



Resources Safety & Health
Queensland

Resources industry occupational health harm prioritisation report

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Executive summary

Background

The re-identification of mine dust lung disease in the Queensland mining industry demonstrated that in addition to serious safety risks, preventing disease and other occupational health harms must also be a focus. However, while all occupational health harms are important, Resources Safety and Health Queensland (RSHQ) is a risk-based regulator, allocating its resources through an evidence-based method to target those harms that pose the most serious risk to resource sector workers.

RSHQ has sought to develop a risk-based prioritisation to ensure occupational health harms are effectively managed across the resources industry for coal, mineral mines and quarries (MMQ), explosives, and the petroleum and gas (P&G) sectors. This report delivers on that objective and will inform RSHQ's work priorities in regulating occupational health harms over the coming years.

Occupational health harms encompass a broad range of considerations that impact the health and wellbeing of resource sector workers. This prioritisation included more well understood individual hazards such as noise, as well as hazard groups such as general hazardous chemicals. This approach enabled the scope of the prioritisation to be managed appropriately, grouping health harms where appropriate, given the potential broad inclusion of health harms relevant across all Queensland resources industries. In addition, health harms such as cardiovascular disease (CVD), were considered where outcomes are impacted by work-related contributions. These health harms also have potential safety implications, impacting an individual's ability to safely perform their work, particularly in high-risk environments.

Methodology

This prioritisation commenced with a comprehensive Baseline Review of 16 occupational health harms conducted by Ernst and Young in partnership with the University of Queensland. The review incorporated available information and data from RSHQ, peer reviewed literature, external data, and reports from other regulators. Consideration was also given to the current legislative requirements and regulatory provisions relevant to each harm, applicable to both the Queensland resources sector and other jurisdictions.

The review concluded that all occupational health harms identified are important to measure, monitor and further control, as none would pose zero risk to resource sector workers. However, it identified that significant gaps may exist in the knowledge base for several significant occupational health harms, including psychosocial hazards, CVD, musculoskeletal disorders, and vibration.

Following completion of the Baseline Review, stakeholder consultation was conducted to better understand the application of monitoring systems, risk mitigation strategies, and to further explore opportunities for improvement regarding the way occupational health harms are identified, controlled, monitored, and regulated in Queensland.

While the stakeholder consultation phase did not identify any standout concerns, harms including CVD, musculoskeletal disorders, psychosocial hazards and diesel particulate matter were highlighted more than others. Stakeholders also provided feedback regarding the selection of health harms that were originally excluded from the review. These included fatigue and legionella, which have well-documented, detrimental impacts on the health of workers. As such, they have been considered for prioritisation.

A bespoke framework was developed by RSHQ to guide the prioritisation for the broad range of occupational health harms. No pre-existing fit-for-purpose methodologies suitable from a regulator's perspective could be identified. The framework was built around a standard risk assessment methodology, incorporating consideration of consequence and likelihood, which were then balanced against the presence of controls from an industry perspective, as well as regulatory controls.

The framework also provided the opportunity to consider additional information such as other relevant jurisdictional regulatory activities to establish an overall priority rating for each occupational health harm. Using the framework, a five point priority rating scale was applied to the occupational health harms.

Using the framework, input from a RSHQ expert workgroup informed the development of a prioritised list of 25 health harms drawn from the Baseline Review and stakeholder consultation submissions. This was conducted over a series of workshops, allowing each group member to contribute additional evidence specific to their field of expertise and industry. Priority scores for each health harm were allocated based on contemporary information available across the resources sector. Industry-specific ratings were also determined by the workgroup where evidence was available.

Results

A total of 25 occupational health harms were prioritised using the framework (**Table 1**). Fatigue and Psychosocial had the highest classifications in comparison to other occupational health harms considered. Both were classified as 'elevated' originally, however, several considerations justified raising these harms to a 'high' priority. The workgroup identified a strong focus on psychosocial

hazards in other jurisdictions, including reviews, review of legislative provisions and development of guidance material. Psychosocial hazards were also identified as a hazard of particular concern from the Baseline Review, and both psychosocial hazards and fatigue were highlighted through multiple stakeholder submissions.

Table 1: Summary of priority ratings for each occupational health harm

Occupational health harm	Residual risk score	Priority rating
Fatigue	7.0	High*
Psychosocial	6.3	High*
Non-ionising radiation: UVR	7.0	Elevated
Asbestos - naturally occurring	6.7	Elevated
Noise	6.7	Elevated
Hazardous manual tasks	6.7	Elevated
Welding fume	6.7	Elevated
Diesel fume	6.7	Elevated
Lead	5.7	Elevated*
Respirable crystalline silica and other particulates (dust)	6.0	Medium
Cardiovascular disease	6.0	Medium
Diabetes	5.3	Medium
Polymeric chemicals	5.3	Medium
Whole body vibration	5.2	Medium
General hazardous chemicals	5.0	Medium
Volatile organic compounds	5.0	Medium
Vanadium pentoxide	5.0	Medium
Blast fume	4.3	Medium
Asbestos - materials	4.0	Low
Hand-arm vibration	4.0	Low
Water-based biological hazards	3.3	Low
Ionising radiation	3.3	Low
Non-ionising radiation: ELF	1.3	Monitor
Non-ionising radiation: LASER	0.3	Monitor
Non-ionising radiation: RF	0.0	Monitor

**These harms have had their priority rating raised based on the presence of additional factors that have an additive effect for how they were prioritised.*

Lead was another occupational harm that was found to have strong additional considerations to justify raising it to the 'elevated' category from 'medium'. However, it was noted lead was more likely to impact the health of MMQ workers, making it a specific priority related to the MMQ industry.

In addition to the whole-of-industry priority ratings in **Table 1**, there may be sector priorities in

the following areas:

- MMQ and P&G sectors:
 - respirable crystalline silica and other particulates (dust)
 - hazardous manual tasks
 - diesel fume.
- P&G sector:
 - welding fume.

One-third of the harms analysed in the prioritisation framework were identified as an elevated priority. RSHQ already has work underway to address many of these harms, including monitoring and analysis of diesel particulate matter exposure, proposed amendments to the MMQ regulation addressing lead, and a series of audits targeting noise currently underway in the P&G industry.

Conclusion

From a broader RSHQ perspective, across all industries, fatigue and psychosocial hazards have been identified as a higher priority in comparison to other occupational health harms considered. Other specific harms have also been identified at a more localised industry level, noting work is underway in many of these areas. This does not mean RSHQ's existing or planned activity on health harms in the short-term will cease in lieu of the prioritised areas.

It is intended that RSHQ's future resource allocation considered during its operational planning phases will be informed by this prioritisation process. Proposed interventions will be undertaken in consultation with relevant stakeholders to address identified priorities, taking into consideration existing projects and changes to knowledge regarding individual health harms.

Acknowledgements

The workgroup who developed and applied the framework to the prioritisation of occupational health harms are a multi-disciplinary team of experts from across RSHQ. Workgroup members included:

- Andrew Batterson, Inspector of Mines (Occupational Hygiene) – Coal
- Andy Bruce, Principal Inspector of Explosives – Explosives
- Anthony Logan, Senior Mechanical Inspector of Mines – Coal
- Donna Jamieson, Senior Inspector – Petroleum and Gas
- Eliza Gill, Principal Occupational Hygienist – Coal
- Fritz Djukic, Senior Inspector of Mines (Occupational Hygiene) – Coal
- Greg Manthey, Inspector of Mines (Occupational Hygiene) – Mineral Mines and Quarries
- Jack Farry, Senior Inspector of Mines (Occupational Hygiene) – Mineral Mines and Quarries
- Kaitlyn Bruschi, Principal Project Officer – Occupational Health
- Liz Grolimund, Manager - Health Strategy and Compliance – Occupational Health
- Micheal Lewis, Principal Occupational Hygienist – Simtars
- Peter Currie, Mines Inspector – Coal
- Samantha Forster, Principal Occupational Hygienist – Mineral Mines and Quarries
- Trevor Brown, Deputy Chief Inspector of Mines – Mineral Mines and Quarries.

RSHQ would also like to acknowledge the contribution of the research team from Ernst and Young (EY), who partnered with the University of Queensland to deliver the Baseline Review of Occupational Health Risks Report, as well as all stakeholders who made submissions to RSHQ during the consultation period.

Acronyms

AIOH	Australian Institute of Occupational Hygienists
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CMSHR 2017	Coal Mining Safety and Health Regulation 2017
CMW	Coal mine worker
CMWHS	Coal Mine Workers' Health Scheme
CoP	Code of Practice
CVD	Cardiovascular disease
DPM	Diesel particulate matter
ELF	Extremely low frequency electric and magnetic fields
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
HAV	Hand-arm vibration
HPI	High potential incident
HRA	Health risk assessment
IR	Ionising radiation
LASER	Light amplification by stimulated emission of radiation
LTI	Lost time injury
MMQ	Mineral mine and quarry
MSD	Musculoskeletal disorder
MQSHR 2017	Mining and Quarrying Safety and Health Regulation 2017
NOHSC	National Occupational Health and Safety Commission
NIOSH	National Institute for Occupational Safety and Health
OC	Open cut
OEL	Occupational exposure limit
OSHA	Occupational Safety and Health Administration
P&G	Petroleum and Gas
PPE	Personal protective equipment
RF	Radiofrequency radiation
RSHQ	Resources Safety and Health Queensland
SEG	Similar exposure group
SSE	Site senior executive
SWA	Safe Work Australia
TWA	Time weighted average
UG	Underground
UVR	Ultraviolet radiation
WC	Workers' compensation
WES	Workplace exposure standard
WHSQ	Workplace Health and Safety Queensland

Introduction

RSHQ has responsibility for regulating safety and health in Queensland's mining, quarrying, petroleum, gas, and explosives industries. To ensure effectiveness as a regulator, RSHQ aims to apply risk-based decision making, using evidence and defined assumptions when setting priorities. This report aligns with that strategic direction and will inform RSHQ's work priorities in regulating occupational health harms over the coming years.

The re-identification of mine dust lung disease in the Queensland mining industry demonstrated that in addition to serious safety risks, preventing disease and other occupational health harms must also be a focus for the regulator. RSHQ has sought to develop a risk-based strategy to ensure occupational health harms are effectively managed across Queensland's resources industries.

Occupational health harms encompass a broad range of considerations that impact the health and wellbeing of resource sector workers. The focus of this prioritisation included more well understood individual hazards such as noise, as well as hazard groups such as general hazardous chemicals. This approach enabled the scope of the prioritisation to be managed appropriately, grouping health harms where appropriate, given the potential broad inclusion of health harms relevant across all Queensland resources industries. In addition, health harms, such as cardiovascular disease (CVD), were considered where the outcomes were impacted by work-related contributions. These health harms also have potential safety implications, impacting an individual's ability to safely perform their work, particularly in high-risk environments.

Method

A sequential, evidence-based process, with several phases was undertaken to allow the prioritisation of selected health harms. An initial Baseline Review and stakeholder consultation were conducted to establish an understanding of health harms. This then informed harm prioritisation.

Step 1: Baseline Review

To build an understanding for the occupational health harms that impact the resources sector, Ernst and Young, in partnership with the University of Queensland (UQ), were commissioned to conduct a Baseline Review. The review incorporated available information and data from RSHQ, peer reviewed literature, external data, and reports from other regulators. Consideration was also given to the current legislative requirements and regulatory provisions relevant to each harm, applicable to both the Queensland resources sector and other jurisdictions. A selection of 16 occupational health harms were included in the review, as well as consideration of potential emerging risks.

Given the very broad range of occupational health harms and the need to manage the scope in consideration of delivering a timely outcome, those harms that generally have an immediate safety focus, as opposed to health impacts, were excluded from the initial Baseline Review, including:

- fatigue
- heat stress
- alcohol and drug impairment on-site
- fluid injection
- legionella and other bacteria
- viruses.

However, these occupational health harms were still considered in the context of their interaction with other inter-related occupational health harms examined through the review. For example, fatigue was considered a potential risk factor when considered in the context of psychosocial hazards. Exclusion from the Baseline Review does not preclude RSHQ from undertaking regulatory activity relating to managing risks associated with these hazards, rather this body of work compliments these and informs future initiatives.

The Baseline Review concluded that all occupational health harms identified are important to measure, monitor and further control, as none would pose zero risk to resource sector workers (**Figure 1**). The recent focus on dusts, including silica, was found to be appropriate, given the exposure and impacts of these harms. However, significant gaps may exist in the knowledge base for many other occupational health harms, including limited overall monitoring and health surveillance data. Psychosocial hazards, CVD, musculoskeletal disorders (MSD), and vibration were highlighted through the Baseline Review for their broad potential impact across industries, as well as the relative lack of knowledge regarding these harms.

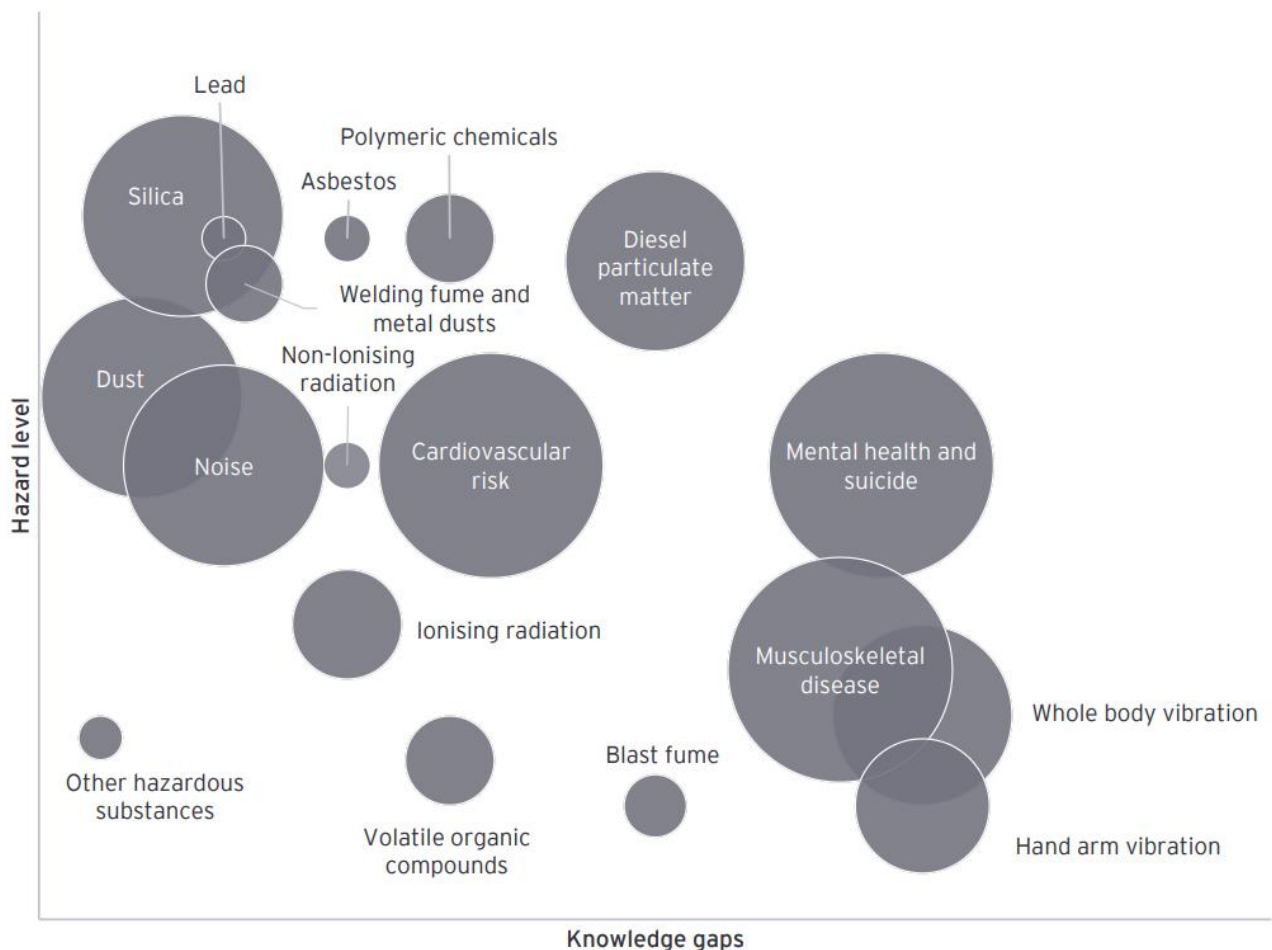


Figure 1: Evaluation of the current state of occupational health harms across all Queensland resources sectors as reported by EY and UQ in the Baseline Review of Occupational Health Risks Report. The hazard level depicts the impact of the harm on the health of the individual. Knowledge gaps refer to the extent of RSHQ knowledge (acknowledging that industry may have more oversight of these harms). The bubble size indicates potential number of workers impacted¹.

Step 2: Stakeholder consultation

Following completion of the Baseline Review, stakeholder consultation was conducted to better understand the application of monitoring systems, risk mitigation strategies, and to further explore opportunities for improvement regarding the way occupational health harms are identified, controlled, monitored, and regulated in Queensland. Healthcare organisations, industry, workers, unions, and registered medical providers approved to perform examinations under the Coal Mine

¹ Ernst & Young, 2021, Baseline Review of Occupational Health Risks Report, available at:

<https://www.rshq.qld.gov.au/resources/documents/occupational-health/occupational-health-risks-qld-resources-industry.pdf>

Workers' Health Scheme (CMWHS) were invited to provide feedback. A total of 16 submissions were received through the consultation period, predominantly from industry and healthcare organisations (**Figure 2**).

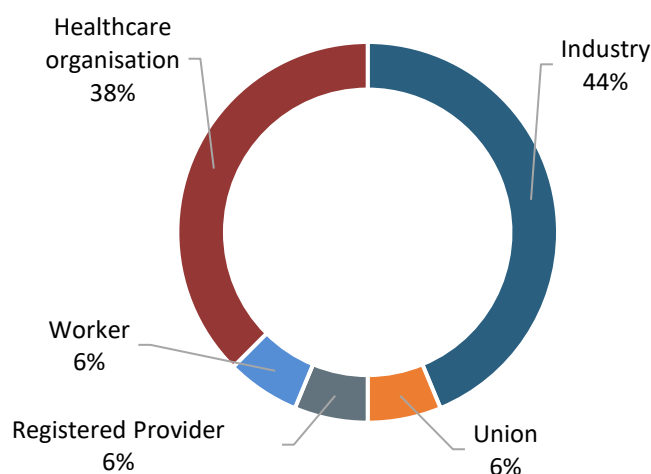


Figure 2: Distribution of submissions received by stakeholder type.

Feedback was received on a broad range of occupational health harms (**Figure 3**), including those addressed through the Baseline Review and others raised by stakeholders, notably fatigue, along with general comments about the regulatory approach taken by RSHQ. Submissions predominantly focused on mitigation strategies in place to address harm exposure, as well as identifying potential gaps in industry and regulator knowledge regarding specific harms.

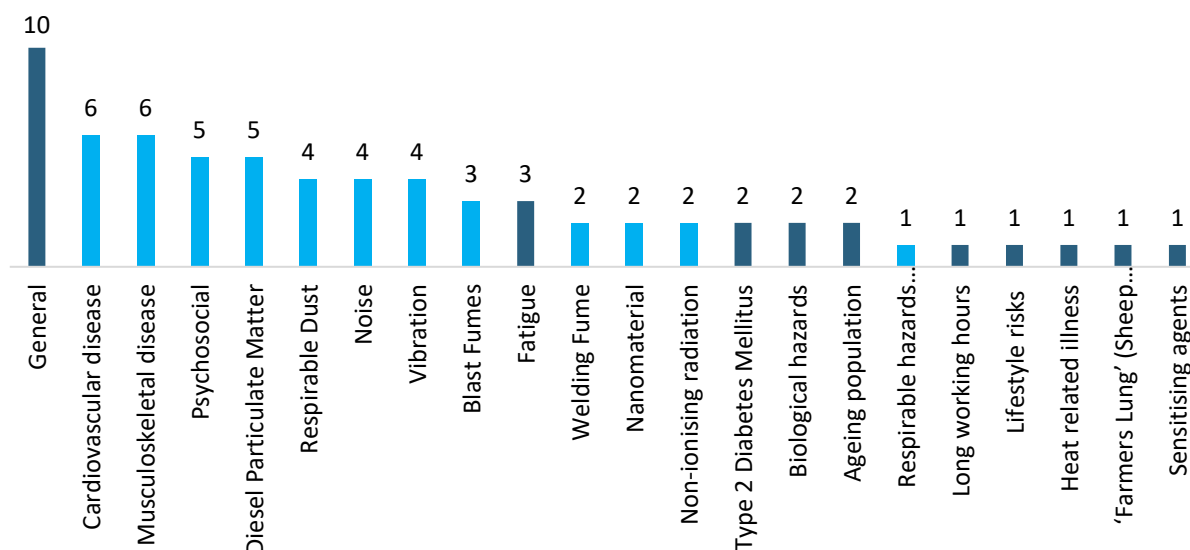


Figure 3: Number of times each harm was addressed in stakeholder submissions. This includes all harms identified through stakeholder feedback, not just those addressed in the Baseline Review.

Feedback categorised as 'general' included broad comments regarding the management of multiple harms, comments concerning functions of the regulator, and other comments not directly relevant to harm prioritisation or attributed to any one occupational health harm.

Specific concerns were raised by stakeholders regarding the management of occupational health harms with compounding factors exacerbating their exposure or impact, as well as the management of interrelated harms with complex aetiologies. Stakeholders also flagged the value of greater access to site-specific health surveillance data collected by RSHQ, but also access to data at an industry level, to provide greater insight into the prevalence of health impacts and to inform proactive preventative strategies.

Fatigue and legionella were initially excluded from the Baseline Review; however, stakeholder feedback highlighted the importance of addressing these occupational health harms due to their well-documented, detrimental impact on the health of workers. As such, they have been considered through the prioritisation process.

COVID-19 was also raised through stakeholder consultation in the context of biological hazards impacting resource sector workers. The Chief Health Officer and Queensland Health provide public health directions that workplaces across Queensland including mine sites, must follow, therefore, COVID-19 was excluded from this review.

Whilst not identified through specific stakeholder consultation, vanadium pentoxide was identified as an emerging occupational health hazard due to future plans for mining and processing vanadium in Queensland. Vanadium pentoxide was also assessed in the prioritisation process.

Step 3: Occupational health harm priority assessment

An extensive exploratory process revealed there was no publicly available fit for purpose framework that could be applied to prioritising health harms across the entire resources sector from a regulator's perspective. As such, a custom framework was developed (**Figure 4**). The framework was built around a standard risk assessment methodology, incorporating aspects of consequence and likelihood, which were then balanced against the presence of controls from an industry perspective, as well as effectiveness of regulatory controls. The framework also provided the opportunity to consider additional information such as compounding factors and other relevant jurisdictional regulatory activities, to finally establish an overall priority rating for each occupational health harm. Detailed descriptors for each consequence, likelihood and control factor in the prioritisation framework are provided in **Appendix A**.

The principles of the framework were aligned to that detailed in the Australian Institute of

Occupational Hygienists (AIOH) 'Simplified occupational hygiene risk management strategies' document, as well as the Queensland Treasury 'A Guide to Risk Management', along with industry examples of risk assessment frameworks, and other available guidelines and standards.

The framework was further refined through a series of workshops with nominated subject matter experts from across RSHQ. These workshops helped to validate the framework and ensure it was appropriate and acceptable across RSHQ.

Approach to consequence rating

The consequence rating, as described in **Appendix A**, was derived entirely from assessing the potential health impacts following exposure to the occupational health harm. Following feedback at the workshops, the concept of *maximum foreseeable loss* was specified when determining the consequence rating. This helped guide consistent classification of health impacts, reducing an element of subjectivity that could be present when rating consequence. Maximum foreseeable loss is defined as the most significant health outcome that could feasibly result from exposure to an occupational health harm. This is different to the health outcomes that would be *most likely* following exposure. When considering occupational health harms such as CVD, this approach to consequence rating also helped frame the focus of the prioritisation, i.e., considering sudden cardiac arrest as the maximum foreseeable loss.

A more quantitative measure of consequence was investigated, such as by determination of attributable risk from epidemiological studies of hazard-disease relationships. However, this approach is limited by a lack of:

- robust data availability,
- access to reliable, evidence-based relative risk studies for the broad range of occupational harms examined,
- internal expertise to derive relative risk ratings, and
- association of historic data with current exposures in the populations of interest.

Following the prioritisation of occupational health harms, it may be beneficial to explore relative risk further to enhance understanding of specific harms.

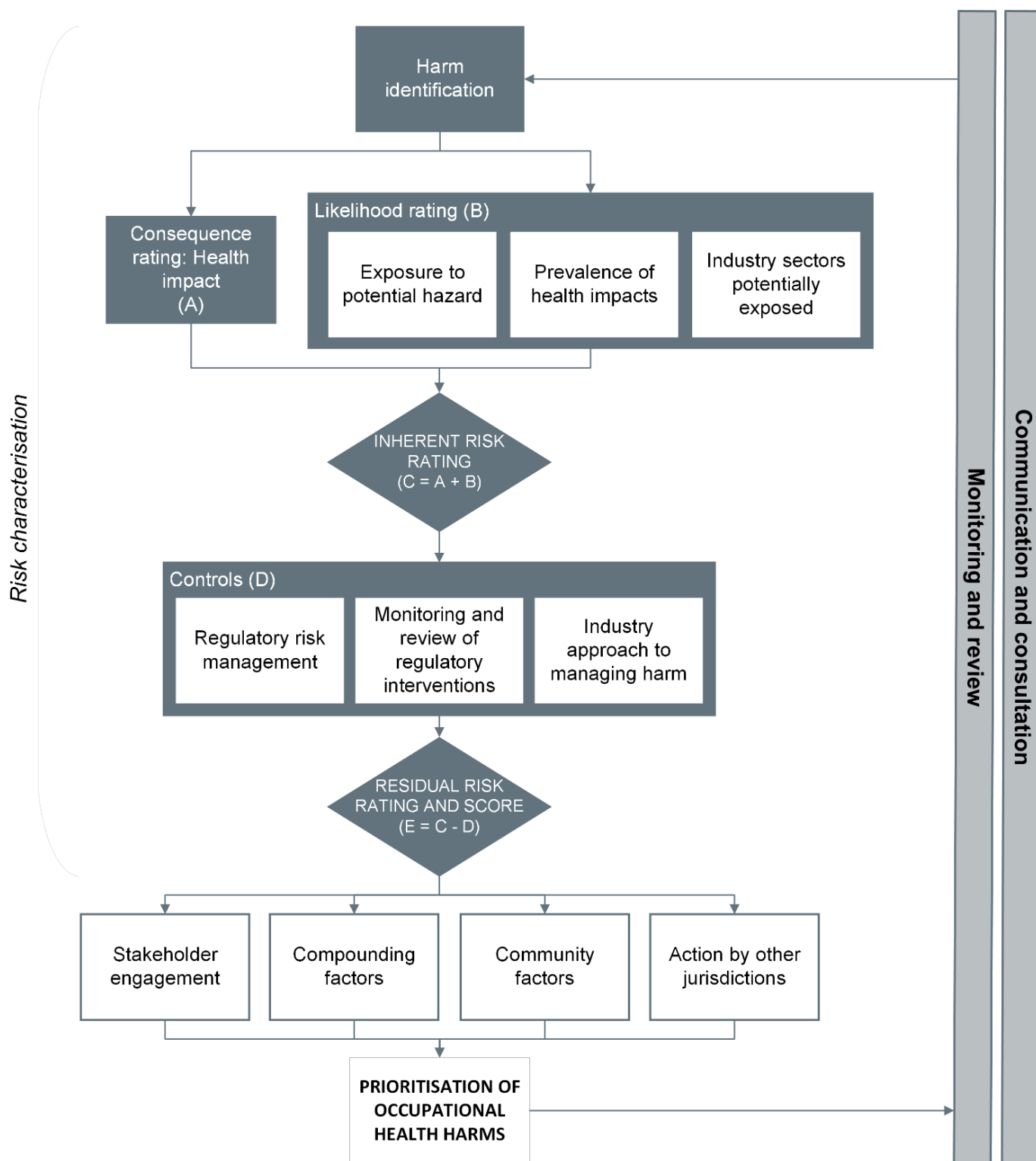


Figure 4: Framework for prioritisation of occupational health harms. The framework was based on modification of the standard risk assessment approach to reflect the regulator perspective and allow for consideration of additional relevant factors.

Approach to likelihood rating

The likelihood rating, described in detail in **Appendix A**, included three key components identified as essential at the internal methodology workshops:

- exposure to potential harm
- prevalence of health impacts
- industry sectors potentially exposed.

The exposure rating was established using the AIOH exposure descriptor, where applicable.² This included consideration of both the magnitude and frequency of exposure to the occupational health harm. A qualitative approach to assessing exposure was selected given the applicability of the prioritisation process to the entire resources sector. Use of specific shift adjusted occupational exposure limits (OELs) were avoided due to the variability in available information for different occupational health harms.

An average of ratings allocated across all three likelihood factors was used to determine a final likelihood score.

Consideration of controls to manage risk

An assessment of 'controls' relevant to each harm were included to determine a residual risk rating, which was used to inform the final residual risk score and priority rating. Control factors considered were:

- regulatory risk management tools
- monitoring and review of regulatory interventions
- industry approach to managing risks including implementation of controls.

The intention of including consideration of controls, as further outlined in **Appendix A**, was to capture what regulatory tools exist relating to managing the risks of exposure to occupational health harms within the Queensland resources sector, how RSHQ is actively monitoring occupational health harms and assessing the effectiveness of relevant regulatory tools, and the efforts taken by industry to manage the risk effectively.

² Australian Institute of Occupational Hygienists Inc. 2020, 'Simplified Occupational Hygiene Risk Management Strategies', Available via Simtars library.

An average of ratings allocated across all three control factors was used to determine a final control score.

Consideration of additional factors

The development of the prioritisation framework identified several factors that did not fit within the likelihood, consequence, or control categories, but were important to consider within the broader regulatory context of the prioritisation process. These factors relate to stakeholder feedback, presence of occupational and community factors which exacerbate the health impacts of the occupational health harm on the target organ, and actions taken by other jurisdictions relating to the occupational health harm. Qualitative information relating to each of these factors was collated during the prioritisation process to inform the final priority rating.

Scoring

A variety of methods to score risk and allocate a final priority rating were considered from relevant guidelines as well as examples utilised by industry. A numerical approach to assessing risk was maintained throughout the risk assessment process, summarised in **Figure 5**. This mirrors the standard risk matrix approach while allowing quantifiable consideration of controls to determine a final residual risk score and priority rating.

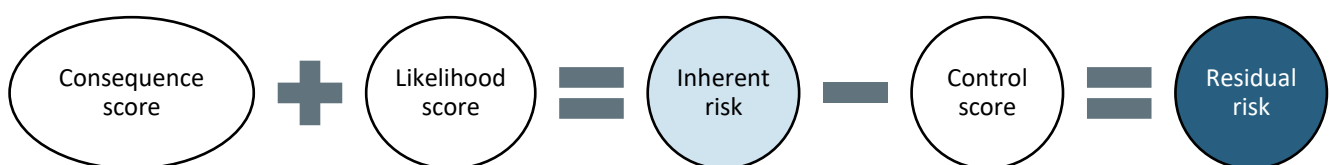


Figure 5: Scoring mechanism for determining residual risk of occupational health harms as part of the prioritisation framework.

Determination of a final priority rating for each occupational health harm was then established from the significance allocated to each factor included in the additional consideration category. The volume and significance of information available within each additional consideration factor category was used to determine if the occupational health harm has a material impact on the prioritisation of harms as well as helping inform potential actions following the prioritisation process.

Internal workshop

Consultation with RSHQ's occupational hygienists and inspectors was conducted through a series of workshops and one-on-one interviews, to derive a final prioritisation level for each harm. These

workshops confirmed the evidence used to inform prioritisation reflected contemporary knowledge, while also providing an opportunity to close any knowledge gaps. Several workshops were held with nominated representatives ('the workgroup') from across RSHQ to develop the framework. This was followed by 12 targeted workshops with the group where priority scores for each occupational health harm were established.

The workshops also provided an avenue to assess specific occupational health harms at an industry sector level. Where a score for a specific factor, e.g., exposure, differed between industries, this information was collected and analysed to identify occupational health harms that may be sector specific.

Results

A total of 25 occupational health harms were prioritised using the framework. Evidence to support the prioritisation of each harm was drawn from the Baseline Review, external stakeholder consultation, internal interviews with subject matter experts, and through the series of focused internal workshops addressing each harm.

Priority ratings for each occupational health harm are provided in **Table 1**. Note that several occupational health harms were found to have the same residual risk score. The order these appear in the table below has no bearing on the priority allocated to them within each priority rating category.

Of the 25 occupational health harms analysed, 9 (36%) were classified as either high or elevated priority. Fatigue and psychosocial hazards were allocated to the 'high' priority category.

Fatigue received the highest priority score of the harms examined. This can be attributed to a high potential severity of health impacts from exposure to fatigue, as well as extensive exposure among a broad population of resource workers, and the presence of a range of compounding factors exacerbating its impact, including safety risks.

Psychosocial was initially assessed as an 'elevated' priority, however, the strong focus in other jurisdictions to provide further legislative clarity and guidance on the management of psychosocial hazards has highlighted a need to explore this further. Consequently, this harm was raised to a 'high' priority.

In addition to fatigue and psychosocial that were classified with a high priority rating, one-third of the harms analysed in the prioritisation framework were also identified as elevated priority. RSHQ already has work underway to address many of these harms, including monitoring and analysis of

diesel particulate matter exposure, proposed amendments to the MMQ regulation addressing lead, and a series of audits targeting noise currently underway in the P&G industry.

Similar to psychosocial hazards, significant additional considerations for lead justified raising this hazard to the 'elevated' category from 'medium'. This includes more advanced actions by other jurisdictions, as well as the potential risk to the community associated with fugitive emissions from lead mining and processing operations. Lead was more likely to impact the health of MMQ workers, making it a specific priority related to the MMQ industry.

Table 1: Summary of priority ratings for each occupational health harm

Occupational health harm	Residual risk score	Priority rating
Fatigue	7.0	High*
Psychosocial	6.3	High*
Non-ionising radiation: UVR	7.0	Elevated
Asbestos - naturally occurring	6.7	Elevated
Noise	6.7	Elevated
Hazardous manual tasks	6.7	Elevated
Welding fume	6.7	Elevated
Diesel fume	6.7	Elevated
Lead	5.7	Elevated*
Respirable crystalline silica and other particulates (dust)	6.0	Medium
Cardiovascular disease	6.0	Medium
Diabetes	5.3	Medium
Polymeric chemicals	5.3	Medium
Whole body vibration	5.2	Medium
General hazardous chemicals	5.0	Medium
Volatile organic compounds	5.0	Medium
Vanadium pentoxide	5.0	Medium
Blast fume	4.3	Medium
Asbestos - materials	4.0	Low
Hand-arm vibration	4.0	Low
Water-based biological hazards	3.3	Low
Ionising radiation	3.3	Low
Non-ionising radiation: ELF	1.3	Monitor
Non-ionising radiation: LASER	0.3	Monitor
Non-ionising radiation: RF	0.0	Monitor

**These harms have had their priority rating raised based on the presence of additional factors that have an additive effect for how RSHQ has prioritised them.*

The prioritisation process is important to guide strategic priorities at a resources industry level. However, it also highlighted nuances in the risk associated with occupational health harms at an

industry focus level for RSHQ. Variability between industries in priority ratings were reported for psychosocial, fatigue, hazardous manual tasks, diesel fume, noise, respirable dusts, CVD, and polymeric chemicals. Variability would also be expected for blast fume, vanadium, lead, asbestos – naturally occurring, and non-ionising radiation – UVR. The available capacity of the workshops was focussed on the broad range of occupational health harms across the resources industry as a whole, however, unpacking these individual harms further at an industry level would be beneficial to identify where specific priorities exist.

When reviewing the relative contribution of consequence, likelihood, and control factors to the final priority score for each harm, it was found that control factors had the most variability between industries and added considerably to inconsistencies between final priority scores (**Figure 6**).

High industry-specific control scores highlight those that have a more advanced regulatory framework or there is better understanding of the harms. For example, the work underway into polymeric chemical use in coal mines has enhanced RSHQ's understanding of the harm and how the risk is managed, thereby increasing the associated control factor score and lowering the overall priority rating. On the contrary, a low industry-specific control score may indicate localised priorities where there are gaps in knowledge, regulatory controls, or monitoring systems, where more focused work may be beneficial. In addition to the whole-of-industry priority ratings in **Table 1** there may be sector priorities in the following areas:

- MMQ and P&G sectors:
 - respirable crystalline silica and other particulates (dust)
 - hazardous manual tasks
 - diesel fume.
- P&G sector:
 - welding fume.

Discussion

A substantial portion of occupational health harms were identified as high or elevated priority after application of the prioritisation framework. These occupational health harms were found to have higher inherent risk scores and lower control scores, which had potential to result in more severe health outcomes and impact a greater portion of the workforce.

Despite these similarities there were also differences between some of the harms, including stakeholder views on the importance of each harm. Knowledge gaps, particularly relating to exposure and prevalence, were also highlighted consistently through the internal workshops as a

challenge to prioritisation. The following section discusses standout harms due to their priority rating and provides further context regarding harm priority ratings. Discussion of these occupational health harms does not negate consideration of the large number of harms that were identified as an elevated priority for RSHQ, such as noise, diesel fumes, or UVR.

Fatigue

Fatigue is a broad term, encompassing a wide range of work-related risk factors, such as shift length, roster patterns and demands of a job role, as well as both mental and physical components, that not only impairs the individual's ability to perform their duties safely but also can have a cumulative, detrimental impact on the health of the individual exposed³. As such, fatigue can be classified as both a hazard and a health outcome. Both occupational and non-occupational factors contribute to fatigue, which can make it difficult to distinguish work-relatedness of health outcomes. Individual factors such as sleep duration and pattern, diet, alcohol, medication, an individual's fitness, and psychosocial factors contribute to fatigue. Work-related factors contributing to fatigue, such as nature of the work performed, physical and mental demands of work, shift length, roster pattern, accommodation facilities and working environment, have also been identified as having a potential impact. This exemplifies the intersectionality of occupational health harms and the importance of avoiding approaching any in isolation.

Fatigue had the highest priority score, on par with UVR, along with considerable additional considerations that justified elevating it to the high-priority category. The immediate safety risks, as well as significant chronic health impacts associated with fatigue have contributed to the 'high' priority rating for this harm. However, it was noted during the workshops that more data is required to better understand the risk attributable to work factors compared with non-work factors.

Psychosocial

Psychosocial hazards are hazards that arise from, or in relation to job characteristics, design, and management, including exposure to harmful behaviours in the workplace, with Safe Work Australia describing 14 key psychosocial hazards that have the potential to cause harm.⁴ Exposure to psychosocial hazards can contribute to stress and depending on the magnitude and frequency of

³ WorkSafe Queensland, 2020, 'Fatigue', Available at: <https://www.worksafe.qld.gov.au/safety-and-prevention/mental-health/Psychosocial-hazards-and-factors/fatigue>.

⁴ Safe Work Australia, 2022, 'Model Code of Practice: Managing psychosocial hazards at work', Available at: <https://www.safeworkaustralia.gov.au/doc/model-code-practice-managing-psychosocial-hazards-work>.

the stress, if not effectively managed, it can present as psychological injuries (anxiety, depression, post-traumatic stress disorder, and sleep disorders). Exposure can also exacerbate physical injuries, such as MSD, chronic disease, and fatigue-related incidents and in some cases lead to self-harm and suicidal thoughts. Workplace Health and Safety Queensland's Code of Practice for Managing the Risk of Psychosocial Hazards at Work⁵ states that severe cases of exposure can lead to death by suicide.

Like fatigue, individual factors outside the workplace can also contribute to stress and make it difficult to determine work-relatedness of subsequent injuries. Psychosocial hazards can be impacted by non-work-related factors such as lifestyle choices, geographic location, gender, medical history, and individual circumstances outside work, e.g., financial, family or relationship pressures. For example, the workgroup observed that there is significant overlap in the community population most at risk for mental health problems, namely males aged between 25 and 44⁶, and those working in the resources sector. The Queensland Suicide Prevention Plan 2019 – 2029⁷ has further reinforced the need to strengthen support to vulnerable population groups such as men in the resources sectors.

Despite the complexities of work and individual -factors impacting mental health, there is a growing body of evidence that suggests mental distress is higher amongst certain resources sector subgroups, such as women and fly-in fly-out (FIFO) workers⁸. Following the 2020 national inquiry report into workplace sexual harassment⁹, a recent Western Australian parliamentary inquiry into

⁵ Workplace Health and Safety Queensland, 2022, 'Managing the risk of psychosocial hazards at work', Available at: <https://www.worksafe.qld.gov.au>

⁶ Parliament of Western Australia, 2014, 'Shining a Light on FIFO Mental Health', Available at: [https://www.parliament.wa.gov.au/Parliament/commit.nsf/\(Report+Lookup+by+Com+ID\)/AD292116C942943E48257D9D0009C9E6/\\$file/Discussion%20Paper%20Final%20PDF.pdf](https://www.parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/AD292116C942943E48257D9D0009C9E6/$file/Discussion%20Paper%20Final%20PDF.pdf)

⁷ Queensland Mental Health Commission, 2019, 'Every life. The Queensland Suicide Prevention Plan 2019 – 2029', Available at: https://www.qmhc.qld.gov.au/sites/default/files/every_life_the_queensland_suicide_prevention_plan_2019-2029_web.pdf

⁸ Parliament of Western Australia, 2015, 'The impact of FIFO work practices on mental health', Available at: [https://www.parliament.wa.gov.au/Parliament/commit.nsf/\(Report+Lookup+by+Com+ID\)/2E970A7A4934026448257E67002BF9D1/\\$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf](https://www.parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/2E970A7A4934026448257E67002BF9D1/$file/20150617%20-%20Final%20Report%20w%20signature%20for%20website.pdf).

⁹ Australian Human Rights Commission, 2020, 'Respect@Work: National Inquiry into Sexual Harassment in Australian Workplaces', Available at: <https://humanrights.gov.au>

sexual harassment against women in the FIFO mining industry¹⁰ uncovered sexual harassment to be prevalent across the industry, leading to a broad range of psychological injuries. RSHQ has already commenced work to ensure sexual harassment is appropriately regulated in Queensland resources industries.

Psychosocial hazards were identified by multiple (5) stakeholder submissions, highlighting issues around legislation and the way psychosocial hazards are regulated, gaps in the CMWHS regarding screening for signs of psychological injury, and concerns around work-relatedness of psychological injury. It was identified as a hazard of particular concern from the Baseline Review, and large resources industry employers have also commenced their own projects to understand the impact of psychosocial hazards in their operations. Along with the importance placed on this hazard group in the community, and the focus placed on it by other jurisdictions, this justified elevating psychosocial hazards to the high priority category.

Lead

Through the prioritisation process, lead was initially classified as a 'medium' priority. However, the potential health implications for multiple generations due to exposure, and additional considerations including more advanced actions by other jurisdictions, as well as the significant community impacts of this harm, have resulted in lead being moved to the 'elevated' category.

It was acknowledged during benchmarking that lead is more likely to impact the health of MMQ workers. This reinforces the importance of the work already commenced by the MMQ Inspectorate regarding proposed lead related regulatory amendments.

Knowledge gaps

Despite the longstanding awareness of many of these harms across resource sector industries, there is still limited data, particularly within RSHQ, regarding exposure and prevalence of adverse health outcomes. This was identified as an issue throughout the Baseline Review and was a consistent discussion point through the prioritisation workshops. Vibration, CVD, diabetes, hazardous manual tasks, nanomaterial, and non-ionising radiation all have the potential to impact large numbers of workers. However, our understanding of these harms is still developing.

¹⁰ Community Development and Justice Standing Committee, 2022, 'Enough is enough: Sexual harassment against women in the FIFO mining industry', Available at: [https://www.parliament.wa.gov.au/Parliament/commit.nsf/\(Report+Lookup+by+Com+ID\)/EF1DF1A3F5DF74A848258869000E6B32/\\$file/20220621%20-Report%20No%202.pdf](https://www.parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/EF1DF1A3F5DF74A848258869000E6B32/$file/20220621%20-Report%20No%202.pdf)

RSHQ's understanding of key harms is generally more progressed for the coal industry, which is reflected in their higher control scores for harms such as respirable dust, diesel exhaust, and polymerics. This prioritisation will facilitate coordination of responses to address opportunities to improve how occupational health harms are managed.

Prevalence rates incorporated into the likelihood factor were taken from a variety of sources including reports of disease diagnosis, high potential incidents, lost time injuries, workers' compensation claims, as well as disease rates from other jurisdictions. However, the work-relatedness of these cases could not always be established. This was particularly true for occupational health harms that have a significant contribution from non-occupational factors, including CVD, psychosocial, fatigue, hazardous manual tasks, UVR and diabetes. Traditionally, occupational diseases are also severely underreported, particularly those with long latencies. This can add further difficulties to drawing strong conclusions from the data.

RSHQ is currently working to enhance data collection and analytic capacity across the resource sector to grow our understanding of occupational health harms. Once fully operational, RSHQ's replacement Enterprise Operating System and ResHealth, will grow RSHQ's understanding of occupational health harms exponentially. Research projects, such as the Monash University Coal Mine Workers' Cancer and Mortality Study, will add to this knowledge base and further inform RSHQ's understanding of priority occupational health harms.

Additional harms

The occupational health harms selected for analysis through the prioritisation process were only a small subset of the potential harms that could be included. The scope of future iterations of this activity has the potential to expand to include additional occupational health harms that were either excluded from the initial review or identified as a future harm of interest. Periodic review of harms found to be within the medium, low or monitor priority categories could also be undertaken to identify any changes to the evidence base that would justify a change in priority rating. For example, radiofrequency radiation is currently classified as Group 2B (Possibly carcinogenic to humans) by the International Agency for Research on Cancer¹¹. If new evidence emerges that would elevate this rating, it will have a dramatic impact on the consequence rating and subsequent priority rating for

¹¹ International Agency for Research on Cancer, 2011, 'IARC classifies radiofrequency electromagnetic fields as possible carcinogenic to humans', available at: https://www.iarc.who.int/wp-content/uploads/2018/07/pr208_E.pdf.

the occupational health harm.

Several occupational health harms included in the current prioritisation assessment were groups of harms that are made up on a collection of specific harms with their own unique adverse health impacts and exposure patterns. General hazardous chemicals are an example of a category of harms that include a wide range of discrete hazardous substances, such as mercury and ammonium nitrate, which could be examined more specifically. Any, or all, of the 14 identified psychosocial hazards could be examined in further detail separately. Hazardous manual tasks could similarly be broken down to consider a range of risk factors including awkward and sustained postures, repetitive movements and high forces that may apply to sedentary tasks and manual handling activities. Examining these specific harms could reveal differences in priority areas within harm categories and between industries.

The analysis of occupational health harm priority at an industry level has also highlighted potential opportunities to explore harms that have greater relevance to specific sectors. Diesel fumes, hazardous manual tasks and respirable dusts were three harms that were found to have greater impacts across the P&G and MMQ industries compared to coal. It is also worth highlighting that residual risk was considered lower across a range of occupational health harms in the coal industry, including hazardous manual tasks, diesel fume, respirable dust, CVD, and polymeric chemicals. This in part reflects the extensive work undertaken by the Coal Inspectorate, as well as through the CMWHS. As described in the results section, the workgroup also suggested industry-specific variability would be expected for blast fume, vanadium, lead, asbestos – naturally occurring, and non-ionising radiation – UVR. Unpacking these harms further would identify where specific priorities exist.

Future iterations of the prioritisation process could also include harms that were initially excluded from this review, such as heat stress and alcohol and drug impairment on-site. Other harms that were suggested by workgroup members included inhalable dust, epilepsy, syncope, and shift work (as a separate occupational health harm from fatigue).

Conclusion

Prioritisation of each harm has confirmed the findings of the Baseline Review, that none of the harms addressed in this analysis poses zero risk to workers. Findings from this assessment will be used to inform RSHQ's regulatory focus on occupational health harms, future allocation of resources and support a coordinated approach across RSHQ. From a broader RSHQ perspective, across all industries, fatigue and psychosocial have been identified as a high priority in comparison to other occupational health harms considered, with other specific harms being identified at a more industry

sector specific level, noting RSHQ has existing work underway in many of these areas.

As RSHQ enhances its data analytics capabilities and deepens its understanding of specific occupational harms, periodic review of occupational health harm prioritisation will be important to detect changes in exposure, disease prevalence, and controls. Growth of the underlying evidence base will guide RSHQ's regulatory direction.

APPENDIX A: Prioritisation framework descriptors

CONSEQUENCE FACTOR	Consequence level				
	1 – Minor	2 – Low	3 – Moderate	4 – High	5 – Significant
<p>Health impact</p> <p>The potential health impact following exposure to the harm. The inherent capacity of the health harm to cause harm.</p> <p>Determined by the <i>maximum foreseeable loss</i> following exposure to the harm, i.e., the worst-case outcome.</p>	<p>First-aid treatment and/ or temporary discomfort</p> <p>OR</p> <p>Insufficient evidence to classify harm.</p>	<p>Full recovery from illness or symptoms with or without medical treatment (no lost time).</p>	<p>Reversible injury (temporary impairment) sustained to worker resulting in loss of productive work time (lost time injury), possibly requiring admission to hospital as an in-patient.</p>	<p>Irreversible impact on health with loss of quality of life of one or more workers (permanent disability).</p>	<p>One or more fatalities, including a prognosis of a significantly reduced lifespan</p> <p>OR</p> <p>Detrimental impact on development of foetus.</p>

LIKELIHOOD FACTORS	Likelihood level				
	1 – Rare or never	2 – Unlikely	3 – Possible	4 – Likely	5 – Almost certain
<p>Exposure to potential harm across Resources Sector</p> <p>Exposure rating based on the availability of qualitative or quantitative information. Should include a consideration for both the magnitude and frequency of exposure.</p>	<p>Occasional contact with the potential harm at low levels.</p>	<p>Periodic contact with the potential harm at low levels.</p>	<p>Periodic contact with the potential harm at moderate levels</p> <p>OR</p> <p>Regular contact with the potential harm at low levels.</p>	<p>Periodic contact with the potential harm at high levels</p> <p>OR</p> <p>Regular contact with the potential harm at moderate levels.</p>	<p>Regular contact with the potential harm at high levels.</p>
<p>Prevalence of health impacts</p> <p>Evidence of health impacts realised through reports of disease diagnosis, workers' compensation claims or other sources, including timeframes since cases reported.</p> <p>Where cases/ diagnoses have not been documented but exposure is reported, potential issues with reporting or detecting health impacts should be considered.</p>	<p>Known health impacts have not been recorded or reported within last 30 years.</p>	<p>Known health impacts have been recorded and reported within last 11 to 30 years.</p>	<p>Known health impacts have been recorded and reported within last 4 to 10 years.</p> <p>OR</p> <p>Possible issues with reporting or detecting health impacts.</p>	<p>Known health impacts have been recorded and reported within last 1 to 3 years.</p> <p>OR</p> <p>Likely issues with reporting or detecting health impacts.</p>	<p>Known health impacts have been recorded and reported within the last 12-month reporting period.</p> <p>OR</p> <p>Known issues with reporting or detecting health impacts.</p>
<p>Industry sectors potentially exposed</p> <p>The extent to which industry sectors RSHQ is responsible for regulating are potentially exposed to the harm at a level considered capable of producing the health impacts discussed, and their operation types, e.g., coal, minerals, quarries, petroleum & gas, and explosives across underground, open cut, upstream and downstream (specific SEGs).</p>	<p>One industry sector and one type of operation potentially exposed, e.g., open-cut coal, and a single SEG within that operation.</p>	<p>Workers within one industry sector and one type of operation, e.g., gas upstream, but multiple SEGs within that operation potentially exposed.</p>	<p>Potential exposure across one industry sector and majority of operations, e.g., coal open cut & underground.</p> <p>OR</p> <p>Workers within multiple industry sectors and operations, but limited SEGs within each operation potentially exposed.</p>	<p>Multiple resource industry sectors, e.g., coal and metalliferous mining, and SEGs potentially exposed.</p>	<p>All or vast majority industry sectors and operation types potentially exposed.</p>

CONTROL FACTORS	Control level				
	1 – Minor	2 – Low	3 – Moderate	4 – High	5 – Significant
Regulatory risk management Presence and stringency of specific regulatory tools including legislation, standards, guidelines, and exposure limits in Queensland resources sector for the harm of interest.	No requirements, standards, or guidelines for risk management and/or occupational exposure limits.	Recommended requirements, standards, and guidelines for risk management and/or occupational exposure limits.	Limited mandatory legislative requirements for risk management with no specific guidelines or standards and/or occupational exposure limits.	Some mandatory legislative requirements for risk management and/or occupational exposure limits.	Extensive mandatory legislative requirements for risk management and/or occupational exposure limits.
Monitoring and review of regulatory interventions Currency and extent of monitoring, review and evaluation conducted to assess the effectiveness of regulatory initiatives to mitigate harm exposure. Initiatives relating to monitoring and review include focused audit and inspection campaigns, regulation review, analysis and review of data from exposure monitoring, health surveillance, incident and workers' compensation, stakeholder consultation etc. Note, this does <i>not</i> include safety and health bulletins and alerts released from inspectorates.	No monitoring and review initiatives undertaken or undertaken >6 years ago. OR A new intervention currently exists to mitigate this risk in Queensland (i.e., no previous data or information available).	Some monitoring and review initiatives undertaken >6 years ago. OR Limited monitoring and review initiatives undertaken in the last 3 to 6 years.	Comprehensive monitoring and review initiatives undertaken >6 years ago. OR Some monitoring and review initiatives undertaken in the last 3 to 6 years. OR Limited monitoring and review initiatives undertaken in the last 2 years.	Comprehensive monitoring and review initiatives undertaken within the last 3 to 6 years. OR Some monitoring and review initiatives undertaken in the last 2 years.	Comprehensive monitoring and review initiatives undertaken within the last 2 years.
Industry approach to managing the harm Extent to which industry takes measures to mitigate risk associated with harm exposure, considering effectiveness and adherence to controls across industry. Includes the extent to which exposure monitoring and health surveillance undertaken by industry and reported to RSHQ.	No known controls in place across any industry, or not well understood.	Reliance on lower order controls, e.g., PPE and administrative controls to manage risk.	Limited use of higher order controls with greater reliance on lower order controls.	Some use of higher order controls (e.g., elimination, substitution, isolation, engineering) among most industries.	Many higher order controls in use with evidence/ data demonstrating their effectiveness. Controls applied across all industries (standard practice).

FACTORS FOR ADDITIONAL CONSIDERATION	Definition
Stakeholder engagement	Significance of stakeholder feedback, what weight RSHQ gives to its consideration.
Compounding factors	Presence of occupational factors that accelerate or amplify the health effects of the harm of interest on the target organ affected, including consideration of the extent of interaction between the compounding factor/s and the harm of interest.
Community factors	Presence of factors that originate outside the occupational setting, e.g., age, lifestyle risk factors, existing health conditions, gender, etc, that may: <ul style="list-style-type: none"> accelerate or amplify the health effects of the occupational harm of interest impact on a person's ability to perform safety critical work either through impairment, loss of consciousness or sudden incapacity which could increase the risk of serious incident.
Action by other jurisdictions	Presence of different regulatory approaches (e.g., legislation, standards, guidelines, exposure limits) or projects relating to harm of interest in other relevant jurisdictions that may provide learnings to Queensland. Include non-resource and international jurisdictions to capture learnings and focus areas in other industries and/ or regions.