

National Environment Protection Council

Assessment of Site Contamination
NEPM Variation

Asbestos



Asbestos – human health risk assessment

Asbestos fibre air levels were measured using a series of simulations and field experiments involving varying concentrations of asbestos fibre and asbestos cement material (ACM) in soil.

The results indicate that:

- ACM produces very low levels of airborne asbestos accept at massive soil concentrations
- that fibrous asbestos shows a significant and linear air asbestos increase with soil contamination.

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A Tiered Approach for the Assessment of the Human Health Risks of Asbestos in Soils

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A tiered approach for the assessment of human health risks of soil contamination with asbestos has been developed. When in a specific tier the human health risk can not be rejected, the assessment in the following tier has to be performed. Because the risks of asbestos are caused by inhalation of asbestos fibers, the emission of fibers from soil to air is the determining factor. In Tier 0 of the tiered approach a generic soil quality standard is used. This Intervention Value is 100 mg/kg_{soil, dry} asbestos equivalents (0.01% by weight), i.e. the sum of the concentration of chrysotile asbestos and ten times the concentration of amphibole asbestos, for bound (non friable) as well as for friable asbestos. Tiers 1 to 3 are site-specific. Tier 1 concerns a simple qualitative testing procedure, in which the potential or probability for emission of asbestos fibers from soil to air is assessed. In Tier 2 the respirable fraction in the soil and house dust, which relates to the potential site-specific exposure to humans, is determined and tested. Finally, when the risk can not be excluded, the concentration of asbestos fibers in outdoor and/or indoor air has to be measured and tested according to a standardized procedure, in Tier 3.

Keywords Asbestos, soil contamination, Intervention Value, risk assessment, chrysotile, amphibole



Asbestos: Human health risk assessment 2

Netherlands vs Australia

Netherlands

limit is 0.01% w/w in soil for either fibrous or ACM asbestos.

limit of 0.1% w/w in soil for non-friable ACM if this is only form present.

- Equates to asbestos air levels below 0.001 f/ml and possibly around 0.0001 f/ml.
- 0.0001 f/ml corresponds to a lifetime risk of 10^{-6} to 10^{-5} in the exposed population (WHO risk figures for mesothelioma)

NEPM (WA DOH)

limit of 0.001% for fibrous material in soil.

- A 10 fold extra "safety" factor is applied for drier Australian soils and no allowance for differences in asbestos type.

limit of 0.01% for non-friable ACM for Residential A.

- default exposure ratios for other exposure scenarios







Asbestos in the NEPM

- ACM in Australia typically contains 10–15 per cent asbestos by weight, bound in a cement matrix.
- ACM in sound condition, even if broken or fragmented, represents a low human health risk.
- If site history or site inspection indicates the possibility/occurrence respectively of asbestos contamination, an assessment should be undertaken.
- This should take the form of a **preliminary site assessment** followed by, only if necessary, a **detailed site assessment** (see Schedule B2 and WA 2009 guidelines)



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Asbestos in the NEPM

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Asbestos in the NEPM

B2: 9.1.1 Preliminary site investigation

- Asbestos cement material (ACM), in soil (including stockpiles and areas of fill) on a site may trigger an initial qualitative assessment on its lateral and vertical distribution in a site.
- Generally accepted guidance for considerations of site setting and characteristics should be applied.
- Emphasis on thorough site inspection statement - Debris, building footprints & uncontrolled fill important.
- Sampling not normally necessary. The default assumption is that the material is asbestos – can check with TEM.

9.1.1.1 ACM in good condition or ACM which crumbles in the hand or unbonded or fibrous material

9.1.1.2 Soil type – acid soils vs clay soils



Asbestos in the NEPM

9.1.2.2 Assessing quantity and distribution – gravimetric approach

- **Site history** should inform any sampling plan for boreholes, test pits or trenches
- The **sampling density** should be sufficient to enable an appropriate management plan to be developed.
- Samples of known weight can be taken from a trench wall, the soil inspected and any ACM found removed by hand, sieved through a 7 mm x 7 mm sieve, washed free of soil, dried and weighed to estimate the mass of ACM present.
- The asbestos ACM % w/w is then calculated based on estimates of the asbestos content of the particular ACM material. Results are compared to the screening criteria.
- Note that **asbestos fines (AF)** are defined as ACM fragments that pass through a 7 mm x 7 mm sieve and that a **soil screening criteria of 0.001%** would normally apply to this form of asbestos contamination.



Asbestos in the NEPM

9.1.3 Management

Complete removal of asbestos from a site often involves extensive and costly investigative and confirmatory sampling and sometimes is not effective or necessary.

In situations where no long-term management is able to occur, high levels of buried ACM >0.1% are not acceptable as there is no guarantee that the ACM will not be disturbed over time.

NB – commencing discussions with Safework Australia regarding leaving any asbestos in the soil



Asbestos in the NEPM

9.1.3 Management (cont)



- Remediation options which **minimise soil disturbance** and therefore public risk are preferred.
- **Management of asbestos in situ** is encouraged. E.g. covering the contamination with uncontaminated fill (50-100cm layer) and/or other protective or warning layers or institutional controls such as registering a memorial on the relevant certificate of title.

B1 & B2 : Asbestos

Summary - General approach for ACM

Low level ACM contamination

- *10 cm² total area of ACM fragments or less per m² (eg one 3cm x 3m piece)* with little associated past soil disturbance – simply remove all visible ACM

Medium level ACM contamination

- *more than 10 cm² ACM fragments per m²* or fragments plus significant soil disturbance – consult relevant regulator or consultant, with the expectation of a surface soil skim being necessary down to depth of likely soil penetration

High level ACM contamination

- *many fragments per m²* and with likely but unknown degree of burial – consult relevant regulator or consultant with the expectation of a more detailed site assessment being required.

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B1 & B2 : Asbestos

NEPM guidance provides screening criteria for assessment of asbestos contamination by appropriate sampling and quantification as % w/w by gravimetric methods.

- 0.01 % w/w asbestos in ACM – standard residential use
- 0.04 % w/w asbestos in ACM - residential, minimal soil access
- 0.02 % w/w asbestos in ACM – parks etc.
- 0.05 % w/w asbestos in ACM - commercial/industrial

More conservative criteria equivalent to a nominal 0.001% w/w asbestos are applicable for FA and AF assessment. Consult regulator or consultant.

ACM = sound asbestos cement material, FA = Fibrous asbestos, AF = Asbestos fines




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Schedule B4: Guideline on site specific health risk assessment

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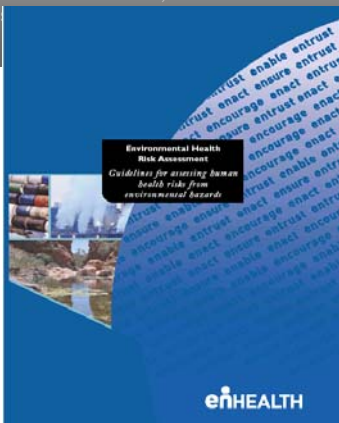
B4 Outline

Chapters

- 1 Introduction
- 2 The Australian risk assessment framework
- 3 Data collection and data evaluation
- 4 Exposure assessment
- 5 Toxicity assessment
- 6 Risk communication and management



enHealth EHRA



2002 – revised for 2011

A national framework for risk assessment

- Issue identification
- Hazard & DR = Hazard characterisation
- Exposure assessment
- Risk characterisation




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EHRA guidance

But wait!

There's more!

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enHealth EHRA guidance

Australian Exposure Factors Guidance (2011)

A stand-alone guidance document incorporating text & tables describing:

- anatomical & physiological parameters**
- dermal exposure parameters**
- ingestion exposure parameters**
- inhalation exposure parameters**
- activity patterns**
- residence & population mobility**

Supported by >300 individual references; citing most recent Australian & overseas data
(e.g. US Exposure Factors Handbook, released July 2009)

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EHRA guidance

New or expanded sections

- **Dose-response assessment**
BMD methodology for both threshold and non-threshold scenarios
guidance on when to use threshold vs non-threshold approach
- **“Target” risk**
applicable only to HRA of carcinogens?
selection of target risk in the range 10^{-6} to 10^{-4} ?
- **Carcinogenic risk assessment**
analysis of Mode of Action to assess human relevance
update on IPCS/US EPA/ILSI approaches
- **Mixtures - Aggregate and cumulative risk assessment**
whether to use independent analysis or aggregate analysis (eg TEF or HI)
- **Conceptual site models**
when & where CSMs might help define exposure scenarios



B4 & B7

Some issues

- HILS are generic – all soils, anywhere in Australia and hence are conservative - HILs/HSLs are derived for the most susceptible sub-population.
- Exactitude should not be confused with accuracy and risk assessment outcomes are an estimate, rather than an actual value.
- Carcinogenic RA is informed by substantial epidemiological data and MOA studies. The value 1×10^{-5} which is often the goal for carcinogenic risk assessment does not necessarily imply 10 in a million additional people will get cancer. Note that background lifetime incidence of cancer is 330,000 per million.



B7 outline

Chapters

- 1 Introduction
- 2 Presentation of the health-based investigation levels
- 3 Generic land-use scenarios
- 4 Toxicity assessment
- 5 Exposure assessment
- 6 Risk characterisation - how the HILs were generated



B7: Land use scenarios

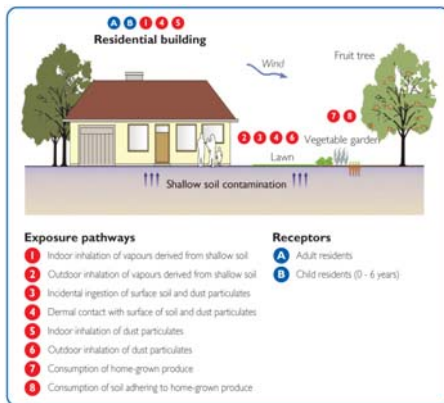
- HIL A** : low density residential scenario with a sizeable garden
- HIL B** : high-density residential scenario without a sizeable garden
- HIL C** : Developed open-space scenario, including parks, recreational areas and secondary school playing fields
- HIL D** : Commercial/industrial scenario.

These land-use scenarios are broadly consistent with exposure settings A, D, E and F respectively, as described in enHealth (2002, 2011).

When land is used for more than one purpose, the HILs that are relevant to the more sensitive land use should be adopted for that site.



Exposure pathways - Conceptual site model



A conceptual site model (CSM) can help understand how human 'receptors' may be exposed to chemicals from relevant environmental sources.

A CSM describes the **source(s)** of contamination, the **pathway(s)** by which contaminants may migrate through the various environmental media and the populations (human or ecological) that may potentially be exposed.

B7 - Exposure pathways

Exposure pathways considered for the four generic land-use categories

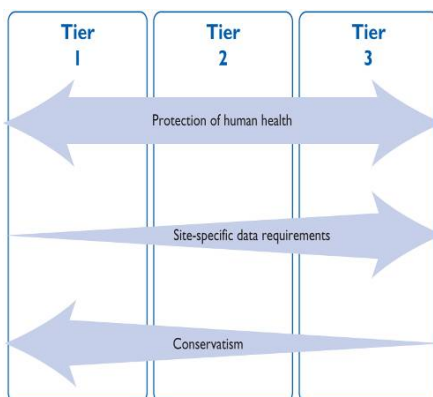
- Indoor inhalation of dust
- Outdoor inhalation of dust
- Dermal contact with shallow soil and dust
- Incidental ingestion of shallow soil and dust
- Ingestion of home-grown vegetables and fruit
- Ingestion of soil adhering to home-grown produce
- Indoor inhalation of vapours derived from shallow soil
- Outdoor inhalation of vapours derived from shallow soil

B7 - HILs

Using HILs

- Tables of **site investigation levels based on human health considerations.**
- **They are not intended to represent clean-up levels or targets for clean-up.** Levels found to be marginally in excess of the HILs do not imply unacceptability or that a significant health risk is likely to be present.
- **Exceeding a HIL means simply that further investigation is needed** and that it should trigger a requirement for a more detailed ('Tier 2') risk assessment.

B7 - HILs



HILs are primarily Tier 1 criteria.

Equal health protection at each tier. As the amount of data and assessment detail increases and the conceptual site model is refined, the level of uncertainty decreases.

A risk assessment progresses from Tier 1 to Tier 2 to Tier 3 when the less-refined risk estimates at lower Tiers may be unacceptable.