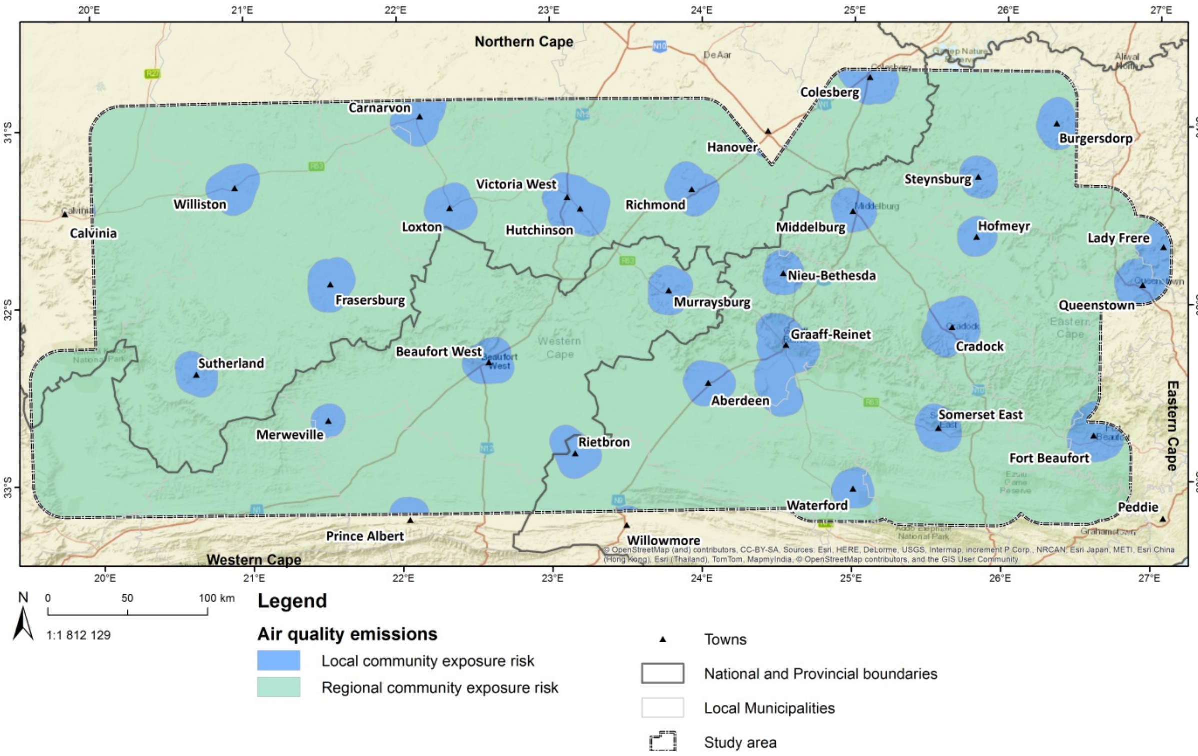
DIGITAL ADDENDA 3A – 3B

Addendum 3A: Spatial distribution of risks

If a wellpad is placed in one of the blue areas, the neighbouring town will be at risk for local community exposure. The green area represents regional community exposure, regardless of where in the study area the wellpads are placed.



Addendum 3B: Taken directly from "Controls and Recommendations to Limit Worker Exposures to Respirable Crystalline Silica at Hydraulic Fracturing Work Sites," Online Supplemental, Esswein et al., 2013

(http://www.tandfonline.com/doi/suppl/10.1080/15459624.2013.788352/suppl_file/uoeh_a_788352_sm4302.pdf)

"Engineering Controls

Based on workplace observations of various points of dust release on sand movers, NIOSH developed two engineering controls, one at the conceptual stage and one at the proof of concept stage. The first is a series of mini-bag houses that attach to the rim of a sand mover thief hatch and exploits positive pressure generated in the sand bins by the air compressor on the sand refill truck. Dust control is achieved as a filter cake develops on the inside of the bag house fabric. The design is intended to be self-cleaning as the filter cake is sloughed as the bag house fabric expands and collapses as air pressure is pulsed at the end of bin filling. This design is intended to be a “bolt-on” retrofit control option for sand movers currently operating in the field, but also could be configured in as part of original equipment manufacturer (OEM) for new models of sand movers. Figures 1 and 2 illustrate the concept of the mini-baghouse retrofit. A second control (at the conceptual stage) is a screw auger retrofit assembly to replace the sand belt on sand mover. This control requires more extensive engineering and mechanical retrofitting to existing sand movers, but could also be included in new OEM models.

An additional active control (which may currently be in production) includes use of a hood and ductwork connected to sand mover thief hatch openings connecting to a central manifold and then to a stand-alone baghouse for dust collection. Other (passive) considerations include enclosures, specifically installation of skirting or stilling curtains along the sides of the sand mover to contain particulate emissions from the sand belt. Similarly, enclosures and shrouding can be considered along the dragon tail with shrouding at the end of the dragon tail to limit dust emissions at the interface of transfer belts and blender hoppers. Keeping the dragon tail as close to the blender hopper or transfer belt to minimize the distance the proppant falls can reduce dust generation. Mandating the use of end caps on fill ports of sand movers is a simple and cost effective way to control silica dust ejected from this point source. Using dust control (magnesium or chloride amended water) on lease roads and at the wellpad area can reduce on-site dust generation. The use of well brines is not recommended as these may contain naturally occurring radioactive materials (NORM), including isotopes of Uranium, Thorium, Radium.

NIOSH recently published *Best Practices for Dust Control in Metal/Nonmetal Mining (NIOSH Informational Circular 9521)* which discusses dust control in underground mining operations.(1) Results from this document have direct relevance in hydraulic fracturing operations. Dust suppression using water misting may be acceptable and effective if misting nozzles are located in the correct locations and fine spray, atomizing nozzles are used. A recent paper found that the use of water spray application reduced respirable silica concentrations by 69-82% in outside stone crushing mills.(2)

While this study involved a systematic approach to understanding risks for work crew exposures to respirable crystalline silica, and is believed to be substantially representative, it may not address all points of dust generation or all options for effective controls.

Personal Protective Equipment

Until a variety of engineering or other controls can be conceived, developed, evaluated and confirmed to be effective for controlling respirable silica exposures to hydraulic fracturing work crews, the use of respiratory protection will be required. NIOSH approved, air-purifying, elastomeric half masks and filtering-facepiece respirators with particulate efficiencies of N-95 and greater are recommended as a minimum protection when PBZ exposures can be confirmed to be less than 10 times the relevant OELs. Because some PBZ samples exceeded either the OSHA calculated PELs or the NIOSH REL by a factor of 10 or more [the maximum use concentration (MUC) for that type of respirator], full-face, air-purifying respirators which are assigned a protection factor of 50 may need to be used in some cases. Considering the NIOSH REL of 0.05 mg/m^3 as a TWA, the MUC for a half face respirator would be an airborne concentration of respirable silica equivalent to 0.5 mg/m^3 as a TWA. In this study, respirable silica concentrations among Sand Mover and T-belt Operators notably exceeded this concentration, especially for Sand Mover Operators.

RECOMMENDATIONS

Conducting workplace exposure assessments to characterize work crew exposures to respirable crystalline silica is a recommended first step in understanding the scope of controls that may be needed. Employers should conduct full-shift worker exposure assessments, unless a decision is made to immediately implement controls and then re-evaluate the degree of exposure hazard based on use of controls. Since silica-containing dusts are generated from multiple locations, multiple types of controls (active and passive engineering controls, administrative and PPE) will be needed to prevent or mitigate workplace exposures.

Worker exposures to respirable crystalline silica should be controlled to the lowest concentrations achievable, certainly below calculated OSHA PELs and ideally below the NIOSH REL. Employers with workers at hydraulic fracturing worksites should focus on the traditional industrial hygiene hierarchy of controls, specifically: eliminate the hazard if possible and substitute less toxic proppant where feasible. Because engineering controls may not be completely effective, employers are encouraged to ensure that an effective respiratory protection program is in place that meets the criteria of the OSHA Respiratory Protection Standard (29 CFR 1910. 134).(2) and consult OSHA Directive CPL 03-00-007, National Emphasis Program–Crystalline Silica, for detailed information on silica hazards, guidelines for air sampling, guidance on calculating PELs for respirable dust containing silica, and other compliance information.”