Investigation into Concerns Regarding Seepage Water in a Rosebery locality 2008/2009

Executive Summary of Final Report – April 2 2009

Public and Environmental Health Service and Environment Protection Authority

Tasmania

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Executive Summary

In October 2008, three residents (Residents 1,2 and 3) from two adjoining properties in Rosebery (Properties A and B) contacted the Department of Health and Human Services (DHHS) and the Environment Protection Authority (EPA) to express concerns that they were being poisoned by environmental pollutants. Their concerns were based on elevated metal results in seepage water samples from their properties. Subsequently two other residents (Residents 4 and 5 at Property C) of Rosebery expressed similar concerns, and questions were raised whether a former resident (Resident 6) may have health issues that were linked to their previous period of residence at Rosebery. There was considerable media and political interest in the issue.

A Project Team, chaired by the Deputy Director of Public Health and comprised of officers from DHHS and EPA, was established to further investigate any connection between exposure and the residents' health concerns in detail and provide a report to the Director of Public Health and the Director of the EPA. Professor Brian Priestly, Director of the Australian Centre for Human Health Risk Assessment was engaged by the Project Team to provide advice as a consultant toxicologist. A Tasmanian consultant physician was also engaged to provide independent medical assessments of some of the residents. Other residents preferred to arrange their own medical assessments.

EPA officers carried out field sampling of soil and water at Rosebery and undertook background research on the Rosebery environment. DHHS coordinated the project and undertook to be the main contact point with the residents, as well as contributing toxicological input, and collecting drinking water samples.

The main issues were various health complaints by the residents themselves and also in their pets including dogs, cats and horses. The residents had noted discoloured ground seepage water, with gas bubbles seen and reported that a "rotten" odour was detected intermittently. They initially attributed these effects to the nearby Oz minerals mine and wished to be relocated immediately on health grounds.

The properties most affected by the seepage were found to be in a relatively low lying area.

An initial assessment by DHHS concluded that there was no immediate major environmental health risk that would require relocation while further investigations took place, as all potential exposure pathways for potential contaminants in soil and water were manageable.

The initial investigations had identified elevated levels of some metals in soil and seepage water and, as a consequence the investigation focussed on metals in soils and metals in water but also included gases (hydrogen sulphide and arsine). After elevated levels of some metals in soils, indoor dust sampling was also recommended.

Throughout the investigation, there were significant problems relating to trust and cooperation between the residents and various DHHS and EPA staff. Some residents did not permit access for certain sampling including indoor dust and there were difficulties with arranging medical examinations and accessing health information.

Soil, Water and Gas Analysis Results

Environmental testing of surface (less than 150 mm depth) and subsurface (150 – 300 mm depth) soil from the residents' properties and some nearby public areas was conducted by the EPA. Overall, most of the samples showed metal concentrations well within the Health Investigation Levels (*National Environment Protection (Assessment of Site Contamination) Measure, 1999)*, however at least one health level (predominately for lead (Pb), arsenic (As) or manganese (Mn)) was exceeded in 13 of 20 surface samples.[1] Nevertheless, statistical analysis of these results indicated that only Pb exceeded health investigation levels in both arithmetic and geometric means, indicating that Pb is the most significant of these three metals in terms of its magnitude and frequency of occurrence. Both arithmetic and geometric means for As and Mn were below the health investigation levels.

Water analyses showed that concentrations of at least one of the metals Pb, As or Mn exceeded the recreational water guideline for 3 of 9 samples collected over the course of the investigation. It is noted that the application of these guidelines are highly conservative as they are based on an assumption that long-term daily ingestion of up to 200 mls of water occurs. In reality, the residents' exposure to seep water is more likely to be through dermal contact (for example during gardening). However, it is considered that the dermal exposure route would also not allow sufficient exposure to the metals in water for them to be a considered significant health risk.

Drinking water samples taken from the council reticulated water supply were within the health limits for metals in the Australasian Drinking Water Guidelines (National Health and Medical Research Council: Australasian Drinking Water Guidelines 2004)

Some dust sampling by the residents indicated elevated levels of manganese in one house and of lead in two others.

Screening tests indicated that the bubbles of gas in the seepage water were unlikely to be oxygen, sulphur dioxide, nitrogen dioxide, hydrogen sulphide, or carbon monoxide.

Hydrogen sulphide and arsine measurements by EPA were at levels below available health-based guideline levels and therefore do not appear to be significant sources of exposure.

The above results were communicated to Professor Priestly and to the Project Team.

Assessment of Health Risks to residents by Professor Priestly

Professor Priestly was engaged to assist the Project Team to assess the possible health impacts on residents of their properties and to advise on the strength of evidence linking their health status with any identified environmental source of metals.

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[1] Health Investigation Levels (HILs) are based on conservative assumptions about soil and dust exposure and the overall amount of a contaminant that might be absorbed by a young child from all sources, while staying well within established toxicological guidance values such as Acceptable Daily Intakes or Provisional Tolerable Weekly Intakes. The exceedance of a soil HIL does not imply that any adverse health effects can be expected; rather the HILs are intended to trigger a more thorough assessment of pathways of exposure and further health risk assessment.

He provided a preliminary report on 17 December subsequent to a site visit to Rosebery on 11 December 2008. A final report, which incorporated the results of further environmental and biological tests, was provided on 27 February 2009.

His report states that none of the results obtained from the soil, dust, water or air indicates a significant risk of toxic exposures from these sources. He further states that this conclusion is reinforced by the available data from blood, urine and hair samples from residents of the three properties in question, and to a more limited extent from blood/urine results from two residents in a neighbouring property.

It is important to note that the blood, urine and hair results were mostly obtained by the residents and forwarded via DHHS to Professor Priestly, who did not have any contact with or reports from the doctors who ordered the tests.

His overall conclusion is that the biological results do not confirm that any significant toxicological exposure has occurred for metals such as arsenic, lead or manganese. Some cadmium levels were above the reference ranges. Inconsistencies between sequential samples in particular individuals and a lack of concordance between blood and urine samples from the same individuals cast doubt on whether significant recent cadmium exposures had occurred or on its possible environmental source. Three residents had elevated urinary arsenic. Further analyses showed reduced levels and also that the arsenic in the urine of all three residents was of a significantly less toxic organic form commonly found in food, particularly seafood and shellfish.

The first of Professor Priestly's recommendations was that any further environmental sampling around the properties in question is not warranted.

His second recommendation was that the health concerns of residents be pursued by appropriate consultation with medical practitioners and that DHHS should do whatever it can do to facilitate this follow up. He states that this follow up should be based on the premise that the strongly held beliefs of the residents that their health problems are related to heavy metal exposure is not supported by the empirical evidence gathered in this investigation.

Professor Priestly provides the caveat that he has been careful not to draw any conclusions about any possible link between the measured levels of metals in the blood or urine of the residents and their health status. This is appropriate because, although a nationally recognised expert toxicologist, he does not have medical qualifications. This is also in recognition of the fact that he did not have available to him the results of any clinical medical examination of the residents. The issue of medical examinations will be discussed later.

The Project Team supports Professor Priestly's conclusions and recommendations.

However, the Project Team has always taken a very cautious approach and has regularly advised the residents of a number of simple hygiene measures they could take to further reduce any ingested soil or dust containing lead, arsenic or other contaminants now or in the future. Similarly, residents have been advised on numerous occasions to ensure they seek medical advice for general health concerns. This advice is still appropriate.

Medical Examinations

The residents made known to the media and to various members of the Project Team a variety of health complaints which they attributed to environmental pollution.

Based on the information available, all but one resident has had at least one medical assessment. An offer of arranging for the residents to be examined at DHHS expense by an independent consultant medical specialist was made. Two residents (Residents 1 and 2) accepted this offer and were examined by a specialist arranged by the DHHS. However, no reports have been received from the specialist by DHHS or the residents at this time. Because of this another offer was made to have residents 1 and 2 reassessed by a multidisciplinary team in Hobart. This offer was declined.

Residents 4 and 5 sought medical assessments privately in preference to seeing the specialist arranged by DHHS. The Project Team has been made aware that the results from the assessment of Resident 5 did not show any evidence of harmful exposure (however, a copy of the report was not provided to the Project Team nor to Professor Priestly) Resident 4 has chosen not to share any reports from their medical assessments. However the resident did agree to their biological monitoring results being shared with an expert clinical toxicologist whose report reassured that there was no evidence of any recent harmful exposure to cadmium.

The Project Team is unaware of any medical assessment being carried out on Resident 3.

The lack of reports for the project team members from the residents' medical assessments is unfortunate. However, in regard to the metals found in the soil and water samples, the opinion of the medical specialists in the Project Team is that biological monitoring such as blood and urine tests are more sensitive and specific indicators of exposure to these metals than signs and symptoms elicited in a medical examination.

The results of most of the blood and urine tests ordered by the independent consultant medical specialist have however, been made available to the Project Team and to Professor Priestly to supplement the tests which have been provided by the residents themselves.

Professor Priestly's conclusion that "…*the biological results do not confirm that any toxicologically significant exposure has occurred for metals such as arsenic, lead or manganese*." (Professor Priestly's Final Report, page 4) is therefore reassuring.

Potential sources of metals in soils

There are several plausible explanations for the elevated metals (Pb, As and Mn) in surface soils, including:

- the levels of metals are associated with imported sulphide-bearing materials (for instance waste rock from mining activities) brought into the properties at some stage before or after construction of the residences; or
- the levels of metals are related to atmospheric fallout of dust from historical and/or current mine practices (potentially including transport of mined materials, historical storage practices of ore, or dust generated by vehicle movement); or
- the levels of metals (especially lead) are related to deposition from transport activities such as the combustion of leaded petrol; or
- the elevated levels are natural, being associated with sulphide mineralisation in the Rosebery area; or
- some combination of the above.

Seeps - Possible origin, and source(s) of metals and gas

Very shallow subsurface water (groundwater) discharges to the surface at two of the residential properties investigated. This was also observed to occur on public land in nearby streets and at a number of other locations throughout the region.

The very shallow groundwater and the associated seeps impact the amenity of the residential properties as the yards are effectively saturated at times or in some areas have water flowing over the surface. As a consequence some areas of the yards are often wet and muddy.

Based on field inspection, a review of literature and anecdotal evidence, the seeps are likely to be as a result of:

- Perched localised groundwater discharging from saturated (and likely sulphide-bearing) fill material; or
- Local "natural" near-surface groundwater table discharging at topographic low points; or
- A combination of the above.

Sulphide-bearing rocks or sediments can generate sulphuric acid when exposed to oxidising conditions. The resulting 'acid drainage' (AD) can mobilise metals from the rocks and sediments, resulting in elevated metals within any waters in contact with these materials. Waters affected by AD often display an orange or red staining when exposed to the atmosphere, due to the precipitation of iron. The process that generates AD can occur in nature when naturally acidic rain water contacts sulphide-bearing rocks.

When specifically associated with current or historic mining sites such drainage is described as acid *mine* drainage (AMD). Typical AMD can be characterised by having a very low pH and very elevated sulphate and metals levels.

The waters on the residential properties contained sulphate as a dominant anion, and this may be indicative that the water under or in the vicinity of the residents properties are influenced to some extent by AD processes, however they are not characteristic of typical AMD.

Literature on West Coast water quality suggests that the water observed at the residential properties represents background water quality. This is supported by the observation that the pH of seep water on the residents' properties was only slightly acidic.

As alluded to above, one plausible cause of the AD influence is localised groundwater-interaction with sub-surface materials such as fill or naturally mineralised material that was observed in the investigation area and that is known to occur in the region.

There are other plausible influences on water chemistry on and around the residential properties, that may (based on water chemistry in the investigation area) may have some limited influence on seep water in the investigation area. These include:

- Groundwater recharge from various creeks in the Rosebery catchment, including Assay Creek, Rosebery Creek and Primrose Creek that are known to be contaminated by acid mine drainage;
- The open cut mine or the 4-level portal workings where groundwater pollution of 'typical' acid drainage may occur and have some limited influence on shallow groundwater chemistry in the investigation area (However, it should be noted that

currently the mine diverts and treats mine water from areas containing point sources of AMD, such as the 4-level portal);
- other unidentified sources of AMD (e.g. unknown mine adits or mine waste disposal sites) that has some limited influence on shallow groundwater chemistry in the investigation area.

Quantifying the relative amount of contribution (if any) of these influences was beyond the scope of this investigation.

The gas bubbles at the seep on Property A were colourless and odourless and therefore not likely to be hydrogen sulphide at levels that would represent a health concern. In addition, testing indicated that arsine was not present in significant concentrations at the properties, indicating it too was not forming the bubbles. One theory put forward by the environmental health consultant contracted by Oz Minerals prior to the formation of the Project Team was that the gas was possibly methane formed by anaerobic breakdown of organic matter. No toxic effects are likely from methane at the low concentrations that might be anticipated in the immediate vicinity of the bubbles. It is also plausible that the algae growing in the area of the seep produces gases (e.g. hydrogen, oxygen).

Other sources of contamination such as contamination from sewage or from mine processing activities were considered but there was no evidence to support either as contributing to the seeps. The elevated metals were unlikely to be "typical" AMD (characterised by very low pH and very elevated sulphate and metals levels) and caffeine was tested for as a marker of sewage. See the following section for further discussion.

Implications for the rest of the Rosebery Community

The existence of lead in soil and dust in the Rosebery area has been known about and actively mitigated in this community for a number of years. Concerns about possible risks of exposure to lead particularly among children and pregnant women led to a series of surveys of blood lead carried out between 1992 and 1999 in children 0-5 years. The average blood lead levels were in line with, or slightly above, national trends. They fell from 10.6ug/dl to 6.8ug/dl during that time, and have not warranted public health concern. In common with other such surveys nationally, higher levels in specific individuals were found for the most part to be associated with behavioural activities and household conditions rather than being directly attributable to fallout or exposure from mining activities. The owners of the mine Oz Minerals have produced community education resources advising residents how to minimise their exposure risk. The project team members have reviewed these brochures and are satisfied with their content and lay out.

It must be noted that, as per conditions within the EPN issued for the mine, Oz Minerals undertakes various actions to minimise dust generation from its activities, including the rehabilitation of cleared areas, the use of a watercart on roadways, and the enforcement of speed limits on the mine site to reduce the generation of dust by vehicles. The mine also undertakes and reports on an atmospheric emissions monitoring program. In addition to ongoing monitoring, a dust deposition survey was begun in April 2008 to inform and enhance this monitoring program.

More recent blood testing offered to residents by the mine has continued to demonstrate satisfactory results, although there has been one incident where two young children had

elevated levels detected following a heavy rainfall event and a washout of concentrate material from the mine site leading to inundation and significantly higher lead levels in soil on one property. This was managed through site remediation, and relocating those affected temporarily.

The situation with arsenic and manganese levels in soil in the area has received less attention and there have been no surveys of environmental levels of these metals or local surveys of inorganic arsenic or manganese in biological samples. However the existing evidence does not suggest a significant hazard and the current education and advice strategies to reduce lead exposures will also protect against any exposure to these metals.

Educational materials have been produced by Public and Environmental Health Service (PEHS) during the project team's investigations, to provide health information on arsenic, lead, cadmium and zinc. These fact sheets have been attached as Appendix 1. These have been sent to the residents concerned as well as to various health professionals in Rosebery and Burnie. A more detailed distribution campaign could be developed if requested. The Oz Minerals mine staff hold quarterly open community meetings. The project team chair has offered to be present at the next community meeting to present the findings of the report to the local community and to discuss with them their views on the need for more information – on lead, arsenic and manganese – if requested.

Overall Conclusions

- *There are elevated levels of some metals in soils in the area of the investigation, and likely in the wider Rosebery area;*
- *The investigation did not identify any link between elevated levels of metals (lead, arsenic and manganese) in soil samples and the biological monitoring results obtained from residents;*
- *The results of this investigation do not indicate any significant health risk to the residents in question or the Rosebery community in general; and*
- *In relation to the investigation of residents' health concerns, no further environmental testing of soil or water is necessary around the properties of these residents.*

Recommendations

It is recommended that:

- *The DHHS continue to encourage these residents to have appropriate medical consultations in regard to their health complaints;*
- *The Public and Environmental Health Service provides information to relevant health professionals on when and how to investigate health concerns that relate to environmental exposures;*
- *The EPA continues working with the Oz Minerals Rosebery mine to ensure that ongoing dust management is in accordance with best practice and that worked out areas of the mine are rehabilitated. The current dust fallout monitoring program should continue; and*
- *Approaches are made to relevant stakeholders to determine whether the drainage can be improved in the properties concerned to minimise tracking of mud indoors and to improve the general amenity of the site.*