Environment Protection Authority

An investigation into metals in sediments from domestic rainwater tanks around the Newmont gold mine in Cadia

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This report has been peer-reviewed by the NSW Environment Protection Authority's independent expert panel.

In June to August 2023, the NSW Environment Protection Authority took sediment samples from domestic rainwater tanks in the area surrounding the Newmont (formerly Newcrest) gold mine in Cadia. This report summarises the sampling results.

Background

The community surrounding the Newmont Corporation gold mine site in Cadia (Cadia Valley Operations) has expressed concern that contaminated dust may be leaving the mine site and contaminating the surrounding land and domestic water tanks.

Many residents in the area surrounding Cadia mine rely on rainwater tanks for their domestic water supply. In response to community concerns, the EPA offered water tank testing for residential properties that are rainwater dependent, as part of a broader monitoring program.

This report summarises the testing of sediment from rainwater tanks in the Cadia Valley area. This study aimed to:

- characterise the metal concentrations in sediment in rainwater tanks in the Cadia Valley area
- provide advice to property owners and tenants on the metal concentrations in their tank sediment
- compare the metal concentrations in tank sediment in the Cadia Valley area to those measured in previous Australian studies
- assess the relationships between concentrations of metals in tank sediment and the distance and direction from the mine.

Approach taken

Sediment samples were collected from 52 domestic rainwater tanks (used for drinking water) in the Cadia Valley area between June and August 2023. Sediment samples were collected from either the first-flush sediment trap or base of the tank using a sampling pole with a dedicated laboratory prepared sample container attached with the top cut off to form a scoop. Sediment was then decanted into a laboratory prepared sample container. Care was taken to minimise agitation of sediments as much as possible when sampling. In some instances, tanks could not be accessed or there was not enough sediment to analyse.

Residential properties were sampled where community members provided an expression of interest to the EPA. Sample locations cannot be provided due to privacy; however, they cover the area surrounding Cadia Valley Operations (approximately 2 to 40 km from the mine, Figure 1).

The samples were analysed for metals of concern, including lead, cadmium, nickel, selenium, copper, arsenic and zinc.

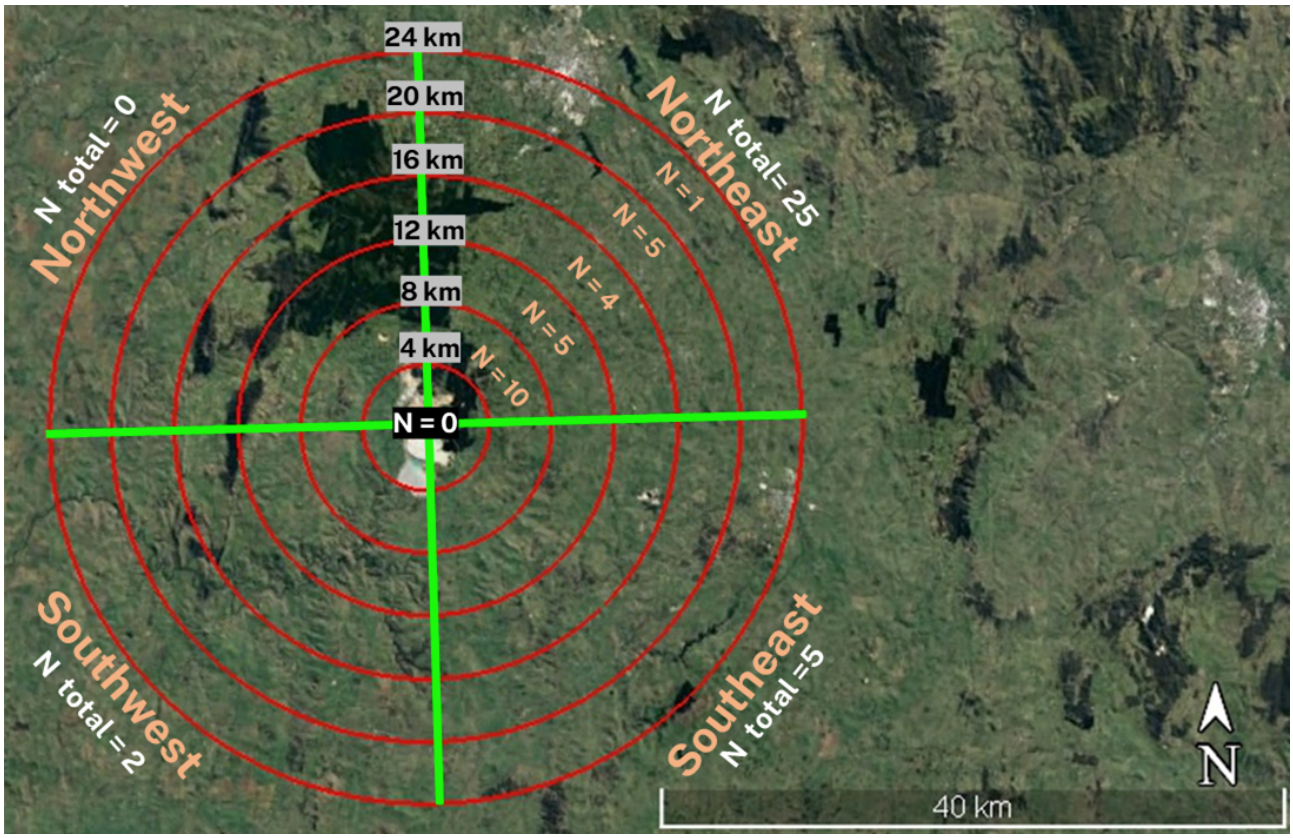
Metals of concern for the sampling program were selected with respect to:

- the metals identified by community testing as being present through their sampling programs
- the nature of Cadia Valley Operations
- potential local sources of metals (e.g. lead flashing on roofs).

Several measures were taken to assure and control the quality of sampling and analysis protocols. Care was taken to ensure sampling poles were cleaned appropriately between samples to prevent cross contamination. One sample duplicate was collected. NATA accredited analytical procedures were used for preparation and analysis of metals in the samples. Laboratory blanks, duplicates,

matrix spikes and certified reference material (CRM) were analysed (1 in 20 samples) and met the general laboratory acceptance criteria.[1]

Figure 1 Number of properties sampled (N) in proximity to the mine



Test results

The EPA collected 52 sediment samples, of which 41 had sufficient mass for metals analysis. The concentration range for each metal of concern in tank sediments is outlined in Table 1.

There are no relevant guideline values comparable to the sediment samples. The Australian drinking water guidelines provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. They are intended to provide a framework for the good management of drinking water supplies that, if implemented, will assure safety at the point of use (NHMRC 2011). The Australian and New Zealand sediment quality guidelines are for the protection of aquatic ecosystems and livestock (ANZG 2018) and therefore they are not suitable to use for sediments collected from rainwater tanks or for protection of human health. In the absence of suitable guideline values we have compared the concentrations of metals in tank sediments collected around Cadia Valley Operations to those measured in other parts of Australia.

[1] <practical quantitation limit for blanks, relative per cent difference < 20% when results >10 x practical quantitation limit for laboratory duplicates, 70–130% recovery for matrix spikes and 80–120% recovery for CRM.

Table 1 **Metal concentrations in tank sediments collected by the EPA, Cadia Valley Operations and Australian studies reported in the literature**

	Concentration range (mg/kg)			
Metal	**NSW EPA (Jun–Aug 2023) n=41**	**Cadia Valley Operations (Mar 2023) n=96**	**Literature**	**Reference**
Arsenic	0.8–20	<5–63	4.8–30.6	Spinks et al. 2005
Cadmium	<0.1–11	<1–39	<1.0–50	Magyar et al. 2011; Spinks et al. 2005
Copper	24–830	6–1,550	Not reported[1] – 1,500	Magyar et al. 2011
Lead	5.9–1,600	<5–4,150	184–6,580	Huston et al. 2009; Magyar et al. 2011; Spinks et al. 2005
Nickel	3–210	<2–211	13–100	Magyar et al. 2011; Spinks et al. 2005
Selenium	<0.2–2	Not measured	Not measured	
Zinc	28–25,000	33–49,000	Not reported[1] – 40,000	Magyar et al. 2011

[1] The lowest concentration of copper and zinc was not reported in *Magyar at al. 2011*.

Comparison with Cadia Valley Operations testing

We have compared EPA testing of sediment to that undertaken by Cadia Valley Operations. Cadia Valley Operations collected 96 sediment samples from residential water tanks in March 2023.

We have not compared results from individual residents but instead the overall range of metal concentrations (Table 1).

The maximum concentrations of arsenic, cadmium, copper, lead and zinc was higher in sediment samples collected by Cadia Valley Operations in March 2023 (Sage 2023) than in sediment samples from the EPA's sampling campaign.

Comparison with typical Australian rainwater tank sediment metal concentrations

Few studies have measured metals in sediment from Australian rainwater tanks (Magyar et al. 2007, Victoria Health 2009, Kus et al. 2010, enHealth 2011). The majority of studies focus on measuring metals in drinking water (point of use) as this is the primary manner in which people may be exposed. Additionally, no standard sampling method has been established for sediment sampling (Magyar et al. 2011).

The results from this investigation are similar to those for sediments from rainwater tanks in studies based in Newcastle, NSW (Spinks 2005) and Melbourne, Victoria (Magyar 2011) (Table 1). The highest concentration of lead found in tank sediments in this investigation was below other reported upper concentrations found in Australian rainwater tanks. This was also true for all other metals of concern with the exception of nickel, where the highest concentration of nickel measured in sediment from a tank around Cadia was twice that measured in previous Australian studies.

Sediment accumulation at the bottom of rainwater tanks threatens the safety of the water column to varying degrees, given its propensity to accumulate high concentrations of contaminants such as lead (Magyar et al. 2006, Kus et al. 2011, Huston et al. 2012). Re-suspension of tank sediment

is common in usual urban conditions (Magyar et al. 2011) and depends on a range of factors such as water level, rainfall intensity, trajectory of inflowing water, tank size/shape, particle size and the type of sediment (Spinks et al. 2005). Additionally, a tank outlet placed too low may allow the tank sediment to enter the point of use source (Huston et al. 2012). Leaching of contaminants from sediment into the water column is also increased as acidity of the water increases. Magyar et al. (2008) found a lowered pH in tanks allowed leaching of lead up to 110 times above the ADWG. Low pH levels are common in rainwater tanks and may be exacerbated by the accumulation of excess vegetation. The range for pH in water samples collected from the kitchen tap around Cadia was 4.7–9.1.

Concentrations of trace metals in tank sediment have been analysed compared to water column concentrations in a few studies (Spinks et al. 2005, Magyar et al. 2011), with Spinks et al. (2005) finding lead levels in sediment up to 343,000 times the concentration of that found in the water column. In the EPA's investigation, we measured lead levels in sediment up to 800,000 times the concentration measured in water collected from the tank tap. Despite the elevated lead in sediment from this tank, the concentration of lead in water in the tank was below the Australian drinking water guideline (NHMRC 2011).

Relationship between concentrations of metals in sediments and distance from the mine

The EPA sampled sediments from water tanks surrounding Cadia Valley Operations. The sample analysis and data assessment were undertaken by scientists from the NSW Department of Planning and Environment. Statistical data analysis was conducted to answer two specific questions:

- Is there a statistically significant relationship between the concentrations of metals in water tank sediments and the distance of sampling locations from Cadia Valley Operations?
- Is there a statistically significant relationship between the concentrations of metals in water tank sediments and the geographic location of sampling locations relative to Cadia Valley Operations? The prevailing wind direction is towards the northeast (Todoroski Air Sciences 2023).

The sampling locations were categorised according to their distance and direction from the mine. The number of properties sampled in each location and distance category is shown in Figure 1. The map does not include exact sampling locations to protect the privacy of residents who took part in the sampling program.

Principal component analysis and regression analysis were used to determine whether there is a relationship between the distance of the sampling points or the location of sampling points and concentrations of metals measured in sediments. Neither the principal component analysis nor the regression analysis showed any meaningful relationships between distance or direction from the mine and concentrations of metals measured in water tank sediments.

What do the results mean?

Key observations from the results of the EPA's testing of sediments in tanks in the Cadia Valley area are:

1. Concentrations of metals in sediments is not widely researched, but the concentrations of key metals found in this investigation are within typical concentrations found in Australian rainwater tanks.
2. No statistically significant relationship was found between concentrations of metals in sediment samples and distance or direction from the mine.

3. Resuspended sediment has the potential to contaminate the water column and tanks should be examined for accumulation of sludge at least every 2–3 years. If sludge is present in the tank it should be removed by siphon or by complete emptying of the tank (desludging).
4. These results indicate the importance of maintaining catchments, tanks and tank water distribution systems in accordance with guidance provided by NSW Health, including first-flush diverters, regular tank cleaning and flushing.[2] Property owners may also consider installing filtration to reduce potential contamination of their drinking water.

[2] Rainwater tanks – Water quality – https://www.health.nsw.gov.au/environment/water/Pages/rainwater.aspx

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