation.

Target organ/effect

The target organs and potential effects of crystalline silica exposure include:

Lungs

- Silicosis – acute, accelerated, chronic, PMF
- Lung cancer
- Chronic obstructive pulmonary disease
- Tuberculosis

Kidneys

- Renal disease

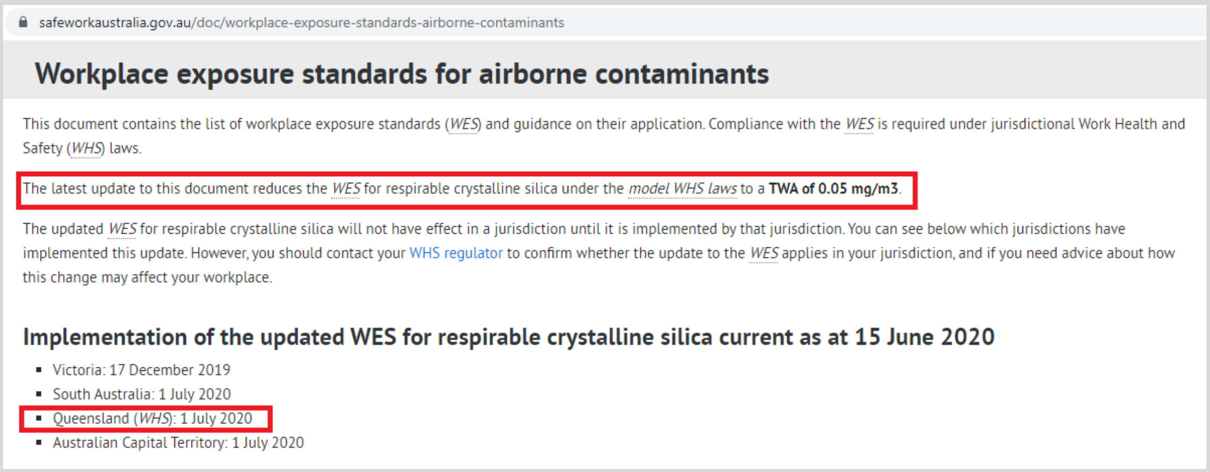
Autoimmune

- Scleroderma
- Rheumatoid arthritis
- SLE
- Sarcoidosis

Airborne crystalline silica can bioaccumulate in the lungs and cause disease of the respiratory system. There is no clear 'no observable adverse effects level' (NOAEL) demonstrated for crystalline silica. Risks to health are occurring at levels previously thought to be acceptable. Limitations in technology make it difficult to determine a NOAEL if it occurs at very low levels of exposure.

Large bioaccumulated loads of crystalline silica in the lung substance (or lung parenchyma) can cause a build-up of connective tissue, termed silicosis, a specific form of pneumoconiosis. Silicosis is an irreversible and progressive condition. Early silicosis may have no untoward effects. However, severe forms can result in poor gas exchange, difficulty in breathing and death. Evidence suggests crystalline silica interacts with other respiratory *hazards*, like tobacco smoke, to cause airway diseases. Smokers are more susceptible to the long term effects of silica dust exposure.

Attachment C1 - TWA 0.05 mg/m3 (1st July 2020)



safeworkaustralia.gov.au/doc/workplace-exposure-standards-airborne-contaminants

Workplace exposure standards for airborne contaminants

This document contains the list of workplace exposure standards (*WES*) and guidance on their application. Compliance with the *WES* is required under jurisdictional Work Health and Safety (*WHS*) laws.

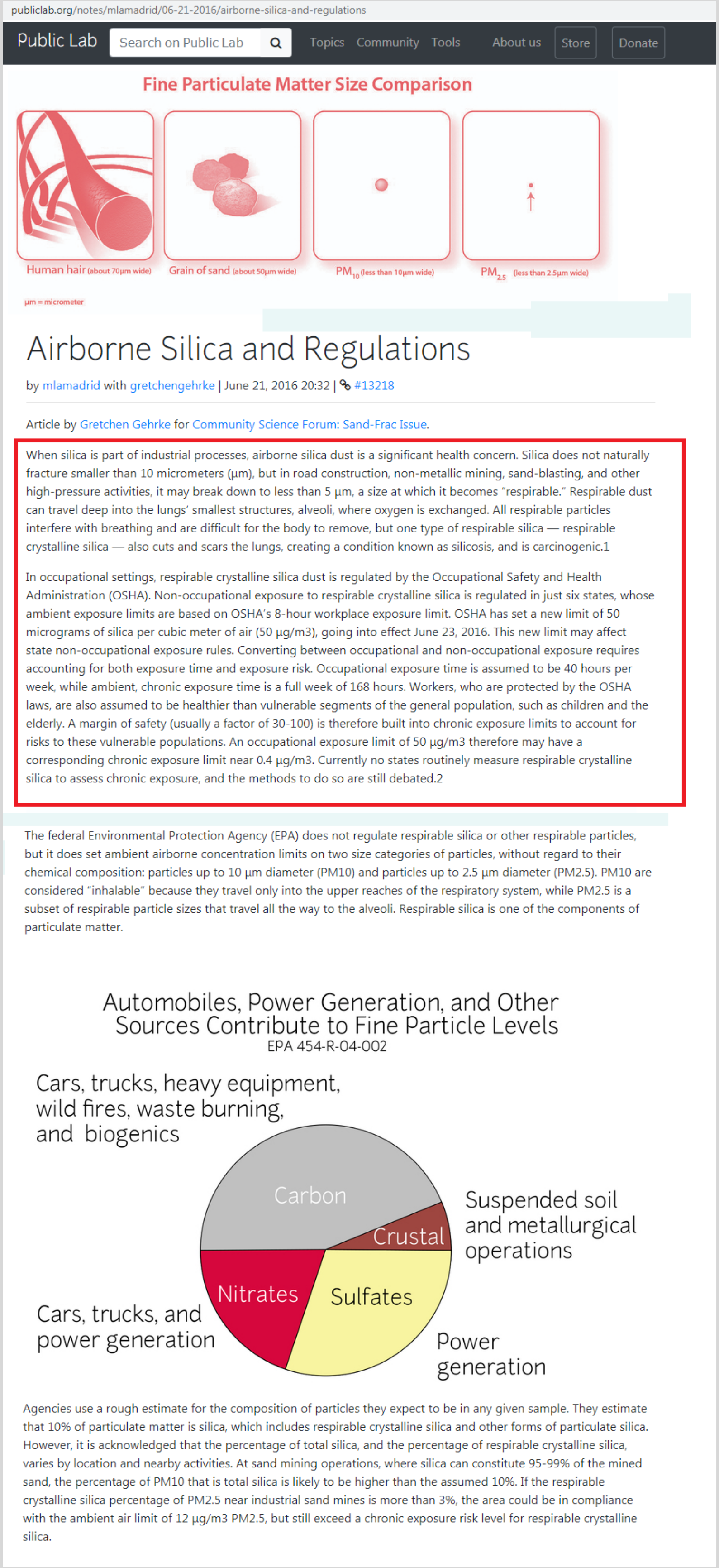
The latest update to this document reduces the *WES* for respirable crystalline silica under the *model WHS laws* to a **TWA of 0.05 mg/m3**.

The updated *WES* for respirable crystalline silica will not have effect in a jurisdiction until it is implemented by that jurisdiction. You can see below which jurisdictions have implemented this update. However, you should contact your WHS regulator to confirm whether the update to the *WES* applies in your jurisdiction, and if you need advice about how this change may affect your workplace.

Implementation of the updated WES for respirable crystalline silica current as at 15 June 2020

- Victoria: 17 December 2019
- South Australia: 1 July 2020
- Queensland (*WHS*): 1 July 2020
- Australian Capital Territory: 1 July 2020

Attachment D1 - Airborne Silica and Regulations



Airborne Silica and Regulations

by mlamadrid with gretchengehrke | June 21, 2016 20:32 | #13218

Article by Gretchen Gehrke for Community Science Forum: Sand-Frac Issue.

When silica is part of industrial processes, airborne silica dust is a significant health concern. Silica does not naturally fracture smaller than 10 micrometers (μm), but in road construction, non-metallic mining, sand-blasting, and other high-pressure activities, it may break down to less than 5 μm, a size at which it becomes "respirable." Respirable dust can travel deep into the lungs' smallest structures, alveoli, where oxygen is exchanged. All respirable particles interfere with breathing and are difficult for the body to remove, but one type of respirable silica — respirable crystalline silica — also cuts and scars the lungs, creating a condition known as silicosis, and is carcinogenic.1

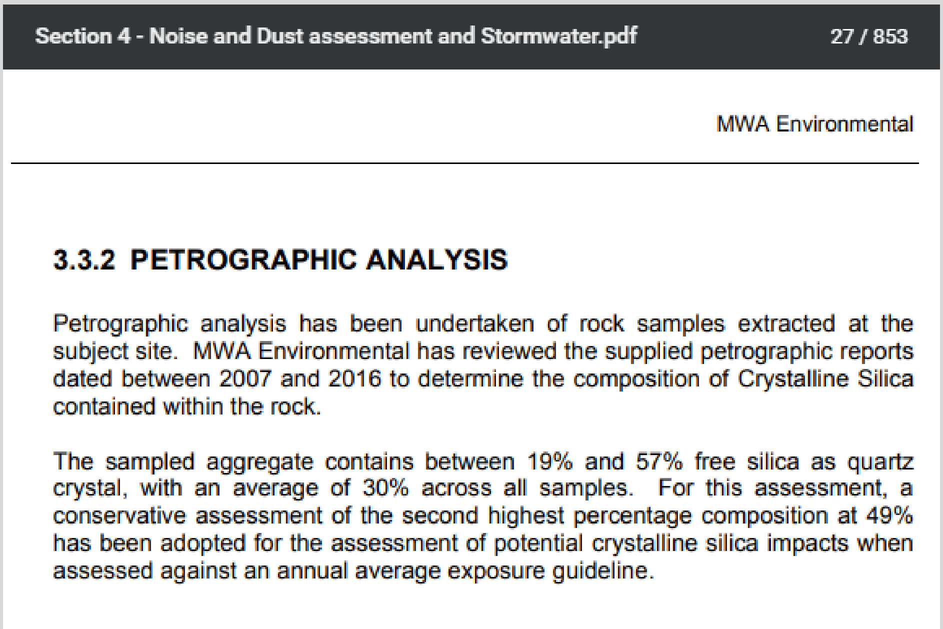
In occupational settings, respirable crystalline silica dust is regulated by the Occupational Safety and Health Administration (OSHA). Non-occupational exposure to respirable crystalline silica is regulated in just six states, whose ambient exposure limits are based on OSHA's 8-hour workplace exposure limit. OSHA has set a new limit of 50 micrograms of silica per cubic meter of air (50 μg/m3), going into effect June 23, 2016. This new limit may affect state non-occupational exposure rules. Converting between occupational and non-occupational exposure requires accounting for both exposure time and exposure risk. Occupational exposure time is assumed to be 40 hours per week, while ambient, chronic exposure time is a full week of 168 hours. Workers, who are protected by the OSHA laws, are also assumed to be healthier than vulnerable segments of the general population, such as children and the elderly. A margin of safety (usually a factor of 30-100) is therefore built into chronic exposure limits to account for risks to these vulnerable populations. An occupational exposure limit of 50 μg/m3 therefore may have a corresponding chronic exposure limit near 0.4 μg/m3. Currently no states routinely measure respirable crystalline silica to assess chronic exposure, and the methods to do so are still debated.2

The federal Environmental Protection Agency (EPA) does not regulate respirable silica or other respirable particles, but it does set ambient airborne concentration limits on two size categories of particles, without regard to their chemical composition: particles up to 10 μm diameter (PM10) and particles up to 2.5 μm diameter (PM2.5). PM10 are considered "inhalable" because they travel only into the upper reaches of the respiratory system, while PM2.5 is a subset of respirable particle sizes that travel all the way to the alveoli. Respirable silica is one of the components of particulate matter.

Automobiles, Power Generation, and Other Sources Contribute to Fine Particle Levels
EPA 454-R-04-002

Agencies use a rough estimate for the composition of particles they expect to be in any given sample. They estimate that 10% of particulate matter is silica, which includes respirable crystalline silica and other forms of particulate silica. However, it is acknowledged that the percentage of total silica, and the percentage of respirable crystalline silica, varies by location and nearby activities. At sand mining operations, where silica can constitute 95-99% of the mined sand, the percentage of PM10 that is total silica is likely to be higher than the assumed 10%. If the respirable crystalline silica percentage of PM2.5 near industrial sand mines is more than 3%, the area could be in compliance with the ambient air limit of 12 μg/m3 PM2.5, but still exceed a chronic exposure risk level for respirable crystalline silica.

Attachment D2 - Petrographic Analysis - up to 57% Silica



Section 4 - Noise and Dust assessment and Stormwater.pdf 27 / 853

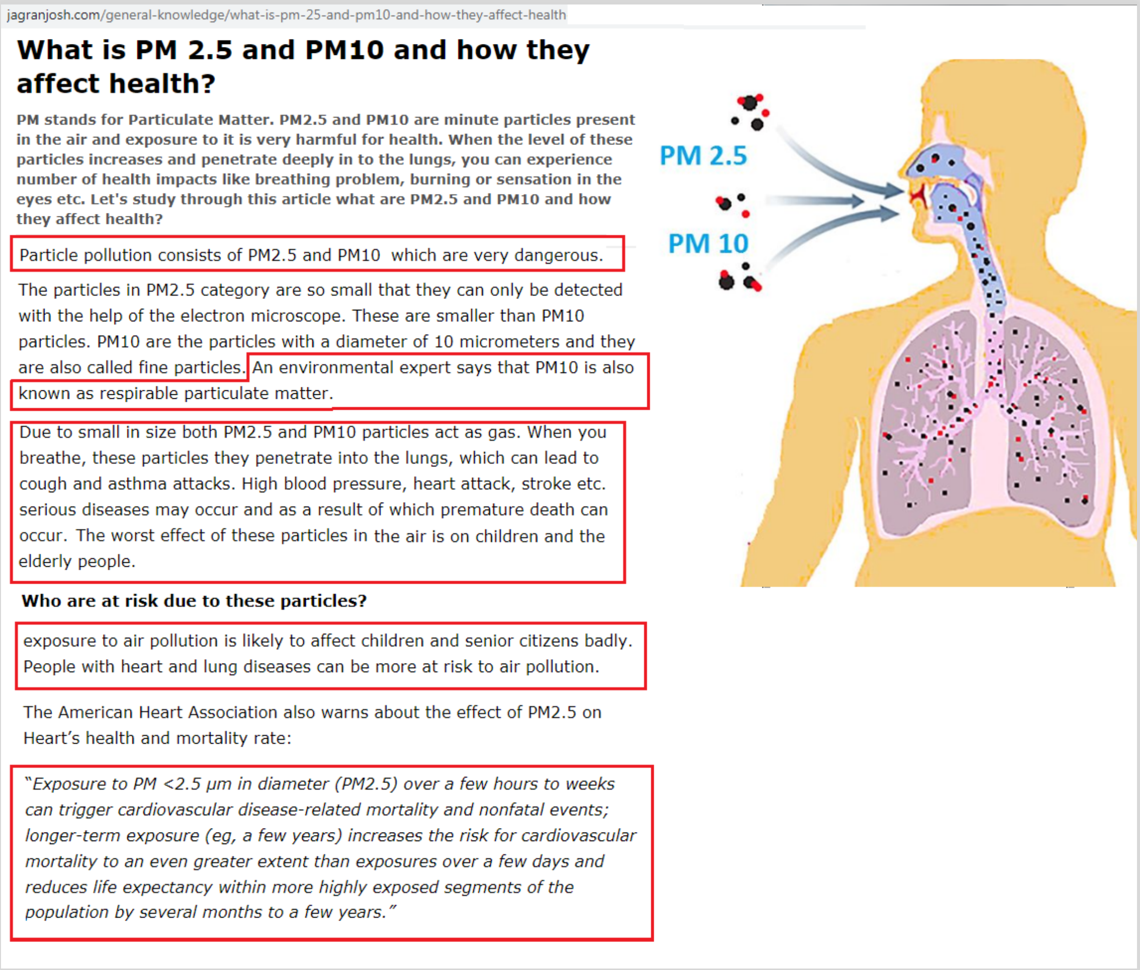
MWA Environmental

3.3.2 PETROGRAPHIC ANALYSIS

Petrographic analysis has been undertaken of rock samples extracted at the subject site. MWA Environmental has reviewed the supplied petrographic reports dated between 2007 and 2016 to determine the composition of Crystalline Silica contained within the rock.

The sampled aggregate contains between 19% and 57% free silica as quartz crystal, with an average of 30% across all samples. For this assessment, a conservative assessment of the second highest percentage composition at 49% has been adopted for the assessment of potential crystalline silica impacts when assessed against an annual average exposure guideline.

Attachment D3 - Particles PM2.5 and PM10 are respirable matter



jagranjosh.com/general-knowledge/what-is-pm-25-and-pm10-and-how-they-affect-health

What is PM 2.5 and PM10 and how they affect health?

PM stands for Particulate Matter. PM2.5 and PM10 are minute particles present in the air and exposure to it is very harmful for health. When the level of these particles increases and penetrate deeply in to the lungs, you can experience number of health impacts like breathing problem, burning or sensation in the eyes etc. Let's study through this article what are PM2.5 and PM10 and how they affect health?

Particle pollution consists of PM2.5 and PM10 which are very dangerous.

The particles in PM2.5 category are so small that they can only be detected with the help of the electron microscope. These are smaller than PM10 particles. PM10 are the particles with a diameter of 10 micrometers and they are also called fine particles. An environmental expert says that PM10 is also known as respirable particulate matter.

Due to small in size both PM2.5 and PM10 particles act as gas. When you breathe, these particles they penetrate into the lungs, which can lead to cough and asthma attacks. High blood pressure, heart attack, stroke etc. serious diseases may occur and as a result of which premature death can occur. The worst effect of these particles in the air is on children and the elderly people.

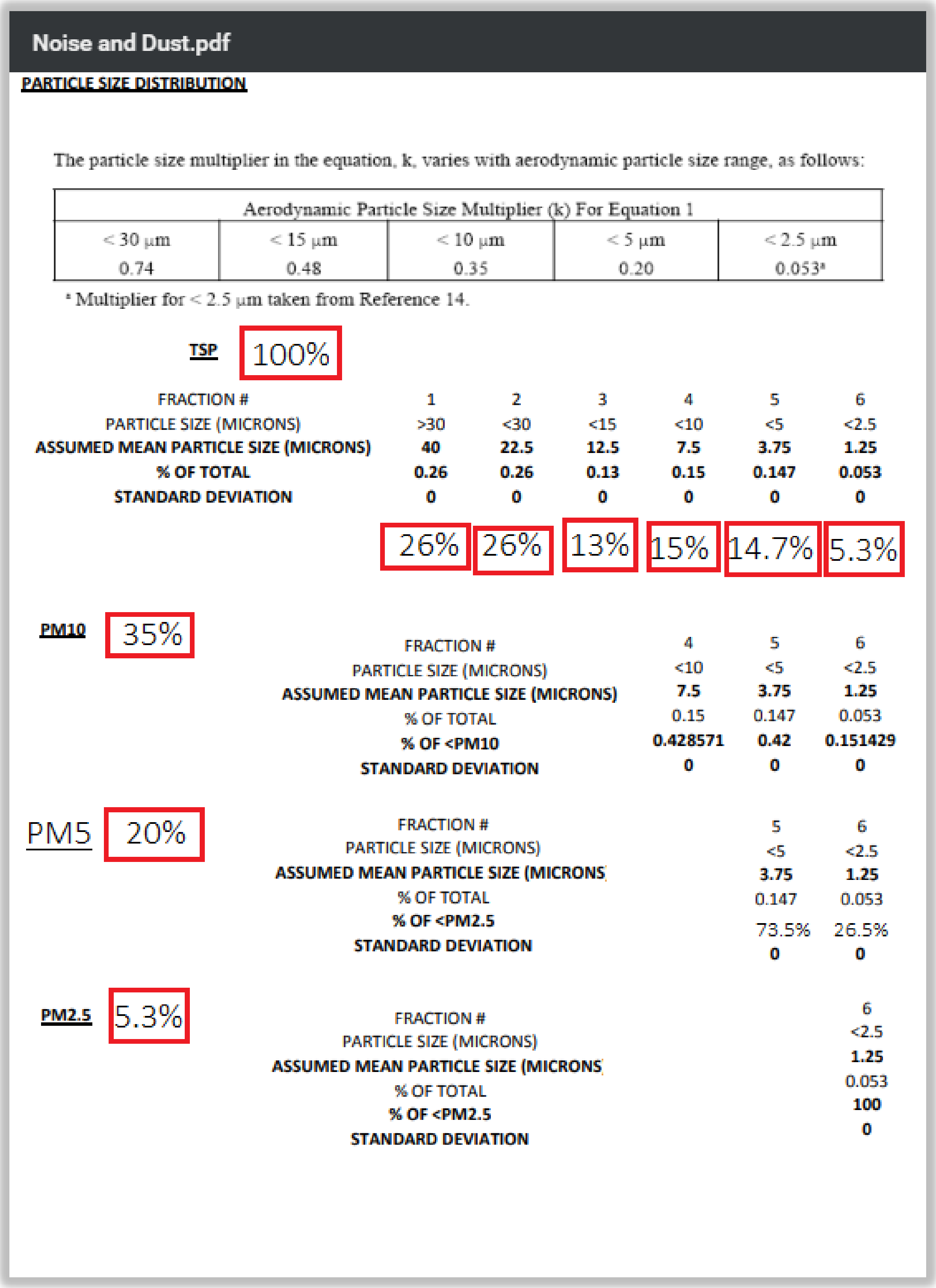
Who are at risk due to these particles?

exposure to air pollution is likely to affect children and senior citizens badly. People with heart and lung diseases can be more at risk to air pollution.

The American Heart Association also warns about the effect of PM2.5 on Heart's health and mortality rate:

"Exposure to PM <2.5 µm in diameter (PM2.5) over a few hours to weeks can trigger cardiovascular disease-related mortality and nonfatal events; longer-term exposure (eg, a few years) increases the risk for cardiovascular mortality to an even greater extent than exposures over a few days and reduces life expectancy within more highly exposed segments of the population by several months to a few years."

Attachment E1 - Development application Particle Size distribution



Noise and Dust.pdf

PARTICLE SIZE DISTRIBUTION

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 µm taken from Reference 14.

TSP 100%

FRACTION #	1	2	3	4	5	6
PARTICLE SIZE (MICRONS)	>30	<30	<15	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**40**	**22.5**	**12.5**	**7.5**	**3.75**	**1.25**
% OF TOTAL	**0.26**	**0.26**	**0.13**	**0.15**	**0.147**	**0.053**
STANDARD DEVIATION	**0**	**0**	**0**	**0**	**0**	**0**
	26%	26%	13%	15%	14.7%	5.3%

PM10 35%

FRACTION #	4	5	6
PARTICLE SIZE (MICRONS)	<10	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS)	**7.5**	**3.75**	**1.25**
% OF TOTAL	0.15	0.147	0.053
% OF <PM10	**0.428571**	**0.42**	**0.151429**
STANDARD DEVIATION	**0**	**0**	**0**

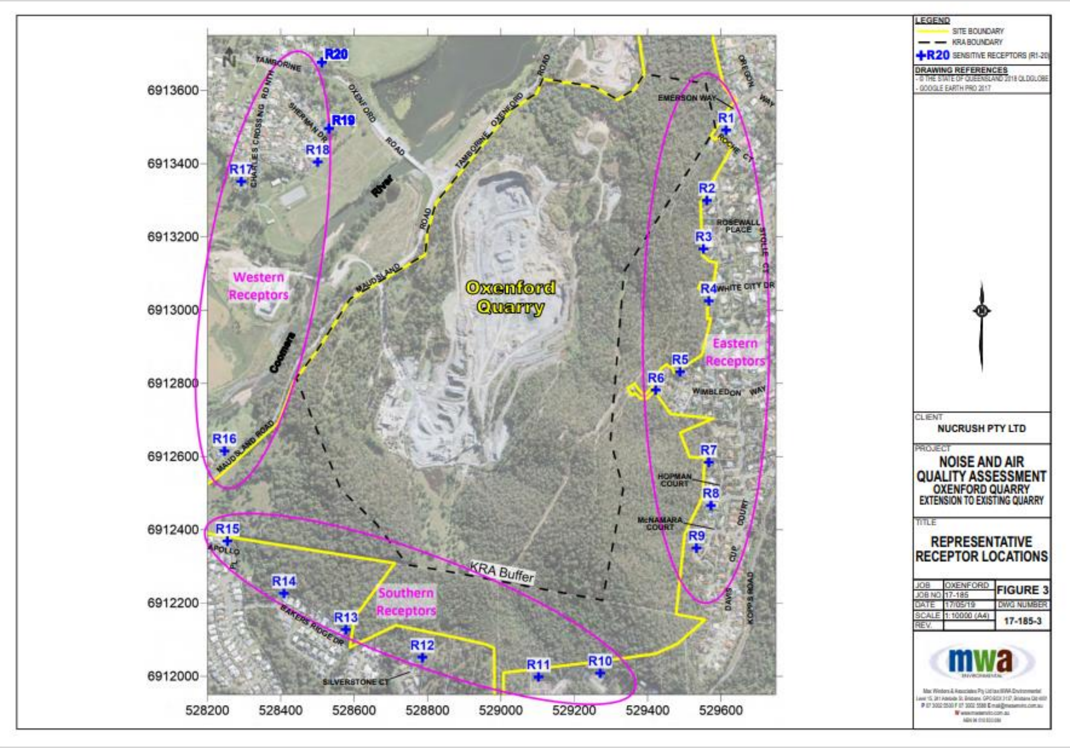
PM5 20%

FRACTION #	5	6
PARTICLE SIZE (MICRONS)	<5	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS	**3.75**	**1.25**
% OF TOTAL	0.147	0.053
% OF <PM2.5	73.5%	26.5%
STANDARD DEVIATION	**0**	**0**

PM2.5 5.3%

FRACTION #	6
PARTICLE SIZE (MICRONS)	<2.5
ASSUMED MEAN PARTICLE SIZE (MICRONS	**1.25**
% OF TOTAL	0.053
% OF <PM2.5	**100**
STANDARD DEVIATION	**0**

Attachment F1 - Development application Air Quality assessment locations



Attachment F2 - Development application Model predicted exposure Stage 1

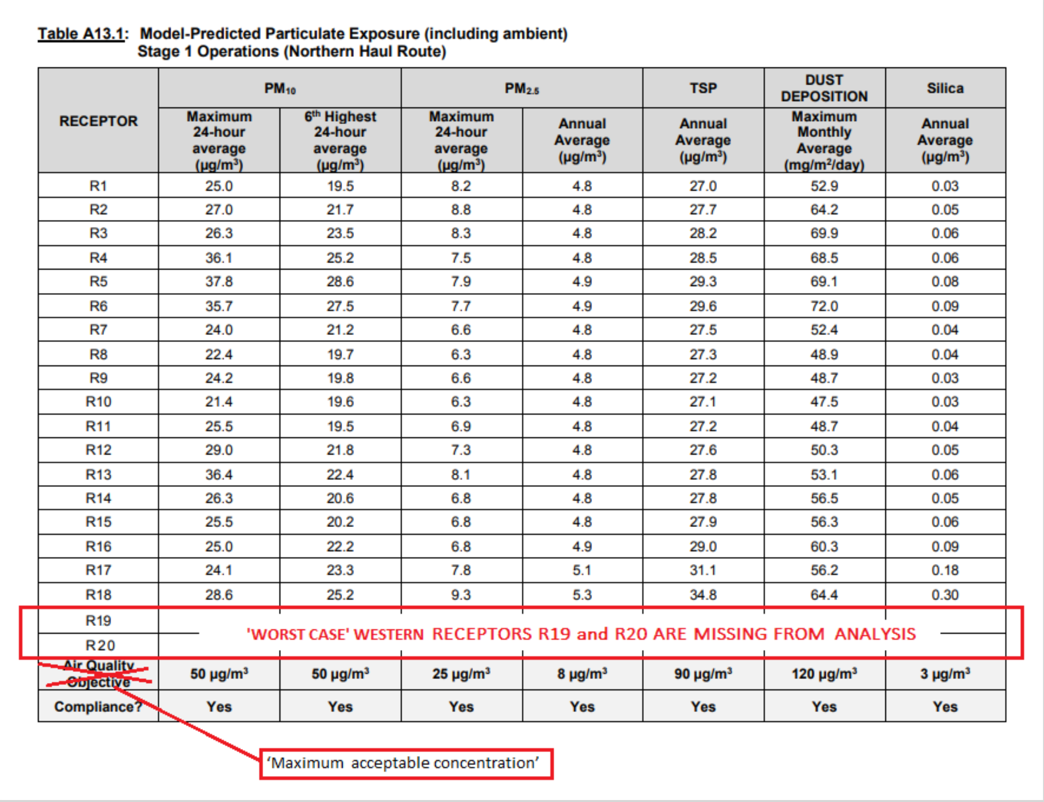
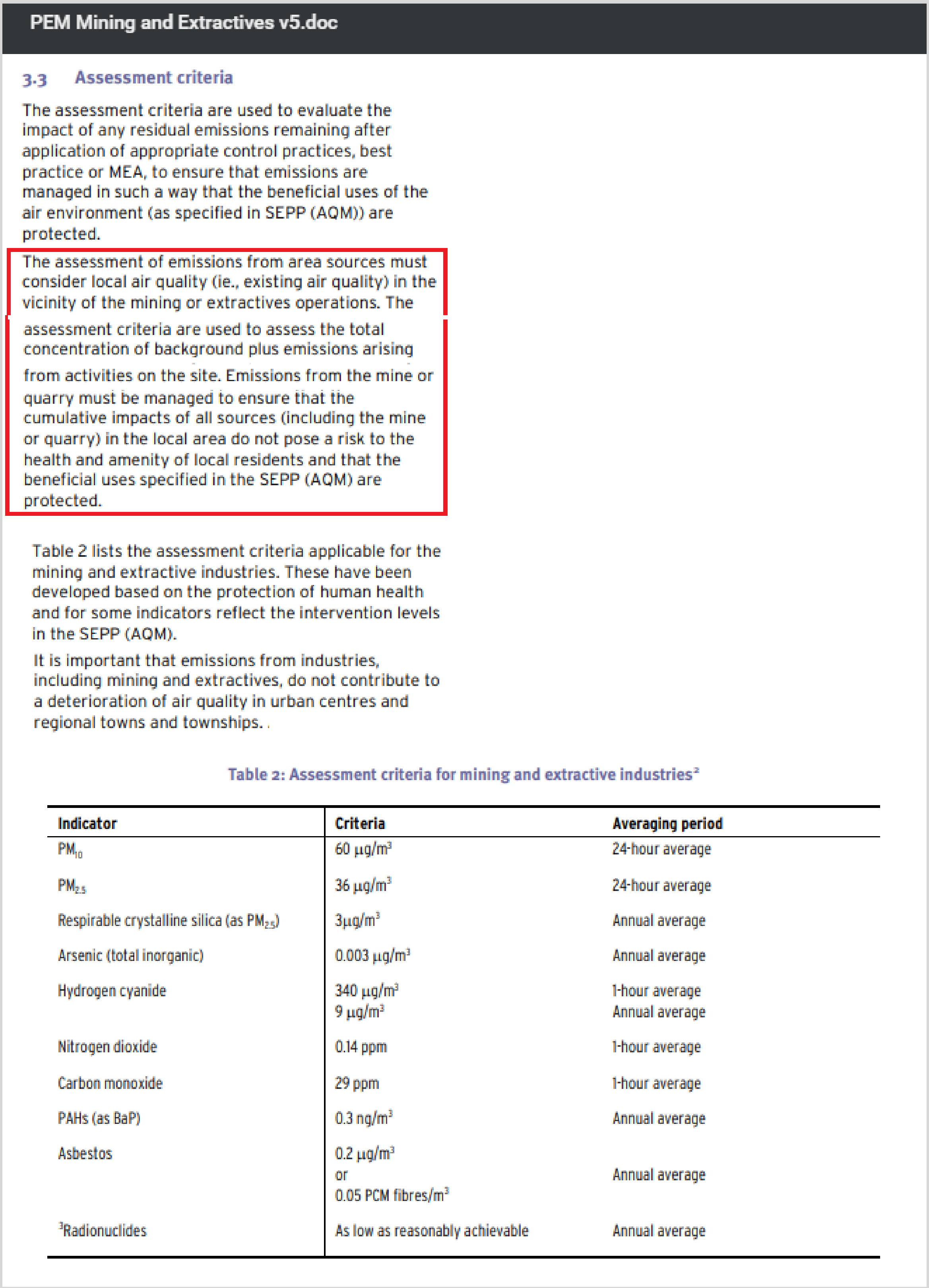


Table A13.1: **Model-Predicted Particulate Exposure (including ambient)**
Stage 1 Operations (Northern Haul Route)

RECEPTOR	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
R1	25.0	19.5	8.2	4.8	27.0	52.9	0.03
R2	27.0	21.7	8.8	4.8	27.7	64.2	0.05
R3	26.3	23.5	8.3	4.8	28.2	69.9	0.06
R4	36.1	25.2	7.5	4.8	28.5	68.5	0.06
R5	37.8	28.6	7.9	4.9	29.3	69.1	0.08
R6	35.7	27.5	7.7	4.9	29.6	72.0	0.09
R7	24.0	21.2	6.6	4.8	27.5	52.4	0.04
R8	22.4	19.7	6.3	4.8	27.3	48.9	0.04
R9	24.2	19.8	6.6	4.8	27.2	48.7	0.03
R10	21.4	19.6	6.3	4.8	27.1	47.5	0.03
R11	25.5	19.5	6.9	4.8	27.2	48.7	0.04
R12	29.0	21.8	7.3	4.8	27.6	50.3	0.05
R13	36.4	22.4	8.1	4.8	27.8	53.1	0.06
R14	26.3	20.6	6.8	4.8	27.8	56.5	0.05
R15	25.5	20.2	6.8	4.8	27.9	56.3	0.06
R16	25.0	22.2	6.8	4.9	29.0	60.3	0.09
R17	24.1	23.3	7.8	5.1	31.1	56.2	0.18
R18	28.6	25.2	9.3	5.3	34.8	64.4	0.30
R19	'WORST CASE' WESTERN RECEPTORS R19 and R20 ARE MISSING FROM ANALYSIS						
R20							
~~Air Quality Objective~~	50 µg/m^3	50 µg/m^3	25 µg/m^3	8 µg/m^3	90 µg/m^3	120 µg/m^3	3 µg/m^3
Compliance?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

'Maximum acceptable concentration'

Attachment H1 - Vic EPA State Environment Protection Policy Air Quality Management (SEPP AQM) for Mining and Extractive Industries - Section 3.3 Assessment Criteria



PEM Mining and Extractives v5.doc

3.3 Assessment criteria

The assessment criteria are used to evaluate the impact of any residual emissions remaining after application of appropriate control practices, best practice or MEA, to ensure that emissions are managed in such a way that the beneficial uses of the air environment (as specified in SEPP (AQM)) are protected.

The assessment of emissions from area sources must consider local air quality (ie., existing air quality) in the vicinity of the mining or extractives operations. The assessment criteria are used to assess the total concentration of background plus emissions arising from activities on the site. Emissions from the mine or quarry must be managed to ensure that the cumulative impacts of all sources (including the mine or quarry) in the local area do not pose a risk to the health and amenity of local residents and that the beneficial uses specified in the SEPP (AQM) are protected.

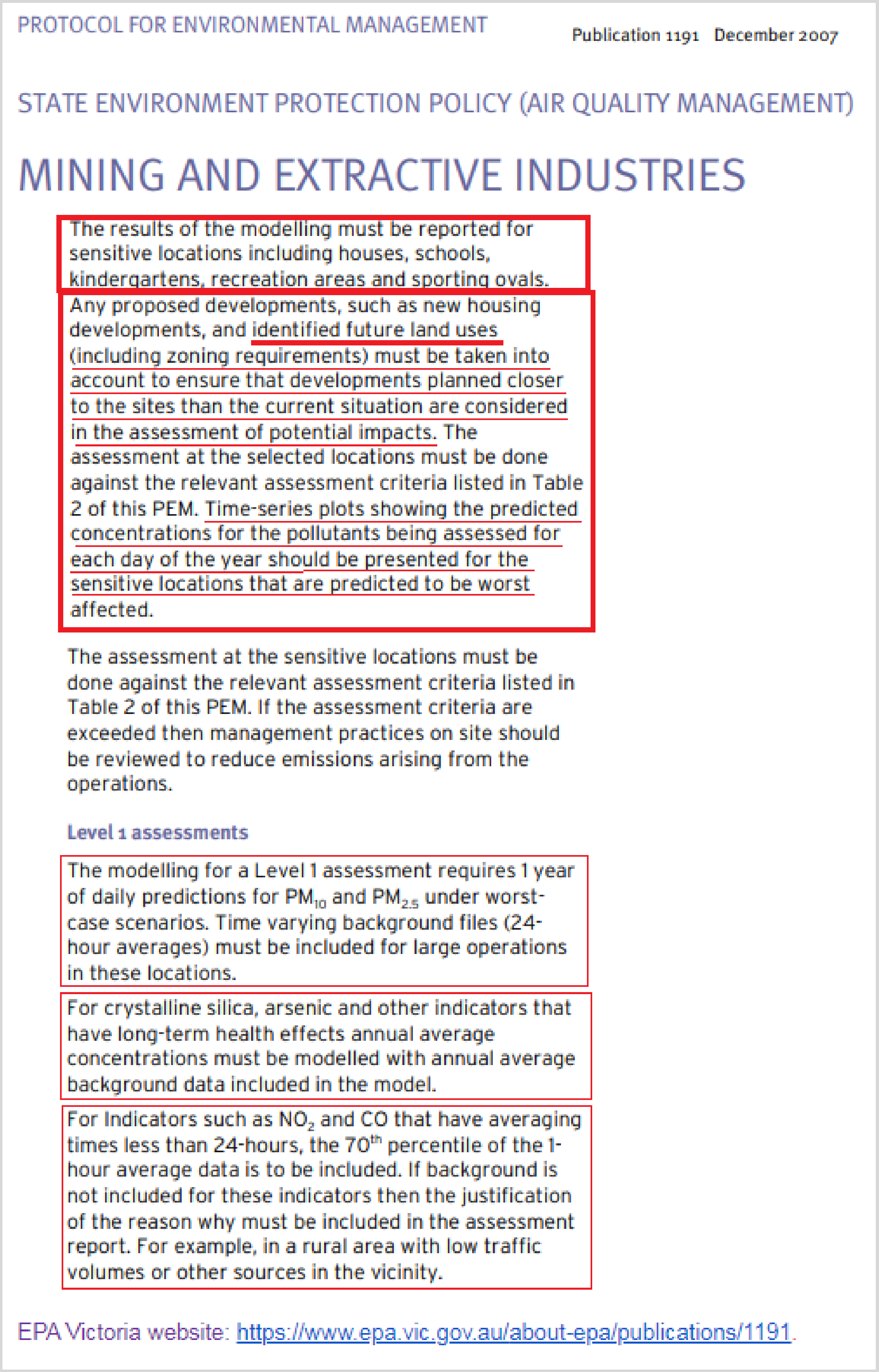
Table 2 lists the assessment criteria applicable for the mining and extractive industries. These have been developed based on the protection of human health and for some indicators reflect the intervention levels in the SEPP (AQM).

It is important that emissions from industries, including mining and extractives, do not contribute to a deterioration of air quality in urban centres and regional towns and townships. .

Table 2: Assessment criteria for mining and extractive industries[2]

Indicator	Criteria	Averaging period
PM_{10}	60 $\mu g/m^3$	24-hour average
$PM_{2.5}$	36 $\mu g/m^3$	24-hour average
Respirable crystalline silica (as $PM_{2.5}$)	3$\mu g/m^3$	Annual average
Arsenic (total inorganic)	0.003 $\mu g/m^3$	Annual average
Hydrogen cyanide	340 $\mu g/m^3$ 9 $\mu g/m^3$	1-hour average Annual average
Nitrogen dioxide	0.14 ppm	1-hour average
Carbon monoxide	29 ppm	1-hour average
PAHs (as BaP)	0.3 ng/m^3	Annual average
Asbestos	0.2 $\mu g/m^3$ or 0.05 PCM fibres/m^3	Annual average
[3]Radionuclides	As low as reasonably achievable	Annual average

Attachment I1 - Vic EPA must include planned developments and total annual average silica required



PROTOCOL FOR ENVIRONMENTAL MANAGEMENT

Publication 1191 December 2007

STATE ENVIRONMENT PROTECTION POLICY (AIR QUALITY MANAGEMENT)

MINING AND EXTRACTIVE INDUSTRIES

The results of the modelling must be reported for sensitive locations including houses, schools, kindergartens, recreation areas and sporting ovals.

Any proposed developments, such as new housing developments, and identified future land uses (including zoning requirements) must be taken into account to ensure that developments planned closer to the sites than the current situation are considered in the assessment of potential impacts. The assessment at the selected locations must be done against the relevant assessment criteria listed in Table 2 of this PEM. Time-series plots showing the predicted concentrations for the pollutants being assessed for each day of the year should be presented for the sensitive locations that are predicted to be worst affected.

The assessment at the sensitive locations must be done against the relevant assessment criteria listed in Table 2 of this PEM. If the assessment criteria are exceeded then management practices on site should be reviewed to reduce emissions arising from the operations.

Level 1 assessments

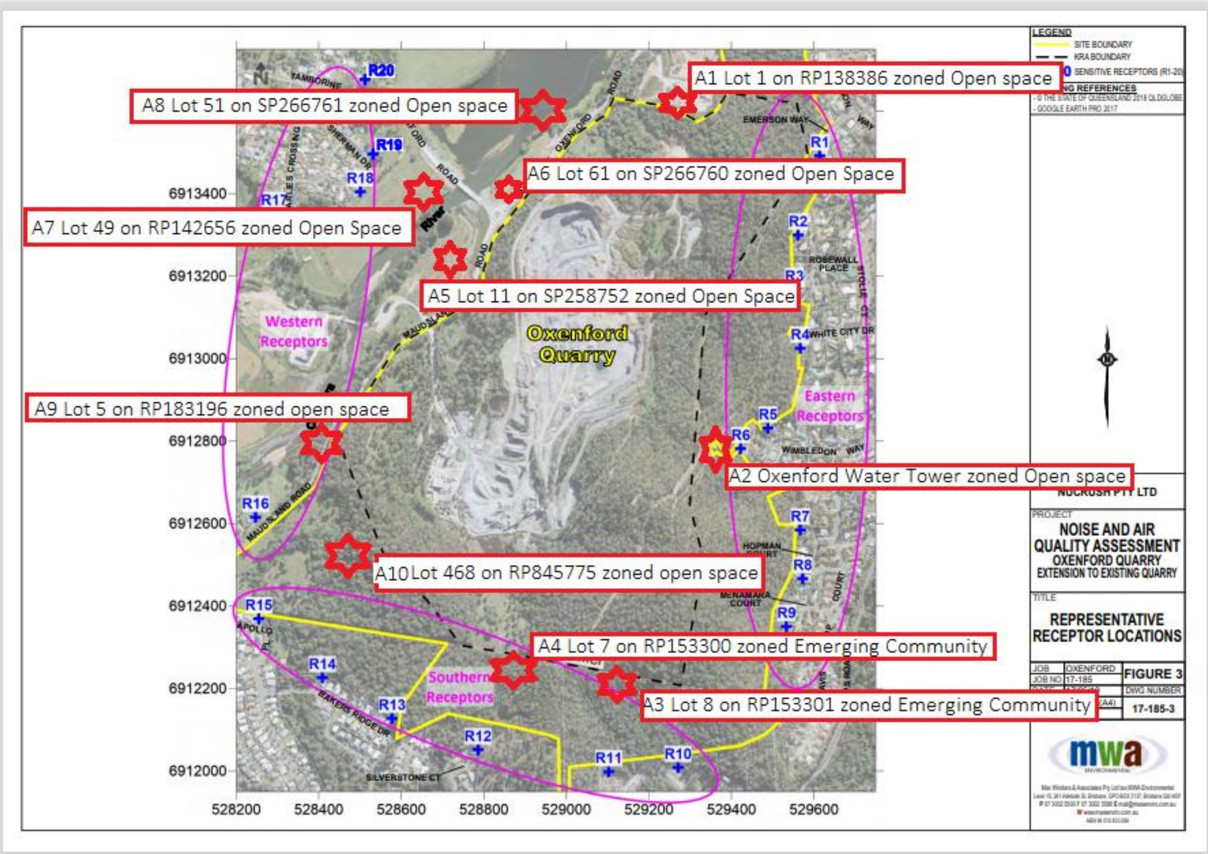
The modelling for a Level 1 assessment requires 1 year of daily predictions for PM_{10} and $PM_{2.5}$ under worst-case scenarios. Time varying background files (24-hour averages) must be included for large operations in these locations.

For crystalline silica, arsenic and other indicators that have long-term health effects annual average concentrations must be modelled with annual average background data included in the model.

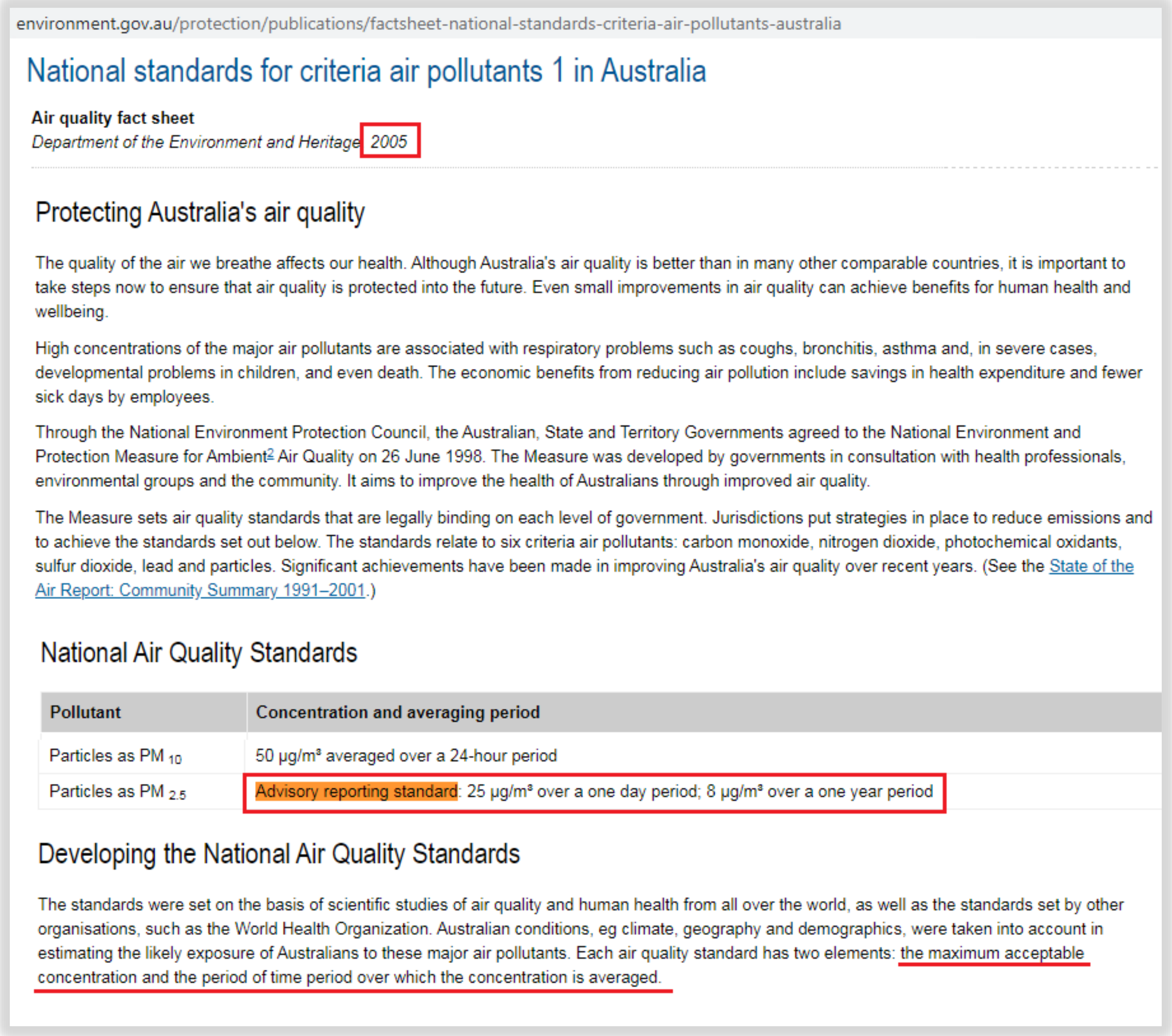
For Indicators such as NO_2 and CO that have averaging times less than 24-hours, the 70th percentile of the 1-hour average data is to be included. If background is not included for these indicators then the justification of the reason why must be included in the assessment report. For example, in a rural area with low traffic volumes or other sources in the vicinity.

EPA Victoria website: https://www.epa.vic.gov.au/about-epa/publications/1191.

Attachment I2 - Receptors modelled by DA and receptors missed



Attachment J1 - Maximum acceptable concentration NOT an Air Quality Objective



environment.gov.au/protection/publications/factsheet-national-standards-criteria-air-pollutants-australia

National standards for criteria air pollutants[1] in Australia

Air quality fact sheet
Department of the Environment and Heritage 2005

Protecting Australia's air quality

The quality of the air we breathe affects our health. Although Australia's air quality is better than in many other comparable countries, it is important to take steps now to ensure that air quality is protected into the future. Even small improvements in air quality can achieve benefits for human health and wellbeing.

High concentrations of the major air pollutants are associated with respiratory problems such as coughs, bronchitis, asthma and, in severe cases, developmental problems in children, and even death. The economic benefits from reducing air pollution include savings in health expenditure and fewer sick days by employees.

Through the National Environment Protection Council, the Australian, State and Territory Governments agreed to the National Environment and Protection Measure for Ambient[2] Air Quality on 26 June 1998. The Measure was developed by governments in consultation with health professionals, environmental groups and the community. It aims to improve the health of Australians through improved air quality.

The Measure sets air quality standards that are legally binding on each level of government. Jurisdictions put strategies in place to reduce emissions and to achieve the standards set out below. The standards relate to six criteria air pollutants: carbon monoxide, nitrogen dioxide, photochemical oxidants, sulfur dioxide, lead and particles. Significant achievements have been made in improving Australia's air quality over recent years. (See the State of the Air Report: Community Summary 1991–2001.)

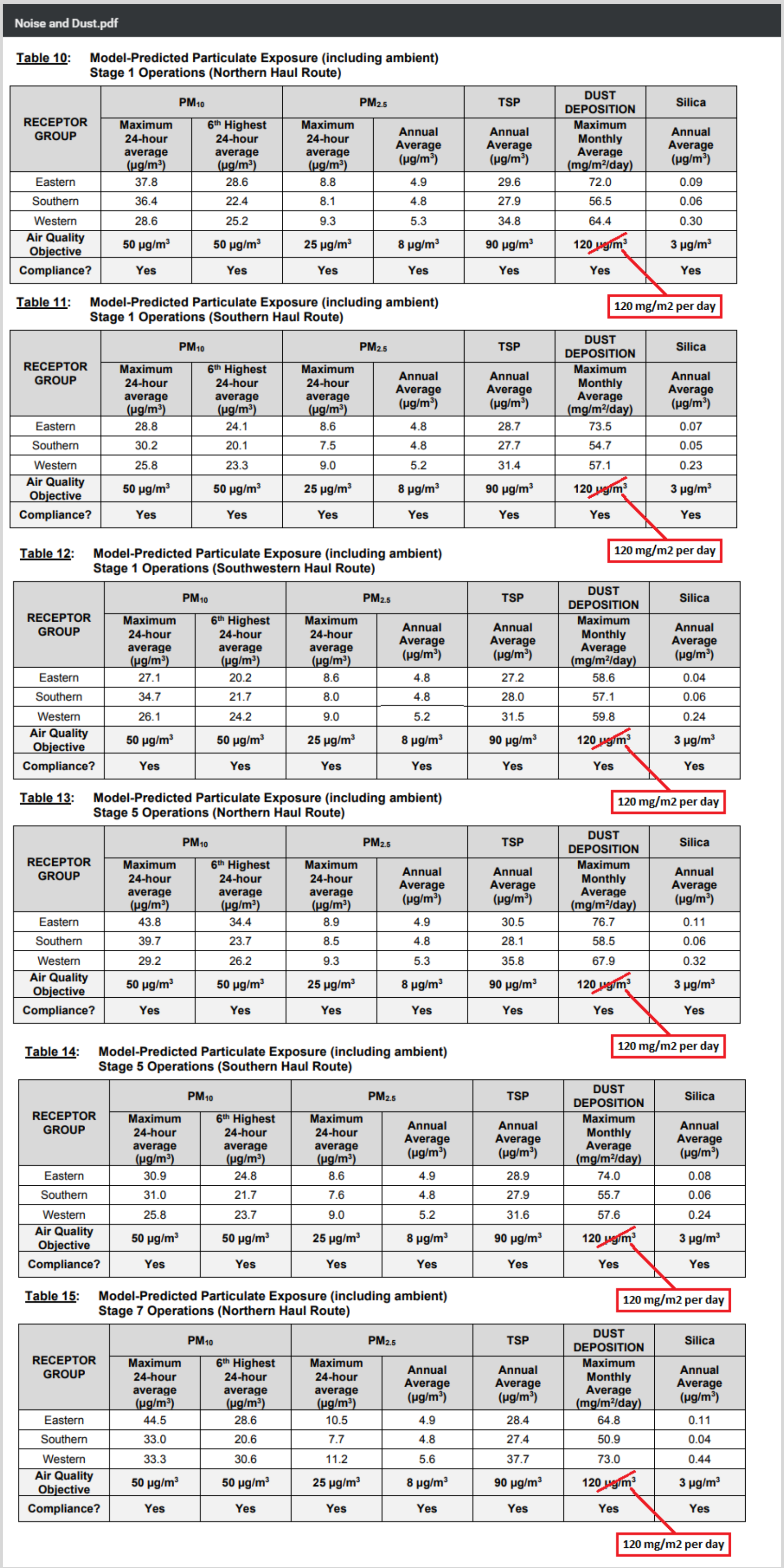
National Air Quality Standards

Pollutant	Concentration and averaging period
Particles as PM_{10}	50 $\mu g/m^3$ averaged over a 24-hour period
Particles as $PM_{2.5}$	Advisory reporting standard: 25 $\mu g/m^3$ over a one day period; 8 $\mu g/m^3$ over a one year period

Developing the National Air Quality Standards

The standards were set on the basis of scientific studies of air quality and human health from all over the world, as well as the standards set by other organisations, such as the World Health Organization. Australian conditions, eg climate, geography and demographics, were taken into account in estimating the likely exposure of Australians to these major air pollutants. Each air quality standard has two elements: the maximum acceptable concentration and the period of time period over which the concentration is averaged.

Attachment K1 - ‘Dust Deposition’ results are incorrectly specified



Noise and Dust.pdf

Table 10: Model-Predicted Particulate Exposure (including ambient) Stage 1 Operations (Northern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	37.8	28.6	8.8	4.9	29.6	72.0	0.09
Southern	36.4	22.4	8.1	4.8	27.9	56.5	0.06
Western	28.6	25.2	9.3	5.3	34.8	64.4	0.30
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

120 mg/m2 per day

Table 11: Model-Predicted Particulate Exposure (including ambient) Stage 1 Operations (Southern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	28.8	24.1	8.6	4.8	28.7	73.5	0.07
Southern	30.2	20.1	7.5	4.8	27.7	54.7	0.05
Western	25.8	23.3	9.0	5.2	31.4	57.1	0.23
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

120 mg/m2 per day

Table 12: Model-Predicted Particulate Exposure (including ambient) Stage 1 Operations (Southwestern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	27.1	20.2	8.6	4.8	27.2	58.6	0.04
Southern	34.7	21.7	8.0	4.8	28.0	57.1	0.06
Western	26.1	24.2	9.0	5.2	31.5	59.8	0.24
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

120 mg/m2 per day

Table 13: Model-Predicted Particulate Exposure (including ambient) Stage 5 Operations (Northern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	43.8	34.4	8.9	4.9	30.5	76.7	0.11
Southern	39.7	23.7	8.5	4.8	28.1	58.5	0.06
Western	29.2	26.2	9.3	5.3	35.8	67.9	0.32
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

120 mg/m2 per day

Table 14: Model-Predicted Particulate Exposure (including ambient) Stage 5 Operations (Southern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	30.9	24.8	8.6	4.9	28.9	74.0	0.08
Southern	31.0	21.7	7.6	4.8	27.9	55.7	0.06
Western	25.8	23.7	9.0	5.2	31.6	57.6	0.24
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

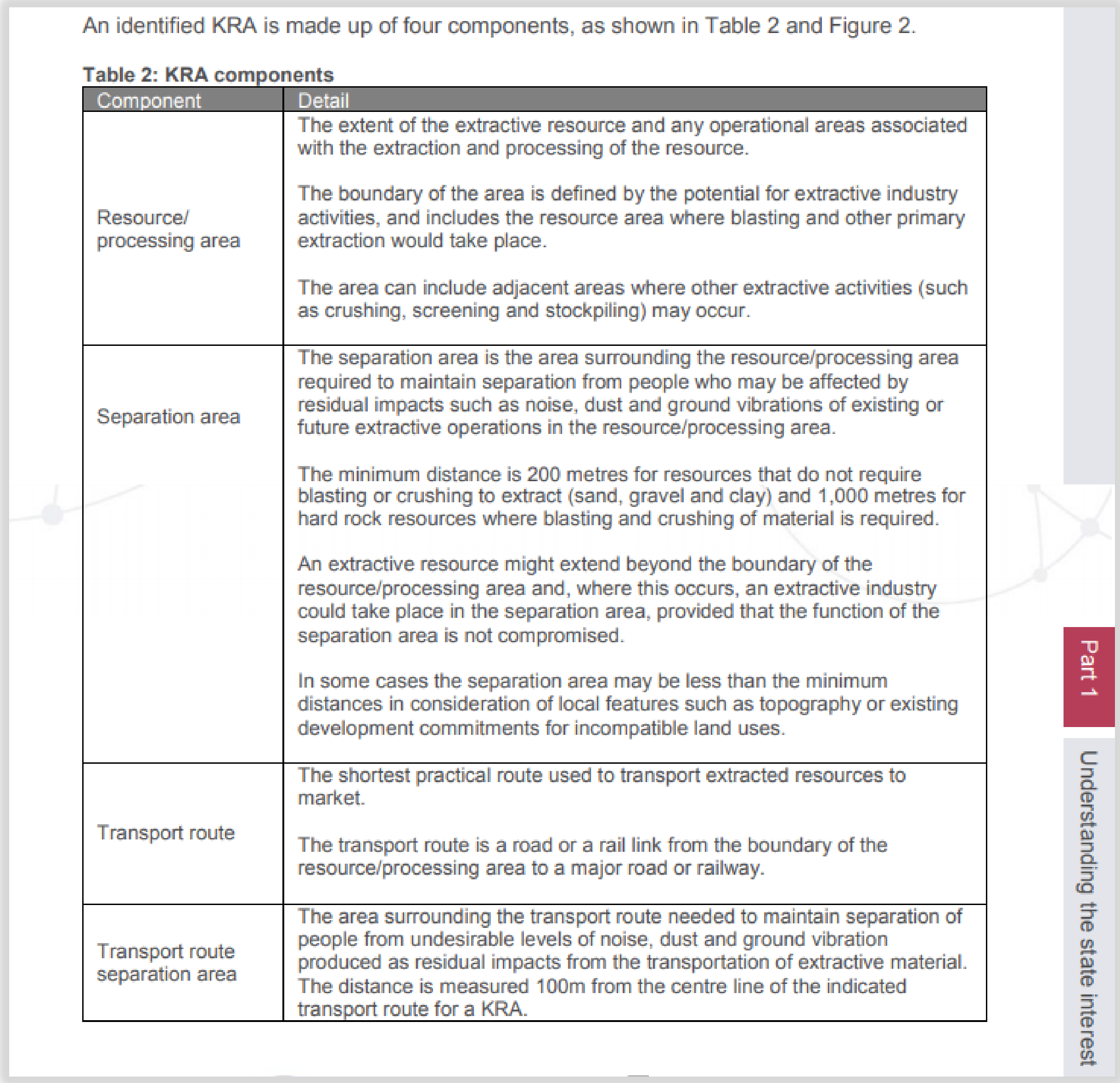
120 mg/m2 per day

Table 15: Model-Predicted Particulate Exposure (including ambient) Stage 7 Operations (Northern Haul Route)

RECEPTOR GROUP	PM$_{10}$		PM$_{2.5}$		TSP	DUST DEPOSITION	Silica
	Maximum 24-hour average (µg/m^3)	6th Highest 24-hour average (µg/m^3)	Maximum 24-hour average (µg/m^3)	Annual Average (µg/m^3)	Annual Average (µg/m^3)	Maximum Monthly Average (mg/m^2/day)	Annual Average (µg/m^3)
Eastern	44.5	28.6	10.5	4.9	28.4	64.8	0.11
Southern	33.0	20.6	7.7	4.8	27.4	50.9	0.04
Western	33.3	30.6	11.2	5.6	37.7	73.0	0.44
Air Quality Objective	**50 µg/m^3**	**50 µg/m^3**	**25 µg/m^3**	**8 µg/m^3**	**90 µg/m^3**	**120 ~~µg/m^3~~**	**3 µg/m^3**
Compliance?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

120 mg/m2 per day

<u>Attachment L1 - DES Guidelines: '1000m separation distance required from blasting quarries'</u>



An identified KRA is made up of four components, as shown in Table 2 and Figure 2.

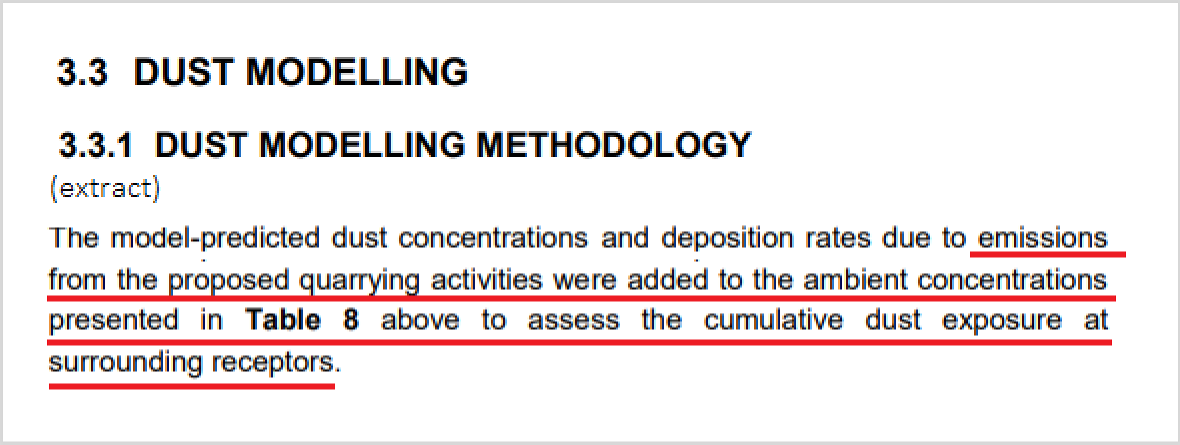
Table 2: KRA components

Component	Detail
Resource/ processing area	The extent of the extractive resource and any operational areas associated with the extraction and processing of the resource. The boundary of the area is defined by the potential for extractive industry activities, and includes the resource area where blasting and other primary extraction would take place. The area can include adjacent areas where other extractive activities (such as crushing, screening and stockpiling) may occur.
Separation area	The separation area is the area surrounding the resource/processing area required to maintain separation from people who may be affected by residual impacts such as noise, dust and ground vibrations of existing or future extractive operations in the resource/processing area. The minimum distance is 200 metres for resources that do not require blasting or crushing to extract (sand, gravel and clay) and 1,000 metres for hard rock resources where blasting and crushing of material is required. An extractive resource might extend beyond the boundary of the resource/processing area and, where this occurs, an extractive industry could take place in the separation area, provided that the function of the separation area is not compromised. In some cases the separation area may be less than the minimum distances in consideration of local features such as topography or existing development commitments for incompatible land uses.
Transport route	The shortest practical route used to transport extracted resources to market. The transport route is a road or a rail link from the boundary of the resource/processing area to a major road or railway.
Transport route separation area	The area surrounding the transport route needed to maintain separation of people from undesirable levels of noise, dust and ground vibration produced as residual impacts from the transportation of extractive material. The distance is measured 100m from the centre line of the indicated transport route for a KRA.

Part 1

Understanding the state interest

Attachment M1 - Cumulative Dust Exposure



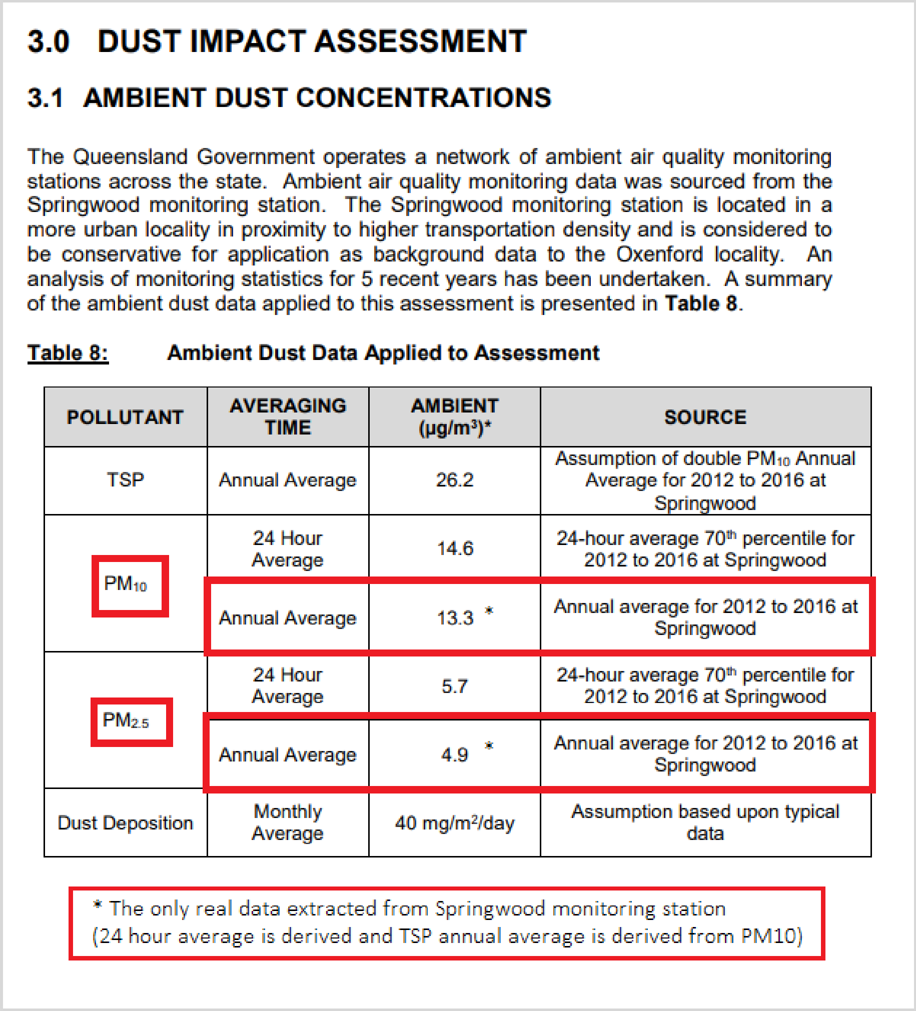
3.3 DUST MODELLING

3.3.1 DUST MODELLING METHODOLOGY

(extract)

The model-predicted dust concentrations and deposition rates due to emissions from the proposed quarrying activities were added to the ambient concentrations presented in **Table 8** above to assess the cumulative dust exposure at surrounding receptors.

Attachment M2 - Ambient Levels referenced by this Development application



3.0 DUST IMPACT ASSESSMENT

3.1 AMBIENT DUST CONCENTRATIONS

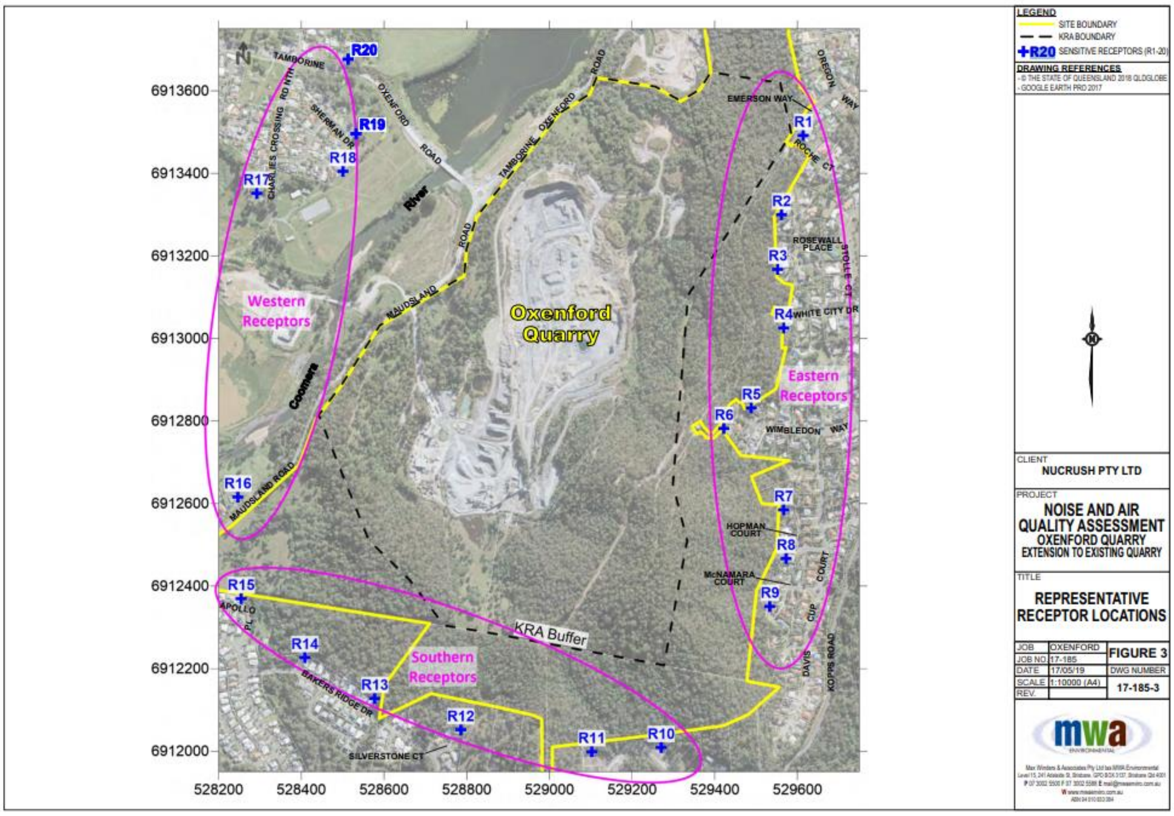
The Queensland Government operates a network of ambient air quality monitoring stations across the state. Ambient air quality monitoring data was sourced from the Springwood monitoring station. The Springwood monitoring station is located in a more urban locality in proximity to higher transportation density and is considered to be conservative for application as background data to the Oxenford locality. An analysis of monitoring statistics for 5 recent years has been undertaken. A summary of the ambient dust data applied to this assessment is presented in **Table 8**.

Table 8: **Ambient Dust Data Applied to Assessment**

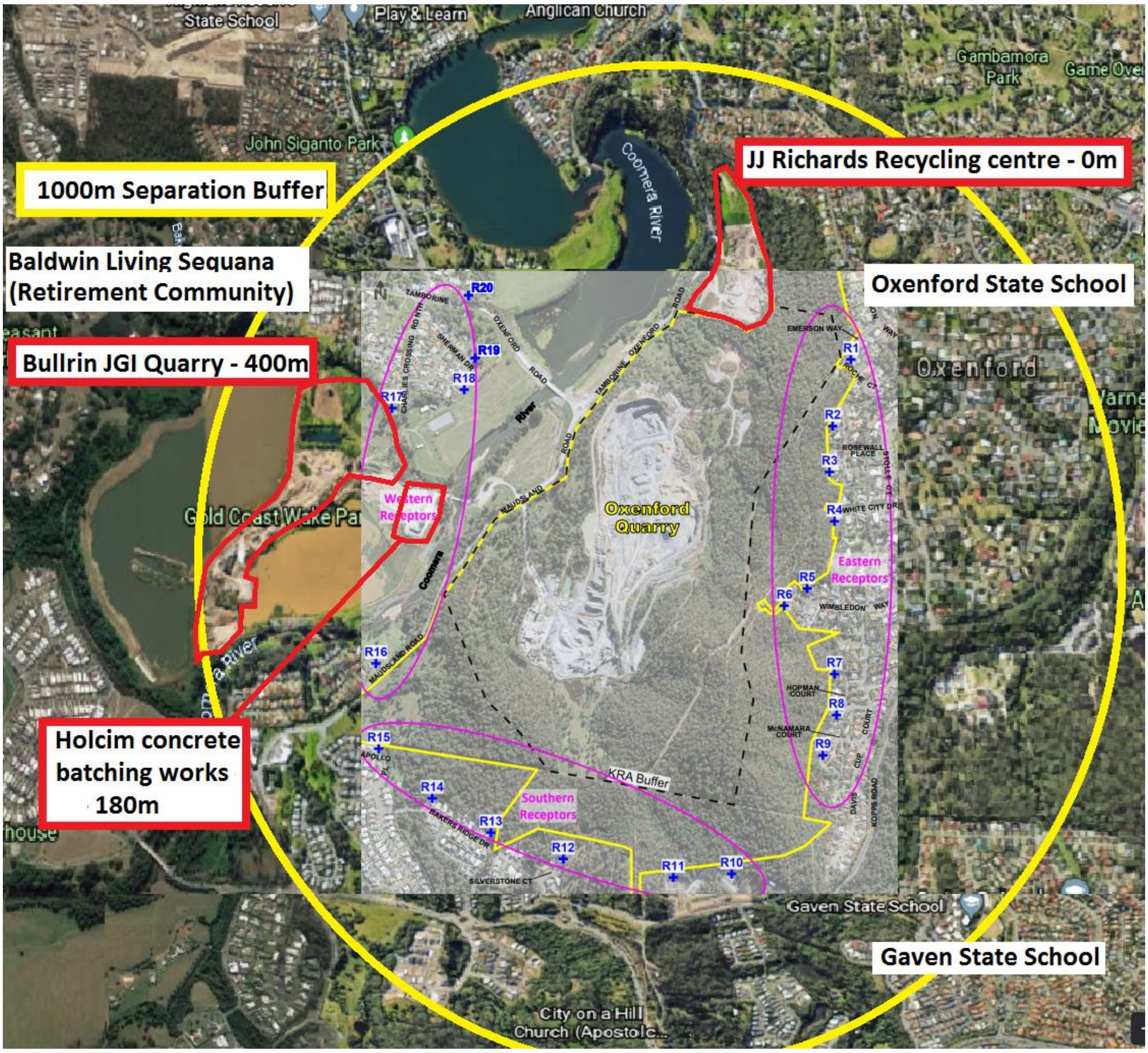
POLLUTANT	AVERAGING TIME	AMBIENT (µg/m³)*	SOURCE
TSP	Annual Average	26.2	Assumption of double PM_{10} Annual Average for 2012 to 2016 at Springwood
PM_{10}	24 Hour Average	14.6	24-hour average 70th percentile for 2012 to 2016 at Springwood
	Annual Average	13.3 *	Annual average for 2012 to 2016 at Springwood
$PM_{2.5}$	24 Hour Average	5.7	24-hour average 70th percentile for 2012 to 2016 at Springwood
	Annual Average	4.9 *	Annual average for 2012 to 2016 at Springwood
Dust Deposition	Monthly Average	40 mg/m²/day	Assumption based upon typical data

* The only real data extracted from Springwood monitoring station
(24 hour average is derived and TSP annual average is derived from PM10)

Attachment N1 - Receptors R16, R17 and R18 are encompassing dusty industrialised areas



Attachment N2 - Receptors R16, R17 and R18 are encompassing dusty industrialised areas



Attachment N3 - Bullrin Quarry operation (34 Maudsland Road, Oxenford) - Google Earth Image

Attachment N4 - Holcim concrete batching facility (34 Maudsland Road, Oxenford) - Google Earth Image

Attachment N5 - JJ Richards quarry and recycling operation (241 Tamborine Oxenford Road) - Google Earth Image