Recommendations

1. Ensure that all Mount Isa residents, in particular young children, have their blood lead levels monitored. This is to ensure that health management actions are taken, any circumstances leading to elevated blood lead levels in children are identified early, and exposures to lead are minimised.
2. Maintain the existing mechanisms in place to minimise transfer of lead to the residential areas, such as the vehicle washing, clean-in, clean-out clothes policies, the Air Quality Control system, road sweeping and watering.
3. Continue to look for ways to minimise the transfer of dusts, particularly those containing lead and other heavy metals and metalloids, from the active mining and processing areas to the city.
4. Emphasise the importance of a clean home environment in Mount Isa.
5. Consider replacing carpets with timber or other hard floor coverings, and cleaning these floor coverings with phosphate-based cleaning agents.
6. Promote personal hygiene, such as cleaning children's hands frequently and before meals and minimising specific habits of very young children such as sucking non-food items and keep away from uses of lead including historical paint and petrol residues.
7. Wash all home grown fruit and vegetables thoroughly before eating/cooking; peeling root crops will also reduce lead exposure.
8. Highlight the improvement in children's blood lead levels that has occurred in Mount Isa as a result of actions taken by MIM and members of the Mount Isa community. These results show that measures being taken are helping to minimise children's blood lead levels and demonstrate that a diligent approach to reducing lead exposures does work.

Bioavailability

The Air Report follows the Australian risk assessment practice in the use of bioavailability in soil and dust. The risk assessment framework requires a toxicity assessment to estimate the bioavailability[1] of lead as part of the hazard and exposure assessment step[2].

Bioavailability is considered the 'gold standard' for measuring uptake of lead by the body, but the cost of the tests and the ethical issues associated with animal testing mean that it often cannot be applied. Hence an in vitro gastro-intestinal simulation is used to measure bioaccessibility routinely which gives a prediction of bioavailability.

WHAT IS BIOAVAILABILITY?

The amount of a substance that is actually absorbed into the body.

The bioavailability of lead is the fraction of the lead ingested and/or inhaled that reaches the circulatory system in the body and can thus be measured in the blood. Bioavailability is the fraction of dose that reaches the systemic circulation of a receptor (e.g. humans) and is determined using living organisms. Because of the ethical issues associated with using people, most of the tests to determine bioavailability of samples of lead-containing materials (such as dirt and dusts) are carried out using animal test subjects.

The concept of bioaccessibility was developed as a proxy for bioavailability to reduce the need to use living animals in the assays. Bioaccessibility is the soluble fraction under laboratory-simulated conditions, i.e. an indicator of bioavailability to the receptor (e.g. humans). The bioaccessibility of ingested lead is determined using a simulated digestive system, mimicking the chemical environment in the stomach and intestines and is easier to measure than bioavailability. Bioaccessibility gives a prediction of bioavailability.

HOW IS IT MEASURED?

Bioavailability can be measured in blood and urine and must be determined using controlled laboratory-based animal studies.

WHY IS IT IMPORTANT?

To help accurately assess the health risks of lead exposure. Not all lead is equal – it exists in many forms. How much lead a person's body can actually absorb depends on the type of lead ingested or inhaled.

AIR REPORT FINDING

The types of lead minerals found in Mount Isa generally had low absorption rates. The Air Report found that less than 10% of lead minerals were bioavailable, while less than 20% were bioaccessible.

The extent of lead minerals being absorbed by the human body is according to the definitions given for bioavailability and bioaccessibility.

References

1. enHealth (2012): Environmental Health Risk Assessment, Guidelines for assessing human health for environmental hazards. Department of Health and Ageing and enHealth Council, Canberra, Australia.
2. NEPC (2013): National Environmental Protection (Assessment of Site Contamination) Measures, National Environment Protection Council, Adelaide, Australia.

Lead Pathways Study
Air Report – Community Overview

For further information,
including supporting publications
and a copy of the full *Lead Pathways Study* – Air Report, visit:

www.mountisamines.com.au

Sustainable Minerals Institute
www.smi.uq.edu.au

Lead Alliance
www.leadalliance.com.au

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Community overview of the report *Health Risk Assessment of Contaminants to Mount Isa City* by:

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SMI CMLR Centre for Mined Land Rehabilitation

The University Of Queensland AUSTRALIA

The University of Adelaide

Mount Isa Mines
A Glencore company

Background: *Lead Pathways Study*

- One of the most comprehensive studies of its kind
- Many years of independent research and analysis
- Looks at pathways and impacts of lead in land, water and air
- Landmark study for Mount Isa region

LEAD PATHWAYS STUDY SERIES

Land Report	✓	Released July 2009
Water Report	✓	Released September 2012
Air Report	✓	Released February 2017

All three reports concluded there was a relatively low health risk from lead in soil, water and air for most of the Mount Isa community.

Key findings snapshot

The Air Report found that the potential exposure risk of children from inhalation was limited (<5%) and mostly from ingestion via hand to mouth activity.

1 Potential pathways

REPORT GOAL

Looks at natural and mining-related pathways of lead into the Mount Isa community and how these contribute to lead exposure.

FOCUS AREA

How do lead particles in air from Mount Isa Mines' operations contribute to lead exposure levels in the community – especially in children under five years of age?

KEY FINDINGS

- There are both natural and industrial sources of mineralisation intermixed throughout Mount Isa
- Urquhart Shale was the most significant source of lead found in air. It is a naturally occurring geological formation found in the western parts of Mount Isa and also the same material that is mined at Mount Isa Mines, before being processed at the smelters
- Air particulates smaller than 10 micrometres in diameter (PM_{10}) emitted from the top of the Mount Isa smelter stacks were not the major source of lead exposure via inhalation in the community
- The major source of lead exposure in the community was via ingestion of particulates less than 250 micrometres in diameter (PM_{250}). These are present on the ground as dust or soil

2 Health risk

REPORT GOAL

Assesses potential health risks, particularly to children.

FOCUS AREA

How much do inhaled or ingested lead particles from air account for lead exposure in the community, particularly in children?

KEY FINDINGS

- Inhaling, or breathing in, airborne particulates (PM_{10}) presented only a small contribution to children's lead exposure
- Ingesting, or swallowing, lead in dust (PM_{250}) was a key contributor to lead exposure in Mount Isa children, requiring attention and action
- The types of lead minerals found in Mount Isa had a lower absorption rate. The Air Report found that less than 20% of lead minerals were capable of being absorbed by the human body

3 Risk reduction

REPORT GOAL

Determines most effective measures to reduce the community's exposure to mining-related contaminants.

FOCUS AREA

How can the potential risks of lead pathways be managed to protect the health and wellbeing of the local community and young children?

KEY FINDINGS

- There are a number of important measures that both Mount Isa Mines and local residents can take to further reduce the community's exposure to lead from mining-related contaminants via the ingestion pathway
- For the community, these include maintaining a clean home environment, good personal hygiene and a nutritious diet
- The Air Report also recommended that all Mount Isa residents, particularly those with young children, access the free blood lead level testing service regularly

2 Findings: COMMUNITY HEALTH

How are you exposed to lead?

Queensland Health found that factors like bare soil in yard areas, owning pets and chewing non-food items increased the intake of lead.

The Air Report found that lead in carpet dust made a significant contribution to the ingestion of lead and presented a higher risk to young children than garden soil.

<5%

INHALATION VIA AIR

Breathing in airborne dust (PM_{10}) contributed less than 5% to total lead exposure for people living in Mount Isa.

37–93%

INGESTION VIA DUST OR SOIL

Swallowing lead in soil or surface dust (PM_{250}) made up between 37% and 93% (median 74%) of total lead exposure contributions.

<24%

INGESTION VIA FOOD

Ingestion via dietary intake of lead made up most of the remaining contribution to total lead exposure contributions, based on national data (Food Safety Authority of Australia and New Zealand).

What happens once you're exposed to lead?

Once ingested, the amount of lead a person can absorb varies depending on a number of factors. Understanding how much lead mineral can be absorbed is important to help accurately assess the health risks of lead exposure.

<10–20%

MINERAL TYPE

This is the most significant factor in how much lead the human body can absorb. Some lead minerals are more easily absorbed than others. Mount Isa city had mineralisation with lower bioaccessibility (mean 2%) than garden soil (mean 24%). *Learn more about bioavailability over the page.*

PARTICLE SIZE

Tiny lead particles (PM_{10}) penetrate deep into the lungs via inhalation and enter the bloodstream. However, exposure via ingestion presents the greatest health risk.

FOOD IN THE STOMACH

The amount of of lead absorbed can reduce dramatically if you have eaten. Good nutrition is also important.

AGE

Children aged less than five years are most vulnerable as they can absorb a lot more ingested lead than adults. Infants and toddlers are most exposed to lead in the environment through ingestion, via hand-to-mouth behaviour. Their central nervous systems and organs are also still developing when young and more sensitive to lead exposure.

Exposure pathway risk

The Air Report has taken all factors into account and determined that most lead exposure to the Mount Isa community is from ingestion (hand to mouth activity).

3 Findings: REDUCING EXPOSURE TO LEAD

Based on comprehensive research and analysis, the Air Report has identified the most effective ways for both Mount Isa Mines and local residents to further reduce the community's risk of exposure to mining-related contaminants.

Mount Isa Mines

- Continue to focus on effective measures to reduce mine dust transfers from key lead sources at the mine site (i.e. haul road dust, mining activities, surface tailings, crushed ore transfer, concentrate handling and surface dust in the lead smelter)
  - Ensure clean-in, clean-out (workplace hygiene) policies continue to be enforced in all work areas

The Community

PERSONAL HYGIENE

- Ensure children wash hands frequently, especially before meals and after touching family pets
- Where possible, discourage young children from sucking on non-food items that are not regularly cleaned
- Discourage children from playing in bare soil and keep away from historical paint and petrol residues

HOME

- Cover bare yard patches with grass
- Replace carpets with hard floor coverings
- Clean floors with phosphate-based cleaning agents (phosphate is known to immobilise lead and reduce its bioavailability upon ingestion)
- Clean houses frequently – vacuum and wet wipe or mop any accumulated dust
- Review pet ownership in areas with elevated lead concentrations

NUTRITION

- Wash home-grown fruit and vegetables thoroughly before eating or cooking
- Peel home-grown root crops or avoid eating home-grown fruit and vegetables that can't be peeled before eating
- Maintain a healthy diet

Particle sizes

Airborne particles are sometimes referred to as 'particulate matter' or PM. They include dust, dirt, smoke and liquid droplets and are measured in 'micrometres'. For comparison, a human hair is about 100 micrometres in diameter.

- Particles up to 250 micrometres in diameter (PM_{250}) are most likely to enter the body via the ingestion pathway as they are more likely to adhere to hands and be transferred into the mouth
- Smaller particles, those less than 10 micrometres in diameter (PM_{10}) and especially fine particles, less than 2.5 micrometres in diameter ($PM_{2.5}$), are of a size most likely to enter the body via the inhalation pathway