Landserv
Environment

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Attention: Dr. Jacquelle Gorski
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QUALITATIVE ASSESSMENT OF RISK POSED BY RESPIRABLE CRYSTALLINE SILICA (RCS) DURING CONSTRUCTION ACTIVITIES FOR YUMBAH NYAMAT

Dear Jacquelle,

In response to your request, Landserv has prepared this assessment of potential RCS risk from site derived dust impacts during the construction of Yumbah Nyamat. It has been completed to address the concerns raised by the community and following a formal request by EPA.

Background

Silica (silicon dioxide, SiO_2) is a natural mineral found in abundance in sand, stone, rocks, and clay as well as in man-made products such as bricks, tiles, concrete and composite stone forms. When combined with other elements the compound is called silicate. Over 90% of the Earth's crust is silicate based and silica is commonly encountered anywhere dust is generated.

Silica can exist either in the form of a crystal, where atoms are arranged in a regular lattice structure or in an unstructured amorphous form. Quartz is the most commonly occurring polymorph of crystalline silica and is typically observed as sand. Quartz is also the second most common mineral and is found in most terrestrial rocks and sedimentary deposits.

When silica containing materials are worked, for example by excavation, cutting, polishing or drilling, crystalline silica can be released as a fine dust which can be breathed in by workers and potentially the public. Occupational and ambient exposure to silica dust can be harmful over a long period of time at low levels or short periods at high levels and can lead to diseases such as silicosis and lung cancer. Crystalline forms of silica are much more hazardous than amorphous forms.

Silica dust is only harmful when inhaled deep into the lungs where oxygen passes through the blood-air barrier in the alveoli. The fraction of silica that is hazardous and can enter deep into the lungs is known as respirable crystalline silica (RCS), it has a typical particle size of less than 5 µm. This respirable fraction requires crystalline silica to be an extremely fine dust and as a comparison that is around 10x smaller than the finest beach sand.

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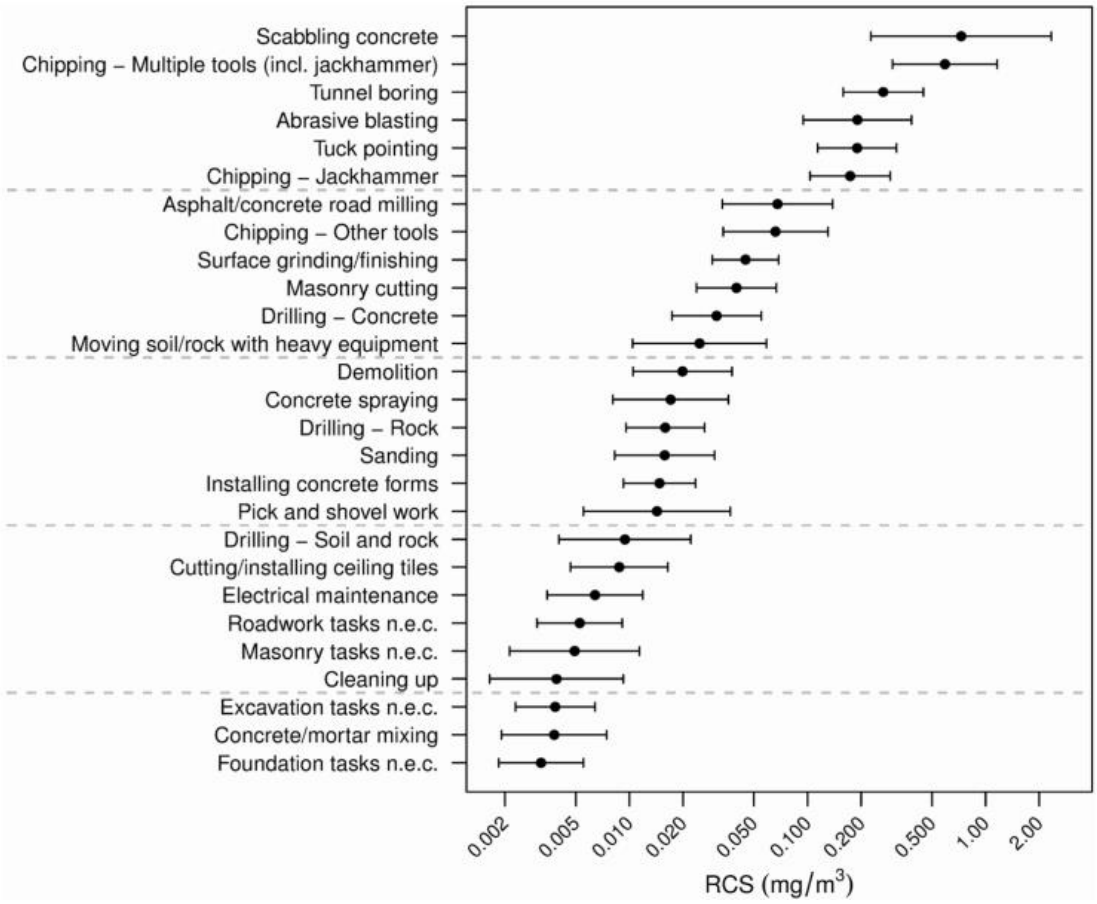
Risk Assessment

There are a range of industrial and construction activities that have the potential to generate varying amounts of silica dust and RCS. Estimated occupational RCS exposure levels for 27 construction tasks, in the absence of management control measures, have been calculated. The approximating model is shown in Figure 1.

Figure 1 – Estimated occupational RCS exposure by task (Jean-Francois Sauve et al, 2012)



The predictive model in Figure 1 for occupational exposure can be used to estimate RCS concentrations for the construction activities proposed during the Yumbah Nyamat site development. Landserv have compared the worst-case upper confidence limit concentrations, for the anticipated activities, against relevant assessment levels in Table 1. This assessment is designed to determine the potential for unacceptable risk posed by occupational RCS exposure at the source of dust generation.

Additionally, the assessment considers the scenario where RCS concentrations for each activity makes up 100% of ambient particulates (PM_{10} and below), and whether that level, if emitted off-site, exceeds National Environment Protection (Ambient Air Quality) Measure (NEPM) criteria. The objective of this element of the assessment is to determine whether off-site non-occupational exposure to RCS from construction activities has the potential to occur at a level that carries unacceptable risk.

The Australian occupational exposure standard for airborne crystalline silica is 0.1 mg/m³ over an 8-hour working day (WorkSafe Victoria). This limit is based on preventing silicosis and lung cancer and is an appropriate assessment criterion to apply in the absence of an ambient RCS guideline.

The NEPM standard for particulate matter covering the PM_{10} fraction is 50 µg/m³ (0.05 mg/m³) average per day. There is no ambient RCS criteria. Applying the PM_{10} criteria, and assuming 100% is RCS, is a worst-case scenario as it includes particulates between 5 µm and 10 µm which are not considered respirable and therefore not harmful to health.

Table 1 – Landserv assessment of Yumbah Nyamat construction activities and potential for RCS exposure above adopted criteria.

Construction Activity	Potential RCS exposure above 0.1 mg/m³ at source [a]	Potential RCS exposure above 0.05 mg/m³ beyond site boundary [b]
Foundation tasks	No	No
Concrete mixing	No	No
Excavation tasks	No	No
Site cleaning / sweeping	No	No
Roadwork tasks	No	No
Drilling soil / rock	No	No
Pick and shovel work	No	No
Installing concrete forms	No	No
Moving soil / rock with heavy plant	No	Yes
Drilling concrete	No	Yes
Masonry cutting	No	Yes

Notes:
[a] Worksafe occupational exposure limit
[b] NEPM Ambient Air Quality limit for PM_{10}

Based on Landserv's assessment in Table 1, all activities proposed at Yumbah Nyamat are unlikely to exceed the RCS occupational exposure limit of 0.1 mg/m³ at the source of dust generation, based on exposure concentrations from Figure 1, therefore presenting a low health risk to site workers. The health risk to off-site receptors, via non-occupational exposure, from RCS contained in dust generated on-site is lower than that at the source. This is due to atmospheric dilution and dispersion through the separation distance and therefore, non-occupational exposure above 0.1 mg/m³ is highly unlikely and the corresponding health risk is negligible.

The activities of moving soil and rock with heavy plant, drilling concrete and masonry cutting have the potential (assuming all dust generated is RCS and emitted off-site without dispersion or dilution in the atmosphere) to cause RCS exposure above the NEPM PM_{10} criterion of 0.05 mg/m³ beyond the site boundary. In the improbable event that this scenario is realised, the RCS concentration would still be below the occupational exposure limit of 0.1 mg/m³ derived to protect human health.

In addition, there are no commercial mineral extraction activities in the Portland area. This indicates that the underlying mineral geology profile does not contain high concentrations of silica and that Yumbah Nyamat earthworks are unlikely to release significant concentrations of RCS to the atmosphere.

In conclusion, the risk to air quality impacts from RCS in site generated dust to off-site sensitive receptors, such as residential areas, is considered to be negligible, and largely non-existent.

It is important to note that non-occupational (ambient) exposure to very low levels of RCS is a normal occurrence and can be from non-industrial as well as industrial sources. Ambient exposure from non-industrial sources occurs naturally through RCS suspended in the atmosphere, an example of which for Portland would be inland dust blown in on a northerly wind. Farming and all forms of construction and demolition are industrial sources which will contribute to ambient concentrations of RCS. Additionally, Portland port activities such as stockpiling and loading of silica containing aggregate is an industrial source of RCS that could potentially contribute to local ambient exposure.

Management and Mitigation of Dust (including potential RCS)

The Yumbah Nyamat construction program will be managed to minimise the potential for dust generation and any RCS exposure. Construction activities will not involve the higher risk tasks likely to generate significant RCS (outlined in Figure 1). For example, concrete scabbling, abrasive blasting and surface grinding are not part of the Yumbah development program, therefore site activities will avoid the risk of both occupational and non-occupational exposure to RCS.

The stripping of the site and deep excavations have the potential to generate dust and there are a number of localised deep excavations programmed. Groundwater is shallow, and it is anticipated that excavated soils will be either moist or saturated, this will further minimise potential dust generation. The bulk of earthworks will involve the stripping of surface vegetation and topsoil and a large extent of the earthworks and grow-out tank establishment will occur under established shade cloth.

To manage the potential for dust impact on local air quality, a comprehensive construction environmental management plan (CEMP) will be developed prior to site works. The CEMP will be reviewed and approved by EPA, Council and DELWP to ensure that appropriate controls are in place. The CEMP will define dust objectives, monitoring, measurement and performance evaluation procedures.

The construction of Yumbah Nyamat will be conducted in accordance with EPA publication *Guidelines for Major Construction Sites.* The following specific management and mitigation measures will be adopted to minimise the environmental impact of dust and potential RCS:

- Land clearance and earth moving activities will be managed to prevent excessive generation of dust by minimising the extent of land cleared and wetting exposed surfaces under windy conditions if required to prevent the generation of a visible plume;
- Dust generation from construction vehicle movements will be minimised by:
  - Restricting vehicle movements to defined roads as far as possible;
  - Restricting vehicle speeds on unsealed roads;
  - Ensuring vehicles transporting dirt or construction materials to and from the site are adequately covered or enclosed to prevent the escape of dust;
  - Spraying unsealed roads with water, if required to prevent visible dust plumes.
- Dust will be controlled through revegetation of disturbed areas as soon as possible following construction activities;

- All construction workers and supervisors will be made aware of dust controls during induction sessions; and
- Any dust related complaints from stakeholders will be recorded and responded to.

Summary

Onsite construction activities will generally emit low volumes of dust, and any impacts will be localised and controlled. It is anticipated that there will not be any impact to air quality beyond the site boundary during construction.

It is a key objective for Yumbah to ensure that air quality is not impacted beyond the site boundary and the CEMP will ensure that this is possible.

Yours faithfully,
Landserv Pty Limited

Mathew Barker
Senior Environmental Scientist