# Appendix N - Inconsistencies in toxicological foundations of NZ guideline values

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## Introduction

Lead is a naturally occurring and widespread element with no known safe threshold for human exposure (Vorvolakos, 2016). Although human activity has increased lead exposure since the Bronze Age, regulatory efforts in New Zealand over the past two decades have significantly reduced blood lead levels (Scott, 2024; Mannetje, 2020). Despite this progress, between 2021 and 2023, there were still 10–14 annual cases of non-occupational lead exposure notifications (Environmental Health Intelligence, 2024). Even low levels of lead exposure, particularly in unborn and young children, have been linked to adverse cognitive and neurobehavioral outcomes (ATSDR, 2020; National Toxicological Program, 2012). Therefore, effective management of lead exposure is necessary to reduce non-occupational lead exposure levels further.

In New Zealand, several government agencies are responsible for setting standards and guidelines related to lead exposure. However, these agencies use different toxicological reference values (TRVs) and endpoints, leading to inconsistencies in how "safe" levels are defined and managed.

## Agency Roles and Standards

### Ministry of Health

Under the Health Act (1956), the Ministry of Health established a blood lead notification level of 0.24 µmol/L (5 µg/dL) in April 2021. Exceeding this threshold triggers a formal notification and follow-up process (Health New Zealand, 2024), guided by *The Environmental Case Management of Lead-exposed Persons* (Te Whatu Ora, 2024). Blood lead levels (BLLs) are considered the gold standard for assessing lead exposure due to their direct correlation with toxicological effects. The Ministry also provides guidelines for indoor dust based on the same 5 µg/dL endpoint.

### Health New Zealand

Health New Zealand sets the New Zealand Drinking Water Standards, which are based on World Health Organization (WHO) guidelines. These standards rely on the now-withdrawn JECFA TRV of 25 µg Pb/day/kg body weight, which was originally intended to keep BLLs below 10 µg/dL (FAO/WHO, 2000; 2011).

### WorkSafe New Zealand

In November 2023, WorkSafe New Zealand introduced new occupational exposure standards for lead:

- **10 µg/dL** for males and females not of reproductive capacity.
- **3 µg/dL** as a biological reference value (BRV) for females of reproductive capacity or who are breastfeeding.

The BRV is based on the 95th percentile of BLLs in New Zealand women aged 18–69, as reported in the Mannetje study (Mannetje, 2020). This value is lower than the Ministry of Health's notification threshold. However, the National Environmental Standard for Commercial/Industrial Soil (NES CS) allows up to 3,300 mg/kg of lead in unpaved sites—intended to protect outdoor workers such as construction and agricultural laborers (Proctor, 1997; Ministry for the Environment, 2011; US EPA, 2017; Hubbard, 2022; Lupolt, 2022). Since this soil standard is not linked to BLLs, it is unclear whether it adequately protects female workers, especially given the lower BRV.

### Ministry for the Environment

The Ministry for the Environment published soil contaminant standards (SCS) for lead in 2011, based on a TRV of 1.9 µg/kg body weight/day (Ministry for the Environment, 2011). This value was associated with a 3-point IQ reduction, which the FAO/WHO deemed concerning, though not recommended as a regulatory limit (FAO/WHO, 2011). The SCS assumes drinking water contains 10 µg/L of lead, reducing the allowable intake to 1.6 µg/kg/day before accounting for dietary intake. The residential soil standard is 210 mg/kg—significantly lower than the 3,000 mg/kg threshold below which the Ministry of Health advises that soil removal may not be necessary (Health New Zealand, 2024). Because the TRV used by the NES-SCS is not implicated linked to a BLL (even though they are derived from a relationship between BLL and IQ (Lanphear, 2005)(FAO/WHO, 2011).

## The Problem

When assessing lead-contaminated sites or exposed individuals, particularly in residential or occupational settings, multiple exposure pathways and intervention strategies must be considered. Tier-1 guidelines are typically used to identify significant exposure pathways. However, inconsistencies in TRVs across agencies can bias decisions toward potentially costly and less effective interventions, such as unnecessary soil removal.

These inconsistencies also complicate the use of tier-2 risk assessment models like the Integrated Exposure Uptake Biokinetic (IEUBK) model, the All Ages Lead Model (AALM), or the Adult Lead Model (ALM). It is unclear which BLL target should be used, especially for women of childbearing age who may be occupationally exposed to lead or lead-based paint.

## The Solution

Lead exposure is a complex, multi-media issue involving dust, food, soil, water, and occupational sources. A unified, all-of-government approach using a consistent toxicological reference value, such as a blood lead level (BLL) of 3 or 5 µg/dL, would enhance the effectiveness of risk management and policy development. This harmonized approach would:

- Enable clearer communication among regulators, health professionals, and risk assessors.
- Improve the consistency and comparability of risk assessments.
- Facilitate timely updates to guidelines as new scientific evidence emerges.

Adopting a single toxicological value will help to ensure that interventions are both scientifically sound and practically effective.

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