

9 June 2023

Ms Michelle Baxter
Chief Executive Officer
Safe Work Australia
Email: WESconsult@swa.gov.au

Dear Ms Baxter

Thank you for the opportunity to comment on the proposed workplace exposure standard (WES) for diesel particulate matter (DPM). Diesel powered engines and equipment are widely used in mining, quarrying and petroleum and gas operations in Queensland. As the independent safety and health regulator for Queensland's resource industry, Resources Safety and Health Queensland (RSHQ) welcomes Safe Work Australia's (SWA) proposal to establish a WES for DPM, in support of protecting workers' health.

Current status

Queensland does not have a legislated exposure limit for DPM for resource industries, however there is a guideline limit of $0.1\text{mg}/\text{m}^3$ (measured as sub-micron elemental carbon) for metalliferous mines¹ and coal mines². This is based on the recommendation from the Australian Institute of Occupational Hygienists³ and recommended maximum workplace exposure for underground environments in New South Wales⁴. The guideline limit for Queensland coal mines will reduce to $0.05\text{mg}/\text{m}^3$ from February 2024.

Challenges in achieving proposed WES for underground coal mines

There are several challenges for underground coal mining operations to manage exposure to $0.015\text{mg}/\text{m}^3$, including interference on measurements from coal dust, barriers in using modern diesel engine technology, barriers in using battery powered engines in mobile plant (vehicles), and potential impacts of ventilation changes.

¹ Dept. of Natural Resources, Mines and Energy (2014), [QGN 21: Guidance note for management of diesel engine exhaust in metalliferous mines](#), version 1, January 2014.

² Resources Safety and Health Queensland (2012), [Shift adjustment of the guideline limit for diesel particulate matter](#), Mines safety bulletin no.127, version 1, 24 December.

³ AIOH Exposure Standards Committee (2017), [Diesel particulate matter and occupational health issues position paper](#), Australian Institute of Occupational Hygienists, August 2017.

⁴ New South Wales Department of Primary Industries (2008), [Guideline for the management of diesel engine pollutants in underground environments](#), MDG 29, April 2008.

Coal dust interference

There are technological issues with analysis of elemental carbon due to interference from coal dust. Coal dust interferes with the final determination of respirable elemental carbon at levels below 0.02mg/m³.^{5,6,7} Research that identified interferences with the elemental carbon determination methodology from coal dust reported “low levels ($\leq 15\mu\text{g}/\text{m}^3$) of elemental carbon were found in electric-powered (i.e. non-dieselized) underground coal mines when impactors with sub-micrometer cut-points were used”.⁸ The National Institute for Occupational Safety and Health’s (NIOSH) Manual of Analytical Methods⁹ also references this finding. As such, the proposed limit of 0.015 mg/m³ presents significant limitations in the measurement and regulation for the proposed WES in underground coal mines where interference is experienced in measurements below 0.02mg/m³.

Barriers in using modern diesel engine technology

The best modern technology for diesel engines cannot be readily adapted into underground coal mines due to intrinsic safety requirements required to minimise the risk of fire and explosion. Previous attempts to introduce latest generation explosion and fire protected diesel engine technology have had very limited success in the Australian underground coal industry. This has been due to multiple factors including:

- difficulties in meeting technical explosion protection requirements for items such as component surface temperatures and injector solenoids;
- costs associated with the development of unique technical solutions;
- reliability, availability and cost of unique components (e.g. injector solenoids);
- very limited market size; and
- lengthy approval and testing timeframes.

Significant improvements in engine emission technology for underground coal mining equipment would be required for the proposed limit of 0.015mg/m³ to be achievable.

Barriers in using battery powered engines in mobile plant

Before transitioning from diesel powered to battery powered engines in mobile plant, more research and development in underground settings is required as issues around battery

⁵ Centres for Disease Control (2016), [Diesel particulate matter \(as elemental carbon\) Method 5040](#), NIOSH Manual of Analytical Methods, 5th edition, issue 4, dated 10 March 2016.

⁶ Birch, M.E. (2016), [Monitoring diesel exhaust in the workplace](#), NIOSH Manual of Analytical Methods, 5th edition, Centres for Disease Control and Prevention, April 2016.

⁷ Noll, J. D. and Birch, E. (2004), Evaluation of the SKC® DPM cassette for monitoring diesel particulate matter in coal mines, J. Environ. Monit., 2004, 6, 973-978.

⁸ Birch, M. E. and Cary, R. A. (1996), [Elemental Carbon-Based Method for Monitoring Occupational Exposures to Particulate Diesel Exhaust](#), Aerosol Science and Technology, 25:3, 221-241, DOI: 10.1080/02786829608965393; p233.

⁹ Birch (2016), pDL-5

capabilities make the technology currently unfeasible. Significant capital outlay, a limited market size and the context of coal mining in a low carbon economy, are barriers to original equipment manufacturers (OEMs) pursuing research on this technology.

Additionally, the development and robust testing of engine packages will take significant time. Once proven, another significant transition period will be required to implement the technology into industry.

Potential impacts of ventilation changes

Any changes made to ventilation within underground mines to reduce DPM levels to $0.015\text{mg}/\text{m}^3$ potentially introduces other significant risks such as increased dust generation (coal and silica). Significant increases in the mine pressure gradients may also affect the integrity of ventilation structures in underground coal mines, increasing the risk of spontaneous combustion of coal.

Progress made in underground coal industry

Despite the challenges, progress has been made to reduce exposure to DPM in underground coal mines. Since 2007, Queensland coal mines have been routinely collecting DPM exposure data, with the underground mines submitting data to RSHQ for industry analysis and reporting on an annual basis. RSHQ's database currently holds 12,000 valid samples for underground coal mines. Almost 5,000 of those were collected in the past five years. Additionally, the Queensland underground coal industry has, for the last decade, held diesel emissions forums, typically on an annual basis, to share best practice controls and approaches, and benchmark exposure data across the industry.

A reduction in average exposures has come from significant improvements in engineering controls such as exhaust treatment devices and emissions-based engine maintenance programs on diesel powered equipment. Given the considerable enhancements of available engineering controls and after extensive review of the exposure data, RSHQ, with support from the coal mining industry and unions, recently reduced the recommended guideline from $0.1\text{ mg}/\text{m}^3$ to an interim 8-hour time weighted average personal exposure guideline limit of $0.05\text{ mg}/\text{m}^3$. All sites have until February 2024 to meet this requirement.¹⁰ Additionally, mines are still required to pursue the reduction of exposures to "as low as reasonably achievable" to ensure an "acceptable level of risk" in accordance with the *Coal Mining Safety and Health Act 1999* (Qld).

Attached are the mean DPM exposure in underground coal mines between 2018 and 2022 for six similar exposure groups with the highest risk of exposure. The graphs show that most sites will be able to comply with an exposure limit of $0.05\text{mg}/\text{m}^3$ but would exceed the proposed WES of $0.015\text{mg}/\text{m}^3$.

¹⁰ Le Roux, J. (2023), [Reduction in the guideline exposure limit for diesel particulate matter \(DPM\) for Queensland coal mines](#), Resources Safety and Health Queensland, dated 15 February 2023.

An analysis of the single exceedance rates in 2022 at 0.05mg/m³ (with no shift adjustment applied) was 13 per cent. At 0.015 mg/m³ (with no shift adjustment applied), the exceedance rate would be greater than 50 per cent, highlighting significant compliance difficulties at the proposed limit. The limited historical DPM sampling data RSHQ received from surface coal mines indicates compliance with the proposed limit is achievable for surface mines.

Conclusions

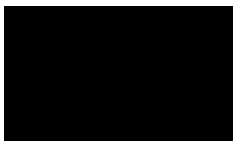
Noting these specific industry circumstances, a WES for DPM could be set at 0.05mg/m³ for underground coal mines with a view to potentially lowering it in the future as technological and engineering advances allow. Implementing a separate industry specific WES for underground coal mines, as published by SWA, is a concept that has already been adopted for carbon dioxide.¹¹ Issues with analysis interference in underground coal mines is unlikely to be an issue at surface coal mines as workers at these operations who are exposed to DPM are unlikely to also be exposed to raw coal dust containing a high ratio of elemental carbon.

RSHQ does not envisage these issues with the proposed DPM WES for other resource operations, for example metalliferous mines, quarries and petroleum and gas operations, where controls can be implemented and/or natural ventilation can help manage exposure to 0.015mg/m³. However, significant changes may be required to the mine design for existing and in-development underground metalliferous mines to meet the proposed exposure limit and a transitional timeframe of three years may be challenging.

As an independent statutory body, this submission does not represent the views of the Queensland Government.

If you have any questions, [REDACTED] – Health Strategy and Compliance, Occupational Health, will be pleased to assist you and can be contacted on [REDACTED]
[REDACTED]

Yours sincerely



Dean Barr
Executive Director
Occupational Health

Att
2018-2022 DPM exposure data from Queensland coal mines

¹¹ Safe Work Australia (2022), [Workplace exposure standards for airborne contaminants](#), 1 October 2022.

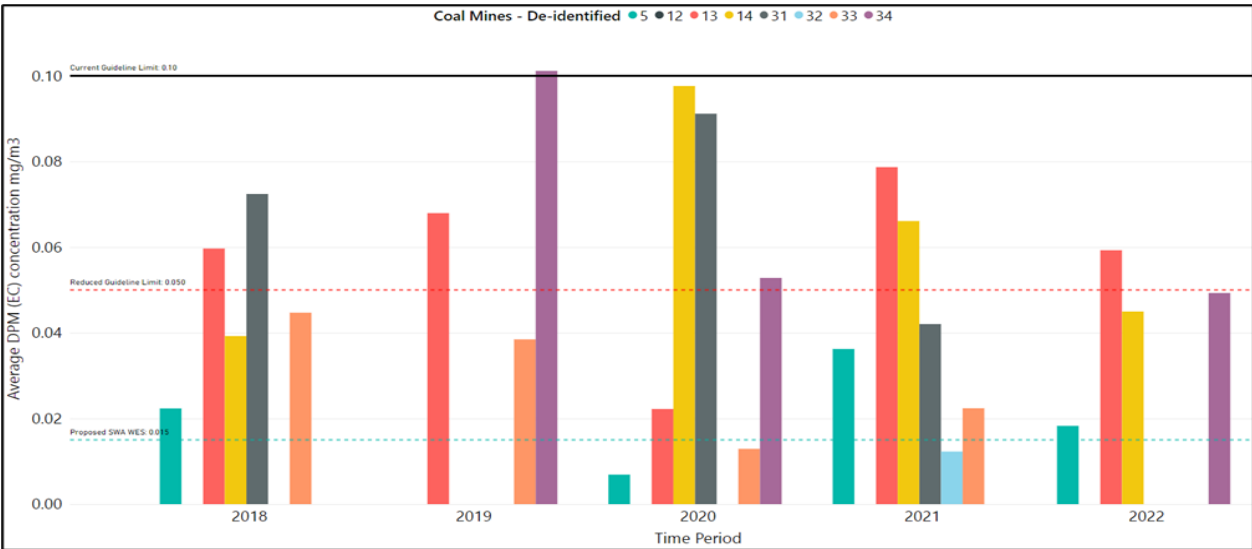
ATTACHMENT

Mean diesel particulate matter (DPM) exposure in underground Queensland coal mines based on similar exposure groups (SEGs) (2018-2022)

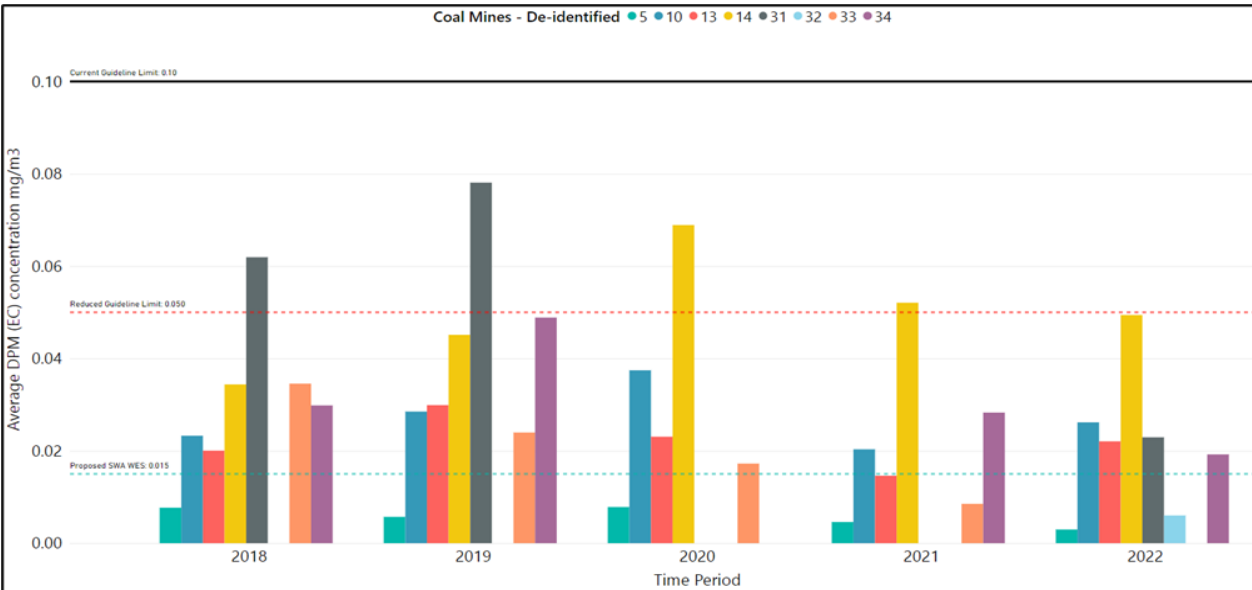
Legend for graphs

- Current QLD guideline limit 0.1mg/m³
- Reduced QLD guideline limit 0.05mg/m³
- Proposed SWA WES 0.015mg/m³

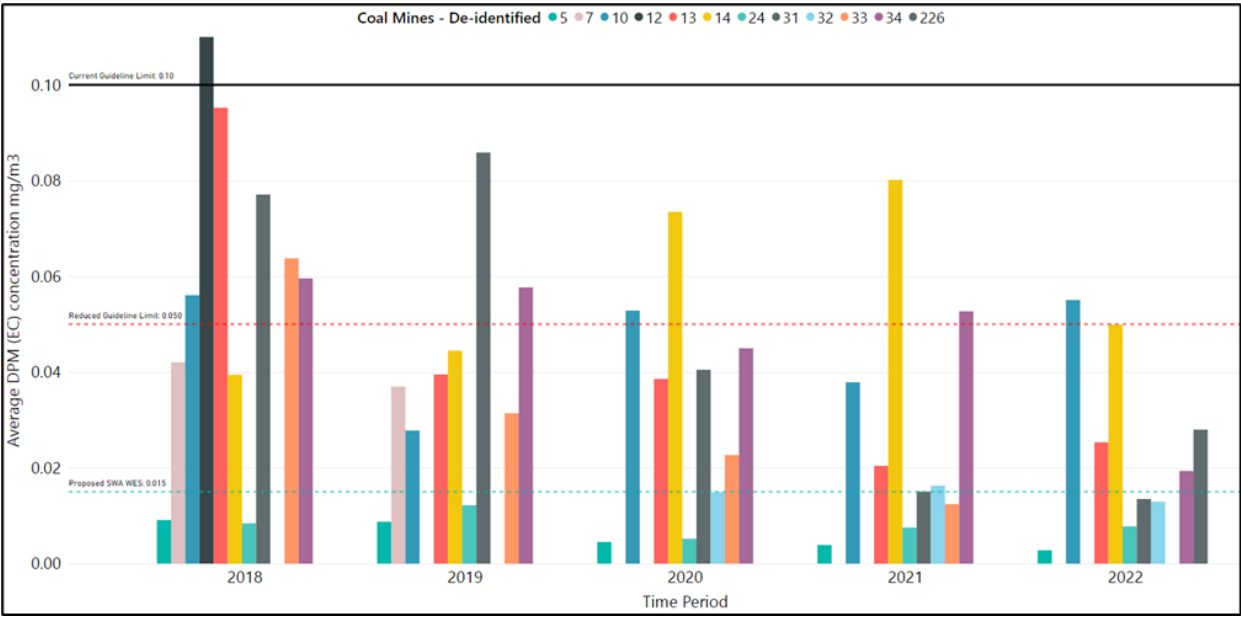
Graph 1 – Mean DPM Exposures for Longwall Move SEG (2018 – 2022)



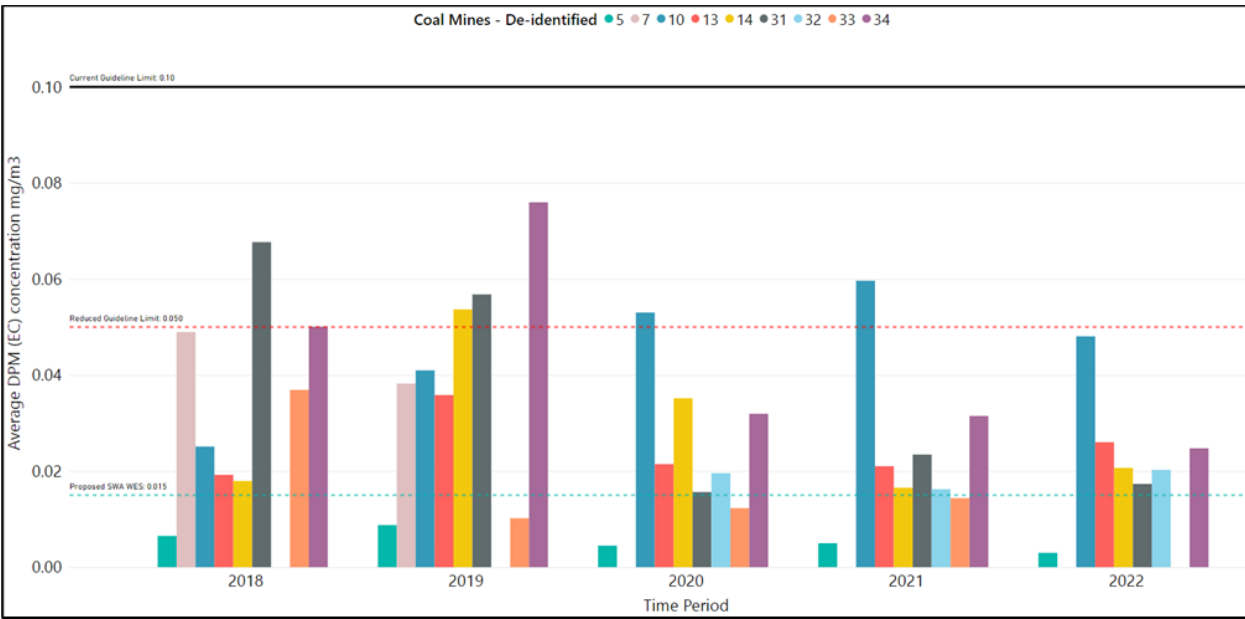
Graph 2 - Mean DPM Exposures for Longwall Production SEG (2018 – 2022)



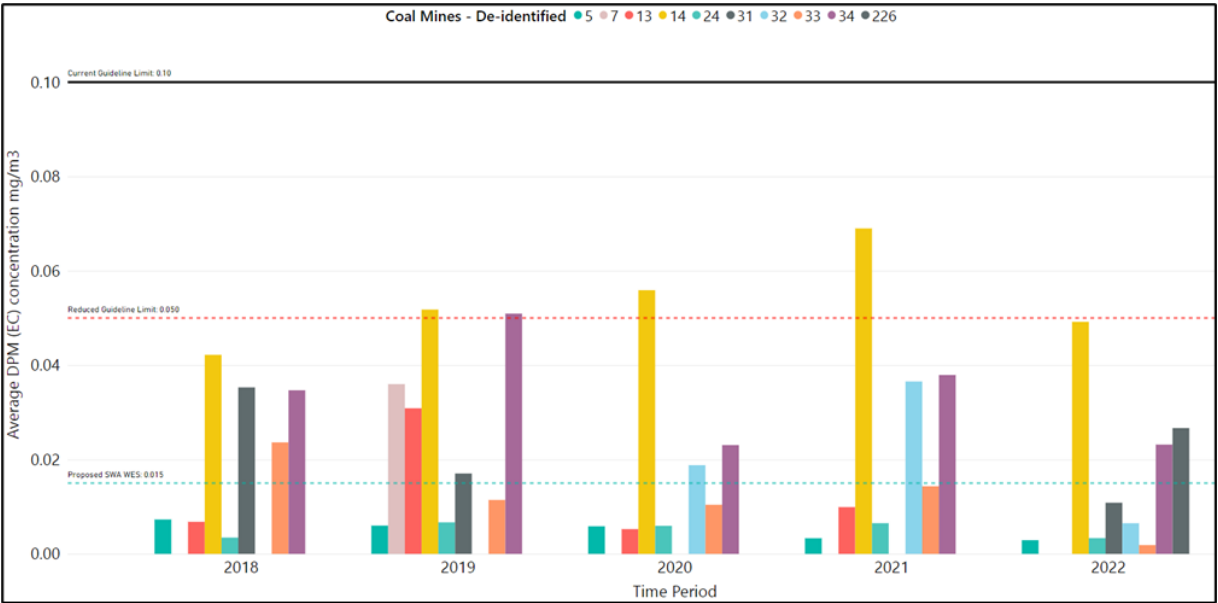
Graph 3 - Mean DPM Exposures for Development Production SEG (2018 – 2022)



Graph 4 - Mean DPM Exposures for Production Support / Bullgang SEG (2018 – 2022)



Graph 5 - Mean DPM Exposures for Underground Maintenance SEG (2018 – 2022)



Graph 6 - Mean DPM Exposures for Ventilation Control Device (VCD) Installers SEG (2018 – 2022)

