The Management of Asbestos in the Non-Occupational Environment

Guidelines for Public Health Services
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Acknowledgements

The Ministry of Health gratefully acknowledges the contributions of Dr Michael Bates (ESR:CDC), Andrew Bichan (Hutt Valley Health), Glen Buckley (Nuplex Industries Ltd), Kevin Campbell (Southern Health), Dr Brian Cox (University of Otago Medical School), Paul Easton (New Zealand Health Information Service), Graham Ferguson (Auckland Healthcare), Lew Graham (Health Link South), Paul Hancock (New Zealand Dairy Research Institute), Tim Hardy (US Asbestos Information Association), Bill Littley (Hawkes Bay Healthcare), Dr Eng Seng Lee (ESR Asbestos Laboratory), Don MacIntyre (James Hardie Ltd), Lyall Mortimer (Department of Labour Occupational Safety and Health), Mary Neazor (Ministry of Education: Property Management), Dr Deborah Read, and Bruce Taylor. These guidelines were derived from work undertaken by John Feltham for the Ministry of Health.
Preface

The unique properties of asbestos have made it a valuable and, in some applications, an essential commercial material for which manufactured substitutes are still inadequate or very expensive.

Public concern regarding ambient levels of asbestos fibres in the air has arisen from an awareness that occupational airborne exposures to asbestos, especially in the extraction and manufacturing processes in the past, caused serious health problems, including asbestosis, lung cancer and mesothelioma.

In 1994 the Public Health Commission (PHC) released its policy advice to the Minister of Health on hazardous substances, which included the recommendation that ‘... the PHC, in consultation with the ... [other agencies] ... prepares recommendations on the control of asbestos outside the workplace for the purpose of avoiding or reducing unacceptable risks to health’ (PHC 1994). These guidelines have been developed as a result of this recommendation.

To protect the health of the public, the policy on the management of asbestos needs to be focused, as well as possible, on the risks to individuals or society that asbestos may present, and on sensible action that is related to the level of risk.

These guidelines are directed at non-workplace exposure to asbestos in air. The risk to health from workplace exposure is a matter for the Occupational Safety and Health Service of the Department of Labour.

These guidelines are intended to assist public health services of Crown health enterprises address public concerns and give sensible advice. Apart from drawing together background information, a protocol is suggested that lays out a response related to the level of likely risk to health, together with consideration of how risks may be evaluated and communicated.

The guidelines are also available on the Ministry of Health’s web site at http://www.moh.govt.nz

The Public Health Group, Ministry of Health, would like your comments on the implementation of the guidelines. They should be addressed to: The Director of Public Health and the General Manager, Public Health Group, Ministry of Health, P O Box 5013, Wellington.
Introduction

Background

Nearly a century ago the adverse effects on health caused by the inhalation of asbestos fibres were recognised in the United Kingdom. Further observations of fibrosis of the lungs amongst asbestos cloth workers and the coinage of the term asbestosis were made in the 1920s. The need for regulatory action was recognised in 1931 by the United Kingdom Government, and Asbestos Industry Regulations came fully into force in 1933.

In New Zealand, prior to World War II, products containing asbestos were imported but not manufactured. It was not until after the war, with the production of asbestos-cement building materials, that manufacturing involving asbestos commenced in any volume.

In 1964 a New Zealand occupational standard was set for asbestos fibres in air and, in 1984, the import of raw friable crocidolite and amosite was banned by a Custom Prohibition Order.

Until the 1980s the concerns in the developed countries about asbestos were primarily related to the gross occupational exposures that had formerly taken place and the legacy of asbestos related occupational disease that was still emerging after long latency periods. In Australia a dramatic rise in the rates of mesothelioma in men occurred in the late 1960s, continued into the 1980s, and now seems to be subsiding. The rise in rates appears to be related to earlier occupational exposures, and the declining rates to the impact of industrial regulations brought in during the 1960s and the closure of the Wittenoom mines. The rate for women rose in parallel, but at a lower level, to that for men, suggesting some occupational and/or para-occupational or neighbourhood exposure (Western Australian Advisory Committee on Hazardous Substances 1990).

In New Zealand, the number of mesothelioma cases amongst women has remained fairly constant at a rate of some 1.3 per million per annum, rather less than the typical rate amongst those not believed to have been exposed to asbestos, which, in other countries, is about 1.5 per million (Cox 1995). Amongst men, however, the annual rate has risen from around 4.3 per million (seven cases) in 1985 to 18.2 per million (31 cases) in 1992, suggesting a relationship with asbestos exposure in the 1950s and 1960s when asbestos-containing materials were manufactured and used on a growing scale. An important conclusion suggested by the low and steady numbers of mesothelioma in women is that the increased presence of asbestos in buildings for a period of some 30 years after World War II has not given rise to exposure with any adverse health effects.

In concert with the growing awareness by the general public of asbestos-related disease, public attention was turning in the 1980s towards environmental protection and the effects of environmental contaminants on the planet and human health. Strides in technology were preceding this new focus in public perception, enabling the identification and measurement of very small concentrations of contaminants in the environment, including the ability to see, count and identify asbestos fibres in greater detail than before.
Public agencies found they needed to respond to the new public interest in asbestos, particularly where it occurred in such places as schools. For example, in the USA, Australia and New Zealand, programmes to manage asbestos risks in schools and hospitals began in the early 1980s. In New Zealand, a report by the Asbestos Advisory Committee was made to the Minister of Labour in April 1991 (OSH 1991).

More recently, some public concern has been expressed about asbestos-cement products, which were used widely in New Zealand buildings until the 1980s. These products normally provide a matrix that binds asbestos fibres, preventing their release, but drilling or sawing that disturbs or damages the material can lead to fibres being released into the air. There is concern that the fibres released by such mechanical work may be a hazard to health.

Purpose of the Guidelines

The guidelines provide guidance to public health services that contribute to the management of risks to health from asbestos in non-occupational settings. People may be exposed to asbestos in non-occupational settings, primarily in and around the home.

Properly applied, the guidelines will assist with determining:

- the risk of an asbestos hazard
- appropriate advice on managing the risk, including risk communication.

In the non-occupational setting, asbestos exposure is unlikely to present a high level of hazard. However, in some circumstances, exposure to asbestos could mean there will be a need for medical observation. If such a case is encountered the affected person should be encouraged to inform their medical advisor. Persons affected by occupational or para-occupational exposure may have heightened concerns about asbestos and require health counselling or other support.

Exclusions

These guidelines exclude the following settings and activities:

- places of work
- ambient (outside) air
- drinking water
- manufactured mineral fibres.

Places of work are covered by the Health and Safety in Employment Act 1992 (HSE Act). The Occupational Safety and Health Service (OSH) of the Department of Labour is responsible for enforcing the HSE Act. The home, public buildings and schools may be places of work if contractors are doing work in them.

Ambient (outside) air is covered by the Resource Management Act 1991. The Ministry for the Environment administers the Act and the Act is implemented by
regional councils in so far as it relates to the discharge of contaminants to air. Asbestos also occurs in ambient air from sources like vehicle brakes. The management of such diffuse sources of exposure are not considered in these guidelines but the public health service should be aware of them. Ambient air inside dwellings and point source release of asbestos around dwellings would, however, be covered by these guidelines.

The effects on health of asbestos in drinking-water have been summarised by the World Health Organization as: ‘While inhaled asbestos is a known carcinogen, there is no evidence that asbestos has any adverse effects on human health when ingested with drinking-water’ (WHO 1994). Accordingly, this guideline does not consider asbestos in drinking-water. Drinking water is covered by the Drinking Water Standards for New Zealand (Ministry of Health 1995).

Most manufactured mineral fibres are non-respirable. Ceramic and carbon-based synthetic fibres may be a hazard, but are not likely to be used as building construction materials.

**Risk Analysis**

A public health risk analysis model is outlined in *A Guide to Health Impact Assessment* and forms the basis for these guidelines (PHC 1995a). There are three sequential steps in the process of decision-making regarding risk:

1. Risk assessment
2. Risk communication
3. Risk management.

Risk assessment asks the following questions: ‘What are the risks?’ and ‘Who will be affected, how, and to what extent?’ It includes hazard identification, dose-response assessments, exposure assessment, and risk characterisation.

As the first step in the risk assessment process, hazards have to be identified. If the assessment of the hazard suggests the likelihood of significant risk is small, or control is straightforward and safe, it may not be necessary to proceed to the quantification of risk. It is generally accepted that the risk from exposure to asbestos in the non-occupational environment is likely to be low.

The next steps in risk assessment are the consideration of dose-response and the assessment of exposure to asbestos fibres in air. Dose-response models are developed from occupational data and extrapolated to low levels of exposure. Both aspects are approximate only and the dose-response models are subject to considerable debate about the validity of the assumptions made. Because of the low levels of exposure from non-occupational sources of asbestos, these guidelines refer to ‘health effects’ in general rather than dose-response relationships. The information from these three steps is used in the final step of risk assessment: risk characterisation.

The acceptability of risk is a decision for either individuals, or society as a whole. Without societal judgements about acceptable risk no decisions can be reached on proposals that carry both benefits and risks. On the other hand, individuals expect to suffer no more than negligible harm unless they are taking voluntary risks in the
bodies have set levels of what they consider to be acceptable risks, but there is no certainty that these levels will be understood or accepted by individuals.

During any communication of risk, there must be adequate consultation on the risks, and public concerns must be taken into account. Risk management seeks to address the following questions: ‘How can risks be avoided or reduced?’, ‘What are the options?’, ‘Are contingency and emergency plans adequate?’, ‘How can differing perceptions of risk be mediated?’ and ‘Can future health risks be predicted?’

Further Information

Much of the information in the guidelines has been drawn from the publications referred to in the references, in particular: Non-Occupational Exposure to Mineral Fibres. IARC Scientific Publications No. 90 (Bignon et al 1989); Asbestos in Public and Commercial Buildings: A literature review and synthesis of current knowledge (HEI 1991); Asbestos and Other Natural Fibres. Environmental Health Criteria 53 (WHO 1986); Reduction of Asbestos in the Environment (IPCS 1989); Toxicological Profile for Asbestos (ATSDR 1990); Managing Asbestos in Place [the ‘Green Book’] (EPA 1990); and Guidance for Controlling Asbestos-containing Materials in Buildings, [the ‘Purple Book’] (EPA 1985).

This document will be available on micro floppy disk in Microsoft Word format on request from the Information Officer, Corporate Communications, Ministry of Health, so that the Report Sheets may be easily reproduced and adapted if necessary to suit individual cases. Users may also find it useful to copy parts of the text from the Graded Response Protocol and other material into the Report Sheets.

Chapter One

Risk Assessment Part 1: Hazard Identification

Main Points

- The risk from exposure to asbestos in the non-occupational setting is considered to be low.
- Asbestos has many useful properties and may occur, therefore, in a wide range of products.
- Asbestos occurs naturally in air and water as well as in asbestos-containing materials.
- The presence of asbestos in materials cannot be determined by visual inspection.
• Treat all moulded fibre-cement products (eg, corrugated sheet) as containing asbestos. Treat any other fibre cement products (including building cladding, panel fences, insulating board and roofs) installed before 1985 as containing asbestos unless otherwise excluded by testing.

• Textured coatings (generally on ceilings) installed after 1964 and up to 1984 are likely to contain asbestos. Treat as friable unless shown otherwise.

• Vinyl floor coverings (which may also be used on other surfaces) installed up to 1989 may contain asbestos.

• Public buildings are likely to contain materials not commonly found in housing, such as sprayed insulation on structural steel or heating pipe insulation. These may contain asbestos, and may be friable.

• Any material suspected of containing asbestos should always be tested before any action is taken that could lead to the release of fibres.

• Asbestos should be removed where friable, and where exposed at demolition or alteration of buildings.

• Property owners should seek expert advice if work with asbestos-containing materials is required.

Asbestos

Asbestos is a common term describing a variety of naturally occurring hydrated silicate minerals containing SiO4 groups linked into chains, which exhibit properties rendering them useful in commerce, particularly when in a fibrous form. The most important forms of asbestos (as shown below) are the serpentine group, of which chrysotile is the most commonly used of all types of asbestos, and the fibrous amphiboles.

Numerous minerals other than asbestos exhibit fibrous structure, a number of which are classified as ‘asbestiform’. Fibrous minerals include, for example, erionite, one of a zeolite of fibrous aluminosilicates, which is a constituent of tuffaceous (volcanic ash) deposits; it is strongly implicated in mesothelioma in some Turkish villages. There are, of course, many other fibres manufactured from slag, rock, or glass from blends of silica, alumina, zirconia and other materials fused to made ceramics. Many of these exhibit properties that may make them hazardous to health.

Two characteristics that all these materials have in common are the capacity to persist in animal tissue for months, if not for years, and a physical form such that their length is often more than 5 microns, their width is less than 3 microns and the length to width ratio is not less than 3 to 1, which is the true definition of a fibre. (Shorter fibres are properly described as elongated particles.)
The most commonly mined forms of fibrous asbestos are chrysotile, an iron-magnesium silicate white in colour; crocidolite, an iron-sodium silicate blue in colour; and amosite, an iron and magnesium silicate grey-brown in colour. Actinolite, tremolite and anthophyllite occur in both fibrous and non-fibrous forms and have rarely been mined as commercial asbestos.

Both the fibrous and non-fibrous forms of amphibole minerals are sometimes found as contaminants of chrysotile, sheet silicate (talc and vermiculite), and other minerals. Tremolite, in particular, may occur as a contaminant in other forms of asbestos including chrysotile, and has been implicated in health effects that may not occur from pure chrysotile.

The morphology of the asbestos fibres differs between the groups. Both are naturally fibrous but the sizes (length and width) and the shapes of industrial fibres differ.

Chrysotile fibres are a bundle of thousands of agglomerated fibrils, which in section appear like a scroll of paper resulting in a vast surface area and possess elasticity, flexibility, and good tensile strength. Chrysotile fibres have a width of 0.1–1.0µm (fibrils less than 0.020µm) and are thinner and curlier compared to those in the amphibole group.

The amphibole group are straight, hard, sharp, needle-like structures that may break longitudinally to form very fine fibrils. Crocidolite retains good flexibility and has high tensile strength. Fibres are 1–2µm in width (fibrils 0.080µm) and up to 70 mm long. Amosite fibres are quite flexible and are less strong than the other forms. Fibre width is 1–2µm (fibrils 0.100µm) and up to 70 mm in length.

The physicochemical properties of importance in industry include:

- incombustibility
- high tensile strength
- resistance to high temperatures
- low thermal conductivity
- resistance in varying degrees to dissolution, or breakdown by strong acid, alkali, or enzymes in the body
- resistance to micro-organisms
- resistance to wear
- electrical resistance.

Amphibole fibres are resistant to acids and generally extremely durable even in aggressive chemical environments. Chrysotile is resistant to alkali, but, being a magnesium silicate, can decompose (over long periods) when immersed in body fluids, and even in water, as the magnesium can leach out leading to an unstable chemical structure.

The properties of asbestos have made it useful for adding tensile strength to composite materials, and for use in materials that need to resist heat, chemical attack and wear. Being fibrous, asbestos is useful as insulation. Asbestos has been lower in cost than manufactured materials which try and replicate the unique properties of asbestos. For many applications the substitution for asbestos by other equally suitable materials is difficult, costly or impossible. Before the health risks were more...
completely appreciated, asbestos was regarded as a ‘miracle’ fibre of great versatility and usefulness.

Fibres obtained from asbestos ore are classified into 150 grades (the Quebec Standard), each corresponding to a specific use in the manufacture of asbestos-based products. The shortest milled asbestos is generally used in moulded goods, such as asbestos-cement products. The longest fibres are used in asbestos textiles.

Milling and other physical treatment leads to the breakage of fibres, leading to thinner fibres that may be in the respirable range.

At least one form of asbestos, chrysotile, can be present naturally in the atmosphere due to natural weathering and disturbance of deposits.

**Asbestos Fibre Dimensions and Type**

**Length and width of fibres**

The concentrations given in this chapter are for fibres greater than 5 microns in length, as these are of greatest health significance (see Chapter 2). It has been estimated that one fibre analysed by phase contrast microscopy (PCM) is equivalent to about 60 fibres found using transmission electron microscopy (TEM) (Guth 1989). Thus ‘TEM fibres’ represent an overestimate of ‘PCM equivalent fibres’.

A further distinction that may arise if the count of fibres is for all lengths, or if gravimetric measurement is used (and converted to fibre numbers) which cannot distinguish between fibre dimensions. In those cases a large proportion of the fibres may not be of great significance to health. For example, it has been estimated that some 98 percent of total fibres counted using TEM in outdoor air and air in public buildings are likely to be well below 5 microns in length (Bignon et al 1989).

Unfortunately, not all reported fibre concentrations quote either the method of examination or the size range counted. A further complication (considered in Appendix 1) is the method of sample preparation.

**When considering reported fibre concentrations, clarify if possible the criteria used in counting and the method of sample preparation.**

**Type of asbestos**

The type of asbestos in asbestos-containing materials in buildings is predominantly chrysotile, for example in asbestos-cement products, decorative coatings, vinyl sheet and tile flooring. Other forms are present, however, in smaller amounts, for example amosite and possibly chrysotile in products prior to about 1950.

Reported concentrations of asbestos fibres in air in various environments seldom identify the type of asbestos. In contrast to chrysotile, the presence of amphibole fibres in rural and urban samples is extremely rare and is usually the sign that some specific local source (or laboratory contamination) is present (HEI 1991).
In public and commercial buildings the balance of opinion is that with few exceptions, the type of asbestos fibre found predominantly in buildings is chrysotile, although some buildings may have sprayed friable crocidolite oramosite (Mossman et al 1990).

**Despite this, it is necessary to determine the type of asbestos in an asbestos-containing material.** The type appears to be unimportant in the development of lung cancer, but the presence of amphibole asbestos is a very important factor in mesothelioma. Further, chrysotile can be contaminated with amphibole.

### Asbestos-containing Materials

Because of the exceptional insulating, fire-resistant and reinforcing properties of asbestos-containing materials, they have been utilised widely in buildings in surface-applied finishes (for acoustical, decorative, and fire-retardant purposes); in asbestos-cement products in sheet and other moulded forms; as thermal insulation in the construction of buildings; as well as in equipment used in buildings.

The presence of asbestos in materials cannot be determined by visual inspection.

In the home the primary asbestos-containing materials are surfacing materials (such as asbestos-cement products used for cladding and roofing, and decorative/textured internal coatings on ceilings and walls); thermal and fire insulation; and moulded and flooring materials (such as asbestos-cement products for gutters and down pipes, or backings to vinyl sheet floor coverings and in the matrix of vinyl tiles).

Less common asbestos-containing material may occur in the home as: lagging or insulation in old heating appliances, or around pipes and older hot water cylinders; some external textured coatings; plastic products, caulking and other composites; woven sheath around old Vulcanised India Rubber insulated wiring; or built-up roofing felts.

Household items of asbestos-containing material may include: asbestos simmer mats for stoves; oven gloves; mats on ironing boards; fire blankets and other asbestos textiles; electric heaters, hair dryers and older model toasters.

Other sources of asbestos dust in the home may include dust from automotive friction materials or take-home dust from occupational exposure to asbestos.

In public buildings, asbestos-containing material may occur as: surfacing materials (eg, sprayed or trowelled asbestos-containing material on surfaces such as decorative finishes on ceilings, fireproofing materials on structural members, acoustical asbestos-containing material on the underside of concrete slabs or decking, and fire- and heat-resistant linings to boiler rooms); thermal system insulation (lagging and moulded insulation of heating and cooling service pipes, ducts, boilers, and tanks to prevent heat loss, gain or condensation, and thermal insulation coatings or layers in the structure); or miscellaneous asbestos-containing material such as asbestos-cement panels, cladding, roofing, pipes and other mouldings, asbestos-containing ceiling or floor coverings, and incidental uses in packings, friction materials, textiles, plastics reinforcement, gaskets and filters.
Asbestos-cement products

Composite materials containing Portland cement, sand, and some form of fibrous reinforcement may generically be called ‘fibre-cement’ products. These products occur in housing and public buildings.

Chrysotile, in particular, is resistant to alkaline cement, which gives it advantage over other reinforcing fibres. Glass fibre, for example, is damaged by cement unless of a special alkali resistant form. More recently, cellulose fibres have replaced asbestos.

In asbestos-cement products the asbestos fibres are bound in the cement/sand matrix, often in small bundles just visible to the naked eye. The material tends to becomes more brittle with age. Surface deterioration can occur due to acid rain, abrasion, or persistent damp conditions aided by organic growths.

Products typically used in housing included Fibrolite (from 1972 to 1982), Durock (up to 1974), Coverline or Highline profiled sheets (1972 to 1982), Hardiflex or Hardiplank (up to 1982), Harditherm (1972 to 1982), and Durotherm (up to 1974). Note that New Hardiflex (used from 1982 to the present day) does not contain asbestos.

The Fibrolite and Durock mix was similar and contained chrysotile and a small amount of amosite. The mix was mouldable into corrugated and other forms such as gutters. Early products, up to the 1950s, probably contained crocidolite and the percentage of asbestos was higher, reputedly up to 50 percent. Hardiflex was not a mouldable material but was more flexible. (Fletchers produced an equivalent product, some of which was in the form of siding.) Sheet material may be found internally as linings in wet areas such as bathrooms, or in storage areas, occasionally as bench tops. Harditherm and Durotherm (22 percent asbestos) was used for fire protection and insulation. It was softer and easily nailed; it may become friable at the edges.

Summary of uses

1. Roofing: bold roll corrugated sheet (*super 6*); narrow roll corrugated sheet, shingles
2. Walls: shingles, flat sheet (generally 9 mm), profiled sheet (eg, Coverline and Hiline)
3. Ancillary: guttering and down-pipes in various sizes, other moulded items (eg, garden troughs), roofing components (eg, verge and ridge trim).

Decorative coatings

Decorative internal coatings produced between 1964 and 1983 generally contained 5–9 percent chrysotile asbestos, and were applied as textured ceilings in housing and public buildings. The coating was able to mask imperfections in a substrate otherwise unsuitable for paint finishes. In public buildings similar coatings were applied for decorative and/or acoustic purposes on ceilings and other surfaces out of reach. Use probably ceased around 1984.
The asbestos fibres and other fillers (such as expanded vermiculite and polystyrene) were bound together with adhesives to form the product. Portland cement was not included.

Trade names of decorative coatings include Glamortex and Whispar. Licensed contractors were generally used by the producers of the products. Nuplex Industries, for example, are able to identify from their records particular jobs, their dates and the contractors used.

The products up to the late 1970s may be beige in colour (those containing vermiculite or perlite), or white (containing expanded polystyrene granules) from 1980 to 1983. The coatings are rather soft, because of the expanded materials in them, and could be damaged by impact or abrasion. Despite the soft nature of the coating, the fibres are generally well bound in a matrix of adhesive and filler-binders unless damaged or disturbed, when the material can become friable. The coating may be softened by water, and any areas that have become damp could suffer deterioration and poor adhesion to substrates; after drying out the material may be friable.

External decorative textured coatings were also made, using resin binders. Use is likely to have ceased around 1984.

**Vinyl tile and sheet**

There are two categories of resilient floor coverings: sheet material, consisting of a polyvinyl chloride layer with a chrysotile paper backing, and floor tiles, in which chrysotile is uniformly dispersed throughout the material. Vinyl-asbestos floor tile is made of 15 percent polyvinyl chloride (and sometimes asphalt) as the thermoplastic binder, with 10 percent to 20 percent asbestos and other mineral additives and pigments. The products may have been installed up to 1989. When sheet material is removed the backing tends to remain adhered to the floor by the glue layer, presenting problems for safe removal. Vinyl sheet floor covering may be referred to as Lino. Linoleum is another material made of canvas coated with oxidised linseed oil.

The vinyl-asbestos floor tile must be regarded as a special type of asbestos-containing material in that abrasion in normal use can release dust if not properly maintained. Properly waxed, these floor coverings can be considered as encapsulated. However, buffing, wax stripping and other abrasive treatments can cause the release of fibres. Unique analytical problems arise in examining dust from such floors, and most fibres are less than 3 microns in length (HEI 1991).

**Asbestos-containing material generally only in larger buildings**

- Acoustic plaster soundproofing. This is a firm, open-pored, plaster-like material, applied by trowel. The soundproofing material is usually exposed and not usually painted.

- Insulation used for thermal system insulation (TSI). Asbestos-containing material used in insulation of air-conditioning ducts, hot and cold water pipes, hot water reservoirs, pressure tanks, and boilers is generally covered with a fabric or metal jacket. Fire doors often contain laminates of asbestos materials covered by wood or metal. The asbestos-containing material enclosed by the outer coverings is likely to be friable.
Lagging. A number of methods of lagging have been used on boilers, condensate tanks, and steam headers; and pipes carrying steam, hot and chilled water and condensate, including:

- raw asbestos/water mixture (or pre-formed asbestos blocks attached to the underlying surface) with an outer layer of wire-netting reinforcement finished with a cement of fine clay/asbestos
- pre-formed pipe lagging of asbestos-containing material, usually in two halves wrapped in calico and traditionally painted red or white
- asbestos paste to finish lagging around valves and bends, and as repair to damaged areas.

Non-Occupational Sources of the Hazard

The following examples are typical of concentrations of fibres in various environments.

The outdoor environment

Typical concentrations of asbestos fibres in the outdoor environment provide a useful yardstick for comparison with indoor environments. Examples of reported values are 0.1 fibres per litre (f/l) but greater than 0.1 f/l downwind of local sources, for example vehicle braking (HEI 1991; ASTDR 1990). The Environmental Health Criteria 53 suggests average outdoor urban air concentrations are less than 1 to 10 f/l and occasionally higher (WHO 1986).

In some circumstances outdoor urban concentrations of asbestos fibres may be due to activities releasing asbestos in the neighbourhood, including diffuse sources such as vehicle braking.

Residential buildings

Reported concentrations all relate to residential buildings containing asbestos-containing materials which were, or were suspected of being, friable or were being damaged. They ranged from ‘not detected’ to 2.0 f/l but were generally in the range 0.2 f/l to 0.4 f/l (HEI 1991; Bignon et al 1989; WHO 1986; CPSC 1983).

Public buildings

Reported concentrations all relate to buildings containing asbestos-containing materials which were, or were suspected of being, friable or were being damaged. Typical concentrations of asbestos fibres in public and commercial buildings containing asbestos-containing materials ranged from 0.1 to 2.0 f/l (HEI 1991; ASTDR 1990; Bignon et al 1989; WHO 1986).

The median concentrations are generally the most representative of asbestos fibres in air and may be summarised as:
Release of Asbestos Fibres from Asbestos-containing Material

In the majority of cases intact asbestos-containing material is not a hazard merely by its presence. Fibres are released when physical actions (deliberate or accidental) disturb the surface. Asbestos-cement materials will release fibres when sawed, drilled, or otherwise worked or damaged. Other asbestos-containing material such as decorative coatings, acoustic insulation and thermal system insulation are vulnerable to damage during building maintenance operations, from vandalism and accidental damage.

Release of asbestos fibres during removal

During the disturbance and removal of asbestos in multi-storey buildings, high concentrations of asbestos fibres have been reported outside the enclosures where work was taking place (IPCS 1989). In the examples given, before work commenced the background average concentration was less than 0.2 f/l. During the removal phase concentrations outside the enclosures increased to between 14 and 290 f/l (generally around 70 f/l) declining over 16 to 35 weeks to between 1.0 f/l and 0.4 f/l. During a simulated maintenance activity on sprayed asbestos a local concentration of around 30 f/l was observed. These results may be improved by the precautions now required of certified asbestos removal contractors, but they emphasise the increased hazard created by removal which takes many months to abate.

Release of asbestos fibres during normal wear and weathering

Fibre release can also occur from natural causes through corrosion and weathering of asbestos-cement products. The measurement of fibres released from corroded and weathered asbestos-cement products has been attempted by Spurney (Bignon et al 1989). Investigations measured the release of fibres in simulated wind speeds between 1 and 5 metres/sec. The results showed that:

- asbestos-cement surfaces corrode and weather as a result of aggressive atmospheric pollution (eg, sulphur dioxide, aerosols and acid rain) in proportion to the acidity of the rain and concentration of pollutants
- the surface cement matrix is destroyed and a layer approximately 0.1–0.3mm of free fibres is built up
- wind disperses the fibres into the ambient air with emissions in the range $10^6$ to $10^8$ fibres per square metre per hour (rates affected by pollution intensity and weather)
- about 20 percent of fibres are dispersed in the air and 80 percent washed out by rain
there were crystallographic changes in the corroded chrysotile fibres and pollutants (metal and organic substances) were deposited on the free fibres

- the fibres released had approximately the same carcinogenic potential as un-corroded chrysotile

- fibre concentrations in the vicinity of buildings with corroded and weathered asbestos-cement products (fibres greater than 5 micrometres) were from 0.2 to 1.2 f/l.

A study on asbestos-cement products in Western Australia found that deteriorating asbestos-cement roofs were common and that asbestos was present in the gutters and run-off water (highest concentration from roofs 10–17 years old). Younger and older roofs produced lower concentrations. Air monitoring at nine sites suggested that the air concentrations are likely to be less than 2.0 f/l and more likely to be less than 0.2 f/l (Western Australian Advisory Committee on Hazardous Substances 1990).

**Drinking water and precipitation**

There is a theoretical possibility of exposure to air-borne asbestos from drinking-water aerosols and dried asbestos deposits. Where significant fibre concentrations were found, the fibre length median was generally between 0.5 and 1.0 microns although fibres greater than 5 microns were present (HEI 1991). Air measurements were made in homes using water containing 24 million f/l and another of 1.1 million f/l. Mean values from a combination of background, showering, and vacuuming activities showed that homes with the more polluted supply gave fibre and mass concentrations about four times higher than the ones with the less polluted supply. No data on exposure from this source have been found.
Views have been expressed in the literature regarding public policy and asbestos:

The available data do not indicate that asbestos-related malignancies or functional impairment will occur as a result of exposure to most airborne concentrations of asbestos in buildings. First and foremost, the levels of airborne asbestos in buildings, even with damaged asbestos-containing material, are magnitudes lower than concentrations in the unregulated workplace in the past and approximately $1/100^{\text{th}}$ of the permissible exposure in the workplace. Recent epidemiological studies of deaths from mesothelioma in the general population also suggest that risk from asbestos in buildings is minuscule. The available data and comparative risk assessments indicate that chrysotile, the type found predominantly in buildings, is not a health risk in the non-occupational environment (Mossman et al 1990).

The incidence rate of mesothelioma in people occupationally unexposed to asbestos and with normal lung fibre content in about one per million person years for either sex. This rare background occurrence suggests that the risk from low levels of exposure to asbestos is minute. Asbestos should be removed where friable, and where exposed at demolition or alteration of buildings . . . (Ferguson 1990).

In summary, the risk from exposures to asbestos-containing materials in the non-occupational environment is low. The provision of advice to ensure people handle asbestos-containing materials appropriately will reduce this risk further.
Chapter 2

Risk Assessment Part 2: Health Effects, Exposure Assessment, and Risk Characterisation

Main Points

- The risk from exposure to asbestos in the non-occupational setting is considered to be low.

- The increased presence of asbestos in buildings for a period of some 30 years after World War II appears not to have given rise to exposure with any adverse health effects.

- Fibre length, width and composition are critical determinants of carcinogenic potency.

- Sampling and analysis of asbestos-containing materials aim to identify the type(s) of asbestos in an asbestos-containing material or in air, and to measure exposure by determining the concentration of asbestos fibres in air.

- Risk is perceived by the general public in social and psychological terms rather than technical risk terms. Risk communication must understand and be sensitive to this and aim to inform, show responsiveness, and be a two-way process.

Possible Health Effects

The inhalation of airborne asbestos at concentrations that have been encountered in occupational settings are known to have caused fibrosis of the lungs and pleura, as well as cancer of the lungs, pleura, peritoneum, and, possibly, at distant sites. However, it is generally accepted that exposures to asbestos in non-occupational settings are not a significant risk.
Asbestosis

Asbestosis refers to diffuse or multi-focal fibrosis (scarring) in the lungs caused by the inhalation of asbestos fibres. The person develops an insidious onset of shortness of breath and dull chest pains. Fibres penetrating to the peripheral air spaces initiate alveolitis, which, if chronic, results in scarring and fibrosis. The extent of lung inflammation and destruction is related to the amount of asbestos retained in the lungs, the fibre type and length, and individual susceptibility. Some evidence suggests that more retained asbestos is required to produce asbestosis than to produce asbestos pleural plaques.

Asbestos is generally regarded as a disease likely to occur only from significant and prolonged exposure to asbestos, a situation exceedingly unlikely to occur from environmental exposure outside the workplace. It has been suggested that 25 fibre.years/ml may be a threshold (eg, 25 years, 40 hours/week in a working environment of 1 f/ml or 1000 f/l); therefore there is likely to be a level below which fibrosis will not occur, or will be insignificant (OSH 1991; Doll and Peto 1985).

Non-malignant pleural conditions

In particular, pleural plaques, and the less common diffuse pleural fibrosis, have been correlated with higher lung burdens of amosite, crocidolite, and probably chrysotile than those of the general population. Cases are often asymptomatic. They tend to develop after long latency periods, usually greater than 20 years after exposure. Prevalence is related to duration of exposure and possibly to peaks of exposure. There is some association with higher incidence of lung and larynx cancer (HEI 1991).

Benign diseases of the pleura may be the only manifestations of exposure to asbestos (occupationally and even non-occupationally). They are, therefore, considered to be of importance as they are likely to be the most common way in which those affected by asbestos could be identified (HEI 1991).

Carcinoma of the lung

Epidemiological studies have confirmed an association between asbestos exposure and lung cancer, even in non-smokers. This association is considered causal, although the rates in various studies have differed. The latency period is measured in years and appears to be directly related to cumulative exposure. A more than additive risk of lung cancer results from exposure to asbestos in combination with cigarette smoke.

The most common is bronchogenic carcinoma or lung cancer. Typically the person will develop a combination of symptoms, including shortness of breath, coughing, and bloodstained sputum. The tumours are indistinguishable from those caused by other agents such as tobacco smoke or radon decay products. Cumulative dose is the main factor and all forms of asbestos should be considered equally potent. High incidence rates of lung cancer have been documented among people with short, intense exposure to amosite.
Pleural and peritoneal mesothelioma

Mesothelioma is a rare cancer of the cells lining body cavities. It is the classic tumour associated with asbestos exposure, and appears to be unrelated to smoking. Some short duration exposures to crocidolite and amosite, but not to chrysotile, have been associated with mesothelioma. For exposure of any duration, amphibole asbestos is more strongly associated with mesothelioma than chrysotile. Other mineral fibres are implicated in mesothelioma, especially erionite.

The latency period is usually 20 to 40 years or more from the times of first exposure, although shorter times have been recorded. The initial symptom is likely to be chest pain. Most cases have been associated with industrial asbestos exposure or household contact with asbestos workers. The incidence (and deaths) per year of mesothelioma from causes other than occupational exposure to asbestos is very low (except in unusual circumstances such as exposure to other fibrous minerals (eg, erionite, as has happened in Turkey)).

Mesothelioma can occur in those for whom no evidence of either occupational or environmental exposure is evident from a detailed history. The number of cases reporting no known exposure to asbestos ranges from about 38 percent of reported cases (McDonald and McDonald 1977) to 28 percent of reported cases (Ferguson et al 1987). In New Zealand the annual incidence is approximately 1.3 per million females and may approximate to an incidence for those not known to have been exposed to asbestos (Cox 1995). The aetiology of these cases seemingly unexposed to asbestos is unknown, but low-level environmental exposure to asbestos and asbestiform minerals has been postulated as a causal factor in these cases. Other suggested causes are radiation, beryllium, chronic inflammation, and non-asbestos mineral fibres.

An important conclusion suggested by the low and steady numbers of mesothelioma in women is that the increased presence of asbestos in buildings for a period of some 30 years after World War II has not given rise to exposure with any adverse health effects.

Male mesothelioma in New Zealand has increased from an annual number of cases of seven in 1985 to thirty-one in 1992, a rate to 18.2 per million males. The age group 45 to 64 years shows a rise from two in 1985 to sixteen in 1992, and a rise from four to fourteen cases over the same period in the age group 65 years and over (Cox 1995). This suggests a relationship with exposure to asbestos in the 1950s and 1960s when the manufacture and use of asbestos-containing materials in New Zealand increased.

Other cancers

Tumours of the larynx, oropharynx, and upper and lower digestive tracts have been reported, in some studies but not in others, to be increased in frequency in some cohorts of workers occupationally exposed to asbestos. The excess risks are small and for environmental exposure assessment these cancers can probably be disregarded.

Key factors affecting fibre uptake and toxicity

There are factors affecting asbestos fibre uptake and toxicity to keep in mind when considering possible health effects from low level exposures to asbestos. Fibre
length, width and composition are critical determinants of carcinogenic potency. In general, fibres with a maximum carcinogenic potency have been reported to be no longer than 8 microns, and less than 1.5 microns in width (IPCS 1989).

**Characteristics of carcinogenic fibres**

The following summary is taken from the concluding remarks by Professor Richard Doll in *Non-Occupational Exposure to Mineral Fibres* (Bignon et al 1989).

- No particle should be described as a fibre unless it is at least 5 microns long and the width is less than one-third of its length. Shorter particles (which should be properly described as elongated particles) are much less carcinogenic, if they are carcinogenic at all.

- The great majority of so-called fibres normally found in air in and out of doors are less than 5 microns in length.

- Asbestos may only be a complete carcinogen for the mesothelium, and may act to produce bronchial carcinoma less directly.

- The essential difference between long and short fibres would seem to be that fibres less than 10 microns long are removed more readily by macrophages.

**Exposure Assessment**

A knowledge of exposure is essential for environmental epidemiology and hazard control. Unlike, for example, lead exposure, the measurement of exposure to asbestos cannot be determined by absorbed dose or other biological measurement (at least not until after death). The options available, therefore, may be ranked as:

- direct estimation by personal air sampling
- indirect estimation by stationary air sampling of personal environments
- exposure categorisation on the basis of questionnaires, interviews, inspections, historical records and/or exposure simulations
- dichotomisation into ‘exposed’ and ‘unexposed’ populations.

**Concentration of fibres in the environment**

The remarks by Professor Richard Doll in *Non-Occupational Exposure to Mineral Fibres* have also been used to provide the following summary relating to fibres in the environment (Bignon et al 1989).

- Estimates of potential risk should be based on both the chemical constitution of the fibres and their size, counting only those that are respirable and more than 5 microns long. This means that ambient pollution must be measured by electron microscopy to distinguish mineral fibres from others (as opposed to occupational settings where nearly all fibres will be of one specific type).
Asbestos fibres that are potentially carcinogenic are present ubiquitously due to weathering of geological formations and human activity. Although the former may be the larger source, it is generally the latter that disperses fibres principally in areas of high population density.

Concentrations of fibres greater than 5 microns in length might be as high as 12 f/l in rooms with damaged asbestos, and 0.9 f/l in some buildings with sprayed or trowelled asbestos.

Despite complex containment of contamination during asbestos removal, higher counts than previously recorded (sometimes an order of magnitude higher) can persist for many weeks.

Out of doors, fibre counts are generally less than 0.5 f/l. Counts are raised in areas of heavy traffic.

For all measures of exposures there are ethical, practical, and cost limitations. Logistical issues, quality control, sampling methods, sensitivity, and specificity all need to be considered, and expert laboratory advice is generally needed if exposure measurement is being considered. The latter two methods above are considered in more detail in Chapter 3. Appendix 1 details the procedures and issues around asbestos sampling and analysis.

Risk Characterisation

Underlying asbestos risk assessment, and hence its health impact, are epidemiological assumptions and exposure measurements. Extrapolation from observations of asbestos workers to predict the cancer risk caused by exposure in non-occupational situations involves measuring exposure and establishing a formula for the relationship between exposure and risk. While there may be little difficulty in estimating the excess risk, provided that the excess is substantial and suitable comparison rates are available for the local population, measuring exposure and choosing an appropriate dose-response model are substantially more difficult.

Risk estimation for non-occupational exposure relies on extrapolation from much higher levels of exposure in industry.

Assessment of risk at low fibre counts can be only indirect, as the counts to which people may be exposed are so far below the levels at which risks have been detected in industry.

Mesotheliomas which have occurred from non-occupational exposure to asbestos are related to para-occupational, domestic and/or neighbourhood exposure near asbestos mines or asbestos using industries.

Lung cancer may have been produced in the same way but it has not been possible to demonstrate it epidemiologically (because of the high background incidence). Alternatively, it may be because this disease is not produced by low levels of exposure to asbestos at all.

For lung cancer there are data to support incidence related to cumulative dose at high and moderate levels, but there are no real grounds that a linear
relationship for lung cancer can be extrapolated back to the dose in non-
occupational settings.

• Estimates of risk (for mesothelioma) that have been made are in broad
agreement that the risk attributable to concentrations of, for example, 0.5 f/l
(0.0005 f/ml) are of the order of a lifetime risk of 1 per 100,000 or less for
10 years’ exposure in school, or some 20 years’ exposure in adult life.
Chapter 3

Risk Communication and Management

Main Points

- The risk from exposure to asbestos in the non-occupational setting is considered low.
- Property owners should seek expert advice if work with asbestos-containing materials is required.
- Risk is perceived by the general public in social and psychological terms rather than technical risk terms. Risk communication must understand and be sensitive to this and aim to inform, show responsiveness, and be a two-way process.

Summary of the Graded Response Protocol

Step 1: Initial response and preliminary assessment

1.1 Gather and record information
1.2 Identify and assess the potential hazard
1.3 Decide whether to proceed to Step 2
1.4 Identify and inform the agency most appropriate to take any further action
1.5 If not proceeding to Step 2 provide support and precautionary advice

Step 2: Inspection and hazard evaluation

2.1 Co-ordinate action/enforcement with the regulatory agency as appropriate
2.2 Confirm initial information
2.3 Obtain and record additional information to enable an adequate hazard evaluation
2.4 Identify and characterise hazards
2.5 Decide whether to proceed to Step 3
2.6 Provide advice to manage hazards and potential exposure, and ensure action is taken
Step 3: Exposure measurement, risk estimation and assessment

3.1 Co-ordinate action/enforcement with the regulatory agency as appropriate
3.2 Sample and analyse to determine presence and type of asbestos
3.3 Measure the concentration of respirable asbestos fibres in air
3.4 Estimate the exposure under normal conditions
3.5 Estimate the excess risk from the exposure and assess its significance
3.6 Communicate the risk
3.7 Recommend actions to manage risk and ensure action is taken

Risk Communication

Community perception of risk is not based on technical risk assessment alone. Public recognition of risks, in contrast to risk assessment based on probabilities prepared by experts, includes intuitive risk perception. The characteristics of such perception appear to be related to concepts of fairness, familiarity, future and present ‘catastrophic potential’, and outrage at involuntary exposure to hazards not of their making.

Asbestos hazards at home, where people expect to be safe, are hazards that will be judged by the public from more than a scientific risk assessment perception. Comparisons with common risks, such as road traffic crashes, will generally not convince a person who feels that they — or their child — are at risk. Involuntary exposures that cause a dreadful disease at some unknown future time, in a way that is still not understood, and for which there is little hope of cure, are particularly alarming.

Effective risk communication is more likely to be achieved if:

- a careful and sensitive explanation is given to assist and improve the level of understanding of the risk
- the feelings of dread towards asbestos-related disease are recognised, and efforts are made to assist a person to come to terms with those feelings before decisions are made
- there are an appropriate urgency and level of response to hazards that may affect a large number of people (especially children) (Warner 1983).

Bear in mind that in general:

- younger adults and better educated individuals tend to have more technical, scientific, and medical knowledge about hazards
- the most concern about risks tends to be expressed by women, particularly women with young children, and by older people
- people tend to simplify complex and uncertain information into ‘rules of thumb’. (In the case of asbestos, these may relate to the perception of occupational risk.)
- people attempt to impose patterns on patternless events
• people overestimate the frequency of rare events and underestimate the frequency of common events

• individuals taking voluntary risks tend to be overconfident and believe they are not subject to the same risk as other individuals

• individuals forced to take involuntary risks overestimate the risk, and are unwilling to agree to ‘acceptable risk’ criteria set out by national and international agencies

• people tend to use past life experiences to relate to new situations, affecting their perception of the new situation (Health and Welfare Canada 1990).

Risk communication needs to be a two-way process as described in some detail in A Guide to Health Impact Assessment (PHC 1995a). It needs to be done in such a way that people are well informed and guided in the actions they can take, while knowing that the experts are taking account of, and acting on, their concerns.

Risk Management

Priorities for managing risk should be based on the risk assessment, but should also consider public perception of risk. The range of risk reduction alternatives must be evaluated, including the social, economic and cultural implications of options.

This could be achieved along two lines:

• control of actions and events that can translate an asbestos hazard into an asbestos risk

• the removal or near-permanent containment of the asbestos hazard.

Asbestos exposures in non-occupational settings may vary greatly. A protocol for the management of such exposures should aim to provide a response that is graded according to the likely harm. Exposures are likely to be several orders of magnitude less than current permissible workplace exposures.

Background to the Graded Response Protocol

The guidelines and protocol aim to assist the public health service identify asbestos hazards and risks using a combination of interview, observation, and laboratory testing. Risk communication and recommendations for the management of hazards and risk may then proceed.

The mere presence of asbestos does not always create a hazard. The risk of developing asbestos-related disease depends upon exposure to airborne fibres of respirable size. A graded response is based on the following three elements:
More fully, these are:

1. the nature and scale of the asbestos hazard and the corresponding potential to be a risk to human health

2. mechanisms that may open pathways of exposure to create risk

3. the nature of the risk in terms of probability, likely consequences, persons affected, and the degree of risk each may face. The existing state of health of each person will influence likely consequences for each individual.

**Approaches to assessing hazards and risks**

A graded response requires some way of assessing likely or actual human exposure to airborne asbestos. There are two complementary approaches:

1. **Inspect, identify and assess indications of fibre release (ie, a hazard)**

This approach identifies hazards. It should be used in every situation before exposure measurement.

Comprehensive inspection methods have been devised to assess many factors in the hope that good correlation would be found with measurements of airborne asbestos. These methods have not shown good correlation and simpler methods of inspection and assessment are preferred. These emphasise friability and indicators of releasability such as condition of asbestos-containing materials, potential for future damage, disturbance, or erosion. Assessments should be made with a minimum of ambiguity in judgements, for example high/low, present/absent ratings. This may be combined with the identification of individuals thought to be at greatest risk, and a description of the nature and scale of the hazard.

Settled surface dust sampling and analysis indicate the presence and level of asbestos contamination and the hazard, but cannot reliably indicate airborne dust concentrations.

At the end of the inspection and assessment process a judgement may be made whether or not asbestos is being released and thus causing some unquantified exposure. It can be said that a risk has been established (ie, hazard + exposure) but the significance of the risk is still uncertain and unquantified.

2. **Measure the actual or potential exposure (respirable fibres in air) from which health risk may be estimated**

Measurement of exposure over time is important in quantifying risk. Exposure measurement by air sampling represents typical exposure, but only provides a measure of exposure over the time of sampling. It gives no indication of the potential
levels of exposure at other times. This adds to the uncertainty of risk assessment and underscores the importance of inspection and assessment.

Low concentrations of asbestos in commonly found non-occupational settings can be difficult and expensive to sample and analyse, so should be undertaken only where hazards appear to be high, children may be exposed, and/or control is likely to be costly or difficult to achieve.

**Graded Response Protocol**

**How to use the Graded Response Protocol and the Report Sheets**

The *Report Sheets* at the end of the guideline have spaces for information and decisions corresponding to the *Graded Response Protocol*. They repeat the information required but once users are familiar with the guidelines, the *Report Sheets* may be used in the field without the whole document. The disk provided with these guidelines may be used to ‘customise’ the *Report Sheets* as users become familiar with them and decide to include or delete information from them.

**The principle is to grade the response to the level of hazard.**

In practice, while Step 1 will always be completed, Steps 2 and 3 will be completed only if appropriate.

**Step 1 : Initial response and preliminary assessment**

The aims of Step 1 are to:

- provide an initial response and support for the concerned person
- identify the agency most appropriate to take further action.
1.1 **Gather and record information**

Using the *Report Sheets* (Appendix 2), collect initial information from the informant by personal or telephone interview or possibly by a site visit.

**Informant details**

- contact person, their address and telephone number
- nature of concern.

**Location of potential asbestos hazard, type of building and building use**

- location (street address) of the suspected asbestos-containing material
- type of building(s) (eg, dwelling, school, public building)
- building use(s)
- other type of location (eg, a landfill, building or demolition site).

**Nature, condition, quantity and accessibility of potential asbestos hazard**

- description of the suspected material
- information on the date that the asbestos-containing material was installed (if known)
- whether it is likely to be an asbestos-containing material (judging by the description and age)
- whether it is likely to be a friable asbestos-containing material
- whether it is inside or outside the home or building
- how accessible the suspect material is
- potential for future damage, disturbance or erosion of the suspect asbestos-containing material
- quantity of the material
- condition of the material (eg, deteriorating asbestos-cement product, damaged insulation)
- whether the potential hazard is airborne (eg, visible dust or other assessment).

**Actions that may translate the potential hazard into a risk to health**

- who is taking, or proposing to take, or has taken the action
- the nature of the action or disturbance affecting the suspected asbestos-containing material
- whether it appears likely that asbestos will be (or has been) released by the actions
- when the action or disturbance of asbestos-containing material is proposed, or when it happened
• whether a change in building use is proposed that may require interior modification and disturbance of services and surfaces that may use asbestos-containing material

• whether renovation or re-modelling is proposed that may disturb asbestos-containing material.

**Persons at risk**

• who may be at greatest risk (eg, children, smokers)
• how exposure could occur to the persons at risk
• the period over which may the persons have been, or will be at risk
• the state of health of the persons or population at risk of exposure.

**1.2 Identify and assess the potential hazard**

Identify and assess:

• the possible presence of a friable asbestos-containing material,* its condition and accessibility

• actions that may release asbestos fibres.

**1.3 Decide whether to proceed to Step 2 — Inspection and Hazard Evaluation**

Take into consideration the need to:

• take action where it appears that work on asbestos-containing material may already have released asbestos fibres

• give support to the informant by explaining the nature of the hazard and its management.

**1.4 Identify and inform the agency most appropriate to take any further action**

Consider whether the identified asbestos hazard requires the attention of the Occupational Safety and Health Service (OSH), the territorial authority or (less likely) the Regional Council.

• Asbestos contamination arising from workplaces, including the actions of contractors at private homes, will require the attention of OSH (OSH 1995).

• Nuisances and/or conditions injurious to health should be acted upon by the territorial authority.

• The discharge of asbestos as a contaminant would involve the Regional Council.

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*A friable asbestos-containing material is defined in the Asbestos Regulations 1983 as *any material that contains asbestos and can be crumbled, pulverised or reduced to powder by hand pressure when dry, and non-...*
The diversion of further action to another agency does not remove the continuing duty of the public health service and the health protection team to respond to public health concerns, and collaboration with the other agencies is important.

1.5 If not proceeding to Step 2, provide support and precautionary advice

Common sense actions to avoid unnecessary exposures or hazards are required to minimise risk.

- Provide copies of the health education resource *All About Asbestos* (Ministry of Health 1996a) and, if appropriate, *Removing Asbestos from the Home* (Ministry of Health 1996b).

- Emphasise the importance of seeking expert assistance if work with asbestos-containing materials is being considered.

- Confirm information given and remove all ambiguity and make a site visit if not done already. Be certain that information given is understood.

In all cases the ability of the concerned person to understand the advice and take sensible action should be taken into account.

*Note that the goal is to reduce the potential for exposure to airborne asbestos due to the release from asbestos-containing material. A principle, therefore, is that exposure should be reduced as the result of remediation, compared with exposure if there were no remediation. Consider this at each stage of giving advice.*

Step 2: Inspection and Hazard Evaluation

The aims of Step 2 are to:

- identify and characterise hazards
- achieve actions to manage hazards.

2.1 Co-ordinate action/enforcement with the regulatory agency as appropriate

2.2 Confirm initial information

Visit the site and, using the *Record Sheets*, clarify, confirm or amend all the initial information.

- Clarify the nature and underlying factors of the concern, as an understanding of the way the risk is perceived is essential in framing advice.

- Inspect conditions at the site.

- Complete a new *Record Sheet* only if absolutely necessary. (Keep the first copy as a record of the initial step.)
2.3 **Obtain and record additional information to enable an adequate hazard evaluation**

Collect information to enable a proper assessment and characterisation of the hazard. Records of buildings held by the owners or the local authority may give some indication of asbestos-containing materials used in the building construction (and what asbestos-containing material may have been removed), but should not be relied upon.

- **Identify any further suspect asbestos-containing material.**
- **Determine composition**, type and approximate amount of asbestos present in the suspected asbestos-containing material from the information in Chapter 1 or by sampling and analysis (see Appendix 1). Complete the asbestos sample record sheet(s) which also provides a space for results.
- **Examine the condition** of the suspect asbestos-containing material for deterioration.
- **Note the accessibility** of the suspected asbestos-containing material (eg, potential for damage, vandalism etc).
- **Assess the quantity** of asbestos-containing material.
- **Obtain a clear description of the actions** that could disturb asbestos-containing material and lead to the release of fibres (eg, drilling and cutting, removal, reuse, renovation, repair or redecoration).
- **Identify persons at risk** and the routes of exposure.
- **Document** the information in the *Report Sheets*.

2.4 **Identify and characterise hazards**

From the complete information obtained, including the results of sample analysis, identify each opportunity for the release of asbestos fibres (including the likely potential release from further damage) and characterise each hazard with information about:

- the type of material: friable/not friable
- the type of asbestos: chrysotile/amphibole
- the degree that asbestos may be released: significant/not significant
- the rank of hazard (high/low), assuming that there is an open pathway for exposure to vulnerable persons.

Note that the presence of amphibole or mixed asbestos types is more hazardous than chrysotile alone.

At this point of the inspection and assessment process a judgement may be made whether or not asbestos is being released and so whether a risk has been established (ie, hazard + exposure). However, the significance of the risk is still uncertain and unquantified.

2.5 **Decide whether to proceed to Step 3 — Exposure Measurement, Risk Estimation and Assessment**
A decision whether to proceed to Step 3 will depend on the factors below:

- the ranking of the hazard in 2.4
- the actual likely open pathways for exposure
- the presence of vulnerable persons
- the number of persons who may be exposed
- cost versus benefit of Step 3
- how important it is to quantify the risk, as opposed to identifying the hazard, and whether such risk assessment will lead to a better decision on priorities and action.

In particular take into further consideration the need to:

- show adequate support and understanding for serious concerns
- assist understanding and reduce uncertainty and/or suspicion
- provide ‘hard’ evidence to support the need for action and/or enforcement
- add to an understanding of environmental conditions and so assist in future situations.

A decision to proceed to Step 3 is not exclusive to providing advice as in 2.6 below. Advice should be offered at this stage regardless of proceeding with exposure measurements and risk assessment.

### 2.6 Provide advice to manage hazards and potential exposure, and ensure action is taken

Common sense actions to avoid unnecessary exposures or hazards are required to minimise risk.

- Provide copies of the health education resource *All About Asbestos* (Ministry of Health 1996a) and, if appropriate, *Removing Asbestos from the Home* (Ministry of Health 1996b).

- Emphasise the importance of seeking expert assistance if work with asbestos-containing materials is being considered.

- Confirm information given and remove all ambiguity and make a site visit if not done already. Be certain that information given is understood.

In all cases the ability of the concerned person to understand the advice and take sensible action should be taken into account. Record the advice given in the *Record Sheets*.

### Step 3 : Exposure Measurement, Risk Estimation and Assessment

The aims of Step 3 are to:

- confirm the presence and type of asbestos in air
- estimate the exposure to respirable asbestos fibres
- communicate the risk
- recommend actions to manage risk.

### 3.1 Co-ordinate action/enforcement with the regulatory agency as appropriate
3.2 *Sample and analyse to determine presence and type of asbestos*

Steps 1 and 2 cannot confirm the presence of asbestos fibres in the air, their type or their concentration. Sampling and analysis of suspected asbestos-containing materials will be relatively simple and quick as no quantification is sought. Air may be sampled or, through discussion with the laboratory, settled surface dust or bulk material samples may be useful.

Take into account:

- the person(s) and location(s) that are of interest
- the factors considered in Appendix 1
- the limitations of the information which will do little more than assist in the characterising of the hazards as considered in 2.4.

3.3 *Measure the concentration of respirable asbestos fibres in air*

Sampling and analysis of the air can provide unambiguous identification of asbestos type and fibre size, as well as fibre numbers per unit volume. The laboratory should be consulted on using appropriate methods to ensure there is no uncertainty about fibre types and that fibre numbers are not under- or overestimated. Sampling should be undertaken only following consultation with the examining laboratory, and with a clear idea of how the results can be used usefully.

3.4 *Estimate the exposure under normal conditions*

Conditions chosen should represent the normal exposure conditions for the target person, not the most or least severe exposures.

Sampling should reflect the spaces most used so that an integrated exposure may be derived. Complications that may arise are changes in use depending on the weather (inside and outside), and changes of use between weekday and weekend. A sufficient number of samples should be planned to reflect these and other variations. The duration of sampling airflow through the filter membrane will be a factor in the sensitivity of the results and needs to be discussed with the laboratory.

When reliable results have been obtained the concentration will be expressed in fibres per unit volume. The fibres of greatest interest are those not less than 5 microns and not more than 100 microns in length, not less than 3 microns in width, with a length to width ratio of not less than 3 to 1.

Adjustment may be made to exposure to allow for time spent in a particular place (eg, at work) if it is assumed that there is no exposure to asbestos elsewhere. This saves the effort of measuring fibre concentration in other places but may lead to errors in overall exposure.

A factor of 2.8 allows for the times at work and at home, and for differing lung ventilation rates at work and at rest. It is based on the assumption of 20 m$^3$/day (140 m$^3$/week) for total ventilation and 10 m$^3$/8 hour workday (50 m$^3$/week) in the occupational setting (ie, a factor of 140/50 = 2.8). For a person at home there will be no adjustment (as 24-hour sampling should be done anyway). If cumulative exposure is required, it will be the concentration multiplied by time (ie, fibres/millilitre × years). This is usually expressed as fibre/year/ml. Sometimes this is written as f/ml-year (which wrongly suggests that years may be a denominator).
3.5 *Estimate the excess risk from the exposure and assess its significance*

Estimates of excess risk may be made by:

- comparing the fibre concentration to which a person is exposed with the typical exposures and lifetime risk estimates
- comparing the significance of the estimated risk against criteria of acceptable risk, taking into account the person at risk
- noting that these risk assessments are more applicable to community risks rather than for individuals. The estimate achieved by undertaking this risk assessment should then be categorised as 'high' or 'low' rather than provided to the exposed person as a number. A number may imply a degree of scientific accuracy that is not possible to achieve in risk assessment.
- noting that the acceptability of the risk to the individual exposed is for them to decide; the expert assists by providing information and improved understanding.

3.6 *Communicate the risk*

Risk estimates calculated by the methods above are estimates only, and may be inaccurate by several orders of magnitude. They are useful for comparison with other risks and so assist in the making of decisions about priorities and the use of resources. The perception and judgement of risk by the public is based on many other factors discussed earlier in this guide.

For this reason, as noted above, risk assessments should not be conveyed as numbers but as categories of ‘high’ or ‘low’ and placed in context with common risks such as road traffic crashes, deaths from smoking tobacco, and so on. Individual susceptibility, tobacco smoking, other exposures to asbestos, and exposures to other hazardous substances will impact on an individual’s risk of adverse health effects from any given exposure to asbestos.

Further guidance on risk communication is provided in:


3.7 *Recommend actions to manage excess risk and ensure action is taken*

Common sense actions to avoid unnecessary exposures or hazards are required to minimise risk. The assessment of risk (rather than hazard) may provide a sharper focus on what needs to be done.

- Provide copies of the health education resource *All About Asbestos* (Ministry of Health 1996a) and, if appropriate, *Removing Asbestos from the Home* (Ministry of Health 1996b).
- Emphasise the importance of seeking expert assistance if work with asbestos-
• Confirm information given and remove all ambiguity and make a site visit if not done already. Be certain that information given is understood.

In all cases the ability of the concerned person to understand the advice and take sensible action should be taken into account. Record the advice given in the Record Sheets.
Roles and Responsibilities

Agencies with roles and responsibilities in preventing or managing asbestos hazards in non-occupational settings include:

- public health services
- territorial authorities (city and district councils)
- property owners, property managers, and property occupiers.

Roles and responsibilities must be considered in three contexts.

1. The regulatory agency with statutory authority to act to bring about remedial action.
2. The person or organisation responsible for taking remedial action.
3. Agencies with statutory functions to ensure that the facts are established and the best advice is made available.

The management of asbestos hazards needs to be exercised in a collaborative way to avoid duplicated effort and wasted resources, and to ensure the most effective statutory response.

Role of the Public Health Service

The public health service may often be first to be made aware of a concern about asbestos. Preliminary investigations (as set out in the Protocol following) should establish the responsible person(s) and any need to pass on this information to the others. Particular roles for the public health service include:

- specialist advice in epidemiology and toxicology where risk assessment is complex
- preparation of statements or advice about the risks to individuals or groups
- scientific advice on whether sampling is likely to be useful
- measurement and identification of asbestos
- advice on how to effectively communicate statements about risk to the public and the media
- advice to lead agencies with statutory authority to effect remedies.
Asbestos Regulations 1983

The place of disposal of asbestos waste is to be approved by the Medical Officer of Health and covered to a depth of 25 cm (regulation 27 (2a)). Other matters involving the public health service or the Director-General of Health include:

- exemptions from regulations, and their revocation
- approval of protective equipment
- power to take samples
- designation of asbestos dust.

Role of the health protection officer

The skills of the health protection officer are necessary for:

1. **Initial response and preliminary assessment**
   - Receive, record and interpret queries and concerns.
   - Identify the cause of concern or complaint, location and associated parties.
   - Provide initial response and support to concerned persons.

2. **Inspection, hazard evaluation and risk assessment**
   - Identify person(s)/groups at risk.
   - Identify compounding risks (eg, smoking, occupational exposure to asbestos).
   - Identify sources of asbestos, asbestos hazards, and open pathways of exposure.
   - Collect environmental samples for laboratory analysis.
   - Interpret laboratory results.
   - Seek advice from the Medical Officer of Health and others if necessary (eg, epidemiologists, toxicologists).
   - Assess the likely health risk from the information collected.

3. **Information and risk communication**
   - Explain how risk should be managed, in consultation with the regulatory agency.
   - Consult with building owners, building managers, and occupiers.
   - Refer information to the regulatory agency with statutory authority to bring about remedial action.

4. Management plans
• Assist regulatory agency to determine appropriate action including, if necessary, the design of appropriate abatement and exposure control strategies.

• Subject to the approval of the regulatory agency, advise building owners, building managers, and occupiers on the implementation of the management plan.

• Monitor the implementation of key abatement processes.

• Ensure clearance monitoring has been undertaken (if appropriate).

• Maintain communication and co-operation with the regulatory agency and other parties (recognising privacy).

• Evaluate the effectiveness of the management plan.

5. Enforcement

• Encourage enforcement by the regulatory agency.

The public health service may also consider health promotion initiatives aimed at increasing awareness of potential asbestos-containing materials and hazards associated with them. Health education resources are available to support such initiatives. A general information booklet, All About Asbestos (Ministry of Health 1996a), has been prepared targeting the general public. While it should always be recommended that expert assistance be obtained if work with asbestos-containing materials is being considered, a further information booklet, Removing Asbestos from the Home (Ministry of Health 1996b), is available if required.

Role of Territorial Authorities

In non-occupational settings, territorial authorities will normally be the regulatory agency with statutory authority to bring about a remedy. Territorial authority enforcement officers may collaborate with the other agencies, and the public health service should provide the territorial authority with information and advice. Territorial authorities have duties and powers to prevent or control asbestos hazards under the following legislation.

Health Act 1956

The Health Act 1956 includes provision for territorial authorities to:

• improve, promote and protect the public health
• cause steps to be taken to abate nuisances or to remove conditions likely to be injurious to health or offensive
• enforce regulations under the Act
• make bylaws for the protection of public health
• issue cleansing orders or obtain closing orders
Section 29 of the Act defines health ‘nuisances’ and generally includes matters ‘likely to be injurious to health’. Particularly relevant are references to:

- accumulations or deposits
- situation or state of premises
- conduct of any trade, business, manufacture or other undertaking.

Enforcement is determined by the District Court if a nuisance is not abated voluntarily except where immediate action is necessary. Works undertaken by a territorial authority to abate a nuisance may result in costs being recovered from the owner or occupier. It should be noted, however, that any person can lay information regarding a nuisance. A nuisance has to exist before any action can be taken and, accordingly, is not an effective means of preventive action.

Under section 41 of the Act, the territorial authority may serve a Cleansing Order on the owner or occupier, specifying the work to be carried out and the time in which to complete it. A Closing Order made under sections 42 or 44 can be issued as a last resort to protect the occupants, but such action will not, of course, resolve any external release of asbestos.

**Building Act 1991**

The Building Act 1991 includes provision for territorial authorities to:

- require work to be done to prevent buildings from remaining or becoming dangerous or insanitary
- take measures to avert danger or rectify insanitary conditions
- issue project and land information memoranda revealing (*inter alia*) known hazardous contaminants.

The First Schedule to the Building Regulations 1991 is the New Zealand Building Code and the most relevant section is that relating to ‘safety of users’, in particular the following clauses:

F1 — Hazardous Agents on Site
F2 — Hazardous Building Materials

F1 is concerned with assessing sites to confirm or deny the existence of hazardous agents or contaminants, and subsequently managing risks to buildings or users in the event a building is constructed on the site. F2 requires potentially hazardous building materials to be used in ways that avoid undue risk to people. Harmful surface or atmospheric concentrations are prohibited. Clause 2.0 of Acceptable Solution F2/AS1 discusses asbestos. Clause 2.0.1 provides that:

Asbestos or materials containing asbestos are acceptable when the asbestos is bonded in a matrix, or encapsulated with an appropriate coating to ensure that no free particles can escape.

A building consent will be required in most cases where demolition or structural alteration works are to occur. The ability to impose conditions on building consents appears to be limited to inspections (section 76) or notice to be given before covering
work (regulation 6). Nevertheless, territorial authorities could, at their discretion, include a ‘Hazardous Building Material Warning’ on relevant consent documents.

Project Information Memoranda (PIMs) issued by territorial authorities must include information identifying special features of the land relating to the likely presence of hazardous contaminants where it is:

- relevant to the design and construction or alteration
- known to the territorial authority
- not apparent from the operative district plan.

Section 44A of the Local Government Official Information and Meetings Act 1987 allows for an application for a LIM (Land Information Memorandum). Section 44(2) states that included in the LIM there must be information concerning the ‘likely presence of hazardous substances’.

PIMs are required for a Demolition (Building) Consent. The PIM will advise if any restriction on demolition, for example a Heritage listing, exists in the City or District Plan.

Sections 64 to 71 deal with dangerous or insanitary buildings. It is possible that the presence of asbestos could lead to a building being considered ‘dangerous’ or ‘insanitary’ for the purpose of the Act. ‘Insanitary’ buildings include those of such construction as to be likely to be injurious to health. In determining whether or not a building is insanitary, consideration must be given to:

- size of the building
- complexity of the building
- location of the building in relation to other buildings, public places, and natural hazards
- intended use of the building, including any special traditional and cultural aspects of the intended use
- expected useful life of the building and any prolongation of that life
- reasonable practicality of any work concerned
- in the case of an existing building, any special historical or cultural value of that building
- any matter that the territorial authority considers to be relevant
- provisions of the building code.

Enforcement action is by way of formal notice requiring a remedy. An application for a Court Order authorising the Council to do required work at the owner’s expense may be made on default.
An offence is committed if a building is used for a purpose for which it is not safe or sanitary.

Cases relating to sections 64 and 65 of the Building Act 1991 may be useful references. These include *Hyslop v Dunedin City Council* (21.6.93) AP 35/93 (J. Doogue, HC, Dunedin) and *Marlborough District Council v Chaytor* (1995) DCR 382. The first case deals with asbestos on a building site.

**Resource Management Act 1991**

- Section 15 prohibits the discharge of contaminants into the environment except where some form of authority or consent exists.
- Section 17 requires every person to avoid, remedy or mitigate adverse effects on the environment.

Enforcement orders (Planning Tribunal) or abatement notices (enforcement officer) may be issued requiring a person to cease, or prohibiting a person from commencing, anything that is or likely to be:

- noxious
- dangerous
- offensive
- objectionable.

Similar action may require a person to do certain things to avoid, remedy or mitigate adverse environmental effects.

The Resource Management Act 1991 also includes provision for territorial local authorities to make plans and rules which deal with hazardous substances. The health protection officer should be aware of the appropriate provisions of plans, since advice given in the absence of such knowledge could create difficulties.

**Local Government Act 1974**

- Part XXXI of the Act provides for local authority refuse collection and disposal services.
- Disposal must be undertaken so as not to be a nuisance or injurious to health. Work generally must be to the satisfaction of the Medical Officer of Health.
- Bylaws may also be made prohibiting or regulating the deposit of refuse of any specified kind.

Demolition material containing asbestos will almost certainly arrive at Council disposal sites. Service managers will need to determine strategies to deal with this issue to ensure environmental risk and Councils’ liability are minimised. Asbestos waste may only be disposed of at sites approved by the Medical Officer of Health, and must be covered to a depth of 25 cm (Asbestos Regulations 1983).
Role of Property Owners

Owners, and their agents, should inform occupiers of the presence of asbestos-containing materials and must also act to remedy any asbestos hazards.

Statutory obligations

Property owners must:

- meet statutory obligations (eg, under the Health Act 1956, the Building Act 1991)
- obtain necessary building consents and any other necessary consents including those for the disposal of asbestos wastes.

Asbestos Regulations 1983

The original Asbestos Regulations 1983 were directed primarily towards the control of asbestos in the workplace and placed general duties on employers and employees. However, the Asbestos Regulations, Amendment No. 1, 1986 introduced the definition of restricted work, which includes work on asbestos used in insulation and lagging; or demolition of buildings containing asbestos; or encapsulation of materials containing friable asbestos; or the use of power saws or abrasive discs for asbestos-cement pipe cutting (without dust control). The amended regulations state ‘that no person shall undertake restricted work unless he holds a Certificate of Competence’. The certificate is now issued by the Secretary of Labour.

The effect of the regulations, as amended, extends control over certain actions with asbestos (the ‘restricted work’) to all persons and so makes it unlawful for home owners (who do not hold certificates of competence) to do ‘restricted work’. Restricted work must be notified to OSH and the public health service of Crown health enterprises (regulation 6B). OSH branch offices hold information on contractors available in an area who hold certificates of competence for asbestos work.

The most common work undertaken by home owners is likely to be with asbestos-cement products (roofing and wall cladding) and decorative finishes. Providing home owners do not try and encapsulate those products if they have become friable, or demolish (as opposed to repairing) buildings containing asbestos, it appears that they would comply with the regulations. The restrictions regarding thermal or acoustic insulation and lagging would still apply as would any work with power tools on asbestos-cement pipes.

The intention of the Department of Labour is that the existing Regulations will be amended and made pursuant to the Health and Safety in Employment Act 1992. That Act’s principal object is to provide for the prevention of harm to employees at work and does not encompass work done on residential property by home owners. Accordingly, OSH feels that home owners would be able to do work on asbestos-containing materials in their own homes, as it is not the intention to require such work to be done by persons holding certificates of competence.
Assessment and management of hazards

Property owners must:

- assess hazards, including damage to asbestos-containing materials or careless or incomplete removal or encapsulation.

Implementation of management plans

Property owners must:

- administer and fund abatement work, environmental sampling, and analysis
- engage certified contractors for abatement work
- monitor the performance of contractors
- ensure routine maintenance work practices prevent asbestos hazards being generated
- monitor the condition of the property and abatement work to ensure that asbestos hazards do not recur
- inform contractors, occupiers and other building users of any asbestos hazards
- advise occupiers on how to manage risks
- inform purchasers of known or suspected asbestos hazards.

Examples of property owners documenting their roles are:


Role of property occupiers

Tenants should advise their landlord of any potential asbestos hazard developing, minimise damage to asbestos-containing material, co-operate with the landlord in facilitating abatement work and act on advice from the health protection team regarding the avoidance of asbestos hazards.
References


Appendix 1
Asbestos Sampling and Analysis

Main Points

Air sampling

- Decide on the objective of sampling; generally this will be of ambient conditions in areas occupied by persons at risk.
- Discuss the sampling objective and methodology with the laboratory.
- Schedule sampling to represent the normal cycle of activity in the area of interest.
- Keep full records of the sample and of the methods used in its examination.
- Agree measurement criteria with the laboratory, including size and types of fibres to be measured, and sensitivity required.
- Agree sampling protocol with laboratory including sampling rate and duration.
- If you need to compare the results with other or earlier samples, make sure you are comparing samples using similar protocols.

Sampling asbestos-containing material

- If in doubt that a material contains asbestos, have it examined by the laboratory.
- Follow the advice on how to take a sample.
- Be clear what it is you need to know from the laboratory examination.
Introduction

Sampling and analysis of asbestos-containing materials will have two aims:

- the identification of asbestos and its types in an asbestos-containing material or in air
- the measurement of exposure, by determining the concentration of asbestos fibres in air.

The identification of asbestos fibres requires sophisticated technology whether the identification is of suspected asbestos in a material, or of the presence of asbestos in a dust. The measurement of exposure to particles that are invisible to the naked eye and a hazard to health requires microscopic examination that identifies the size and types of asbestos fibres. The sampling strategies and methods of examination need to be selected for each particular circumstance, requiring close co-operation between the examining laboratory and the health protection team.

Air Sampling

Air sampling strategies

Aspects to consider of an air sampling strategy are:

1. objectives of air sampling
2. sampler configuration and design
3. personal versus area sampling
4. scheduling of sample collection
5. statistical design
6. record keeping and quality assurance.

1. Objectives

Once the presence of asbestos fibres in air has been established, several different objectives can be addressed in evaluating exposures to airborne asbestos, including:

1. Measurement of personal exposures of individuals at particular risk, or of those who serve as sentinels for groups having similar exposures.

2. Measurement of ambient concentrations in areas occupied by persons at potential risk. These should be done during normal conditions of occupancy and activity. More elaborately, time-weighted average exposures could be calculated by combining time-activity patterns of individuals or groups and the asbestos concentrations in the areas in which they spend their time.

3. Source-related measurements. These can indicate the potential for human exposure and may range from the measurement of actual fibre release from asbestos-containing material (whether disturbed or not), to estimates of the potential fibre release under specific simulated circumstances.
2. **Sampler configuration and design**

The aim of configuration and design is to obtain a uniform deposition of a representative sample of airborne asbestos onto the filter surface. The laboratory should be informed of the exact situation and objectives and be asked to advise on appropriate steps.

An option is the use of an aerodynamic size-selective inlet to prevent access to the filter of background particles and fibres that are too large to penetrate the upper respiratory tract. Inlets to accomplish this have been designed to meet the essentially equivalent criteria of ‘International Standard, ISO 1983’ (HEI 1991).

3. **Personal versus area sampling**

Building employees who disturb asbestos-containing material in the course of their work will be exposed to highly variable air concentrations of fibres. These are occupational situations (the responsibility of OSH) requiring personal monitors drawing from the breathing zone. It is conceivable, however, that a home owner who insists on removing, or working on, asbestos-containing material in the home may require similar personal monitoring.

For building occupants not in contact with asbestos-containing material, samples collected from representative fixed locations should provide adequate estimates of personal exposure. Compared with personal sampling, area sampling is more practical and efficient and higher sampling air flow rates are possible.

The addition and removal of asbestos in air may be viewed in terms of sources and sinks. The primary source will be the asbestos-containing material that is releasing fibres; the secondary sources will be the re-suspension of fibres that have settled within the space. Sinks will be the removal and settling of fibres. The concentration of fibres measured will be the equilibrium concentration over the time of sampling. Activity and ventilation will therefore influence the concentration measured and should remain as close to the norm as possible.

4. **Scheduling of sample collection**

For general building occupants, air concentrations of asbestos fibres should be measured over relatively long time periods corresponding to occupancy cycles, that is, at least one full day or long enough to capture typical building activity patterns.

In buildings with air conditioning or ventilation systems, the pattern of exposure may vary with the seasons or even with individual days. Besides the indoor sampling, outdoor air samples should be collected near ventilation inlets to determine the contribution that outdoor air may make to indoor fibre concentrations.

In the home, the variation of activity between weekday and weekend activity should be reflected as well as changing activity patterns (particularly of children) due to the weather.

5. **Statistical design**

A statistical design should be discussed and agreed with the laboratory, taking into account:

1. the purpose of the study
2. the definition of the population under study

3. a statistical sampling strategy to obtain a representative sample of that population

4. the need for multiple (spatial), or repeated (temporal), sampling

5. sample size, for example to estimate the mean exposure to a specified degree of confidence

6. the expected temporal and spatial variability in measurements.

Because of the analytical limitations for a single sample analysis when evaluating the concentration of fibres, many of the samples are generally below the analytical sensitivity. An appropriate statistical strategy may need to be considered by the examining laboratory when interpreting such data (Rao et al 1991).

6. **Record keeping and quality assurance**

Proper interpretation of air sampling data depends upon full consideration of all data relevant to the sample. In addition to the objectives above, information will be needed to verify whether concentrations exceed some acceptable value; show a trend; correlate with building activities, maintenance or asbestos removal; or correlate with use of ventilation or air conditioning systems.

Accordingly, all sampling data should be related to factors that may influence the results or be of value in interpretation. Record sheets are provided at the end of the document.

7. **Air Sampling and Measurement of Asbestos**

*Purpose of Measurement*

Measuring airborne asbestos evaluates the potential or extent of human exposure to airborne fibres. The measurement strategy needs to recognise the following (Johnson et al 1982):

1. Fibres within certain size ranges, if respired into the lung, can cause lung fibrosis, lung cancer, and mesothelioma.

2. Health effects depend on where fibres are deposited (or migrate) and their physical-chemical properties. Important variables are length, width, composition, surface chemistry, and durability. (At high exposures, which exceedingly unlikely in the context of these guidelines, consider the rate at which inhaled particles of all types accumulate, and whether this alters normal particle clearance rates. In such circumstances additional sampling to detect peaks is required.)

3. Other particles and fibres coexist in air, often in much greater concentration than asbestos, so the appropriate method should be used.

4. Methods to identify and count asbestos fibres need to reflect the very different conditions presented by environmental concentrations, where concentrations are generally very low, compared with occupational situations.
5. The sensitivity of measurement methods needs to satisfy either (a) typical ambient air concentrations; or (b) levels commensurate with lifetime risks of the order acceptable to the public.

There is a question about the measurement index best suited to assess the relatively low exposures and risks in the public environment (Bignon et al 1989). Bearing this in mind, the guidance of the analysing laboratory should be sought on sampling methods and the analytical information required.

**Sampling of Suspected Asbestos-containing Materials**

**Objectives of sampling**

The objective of sampling a suspected asbestos-containing material is to verify, or otherwise, the presence of asbestos and provide other information that will help in a risk assessment. Identification of asbestos can only be achieved by scientific examination. Any suspect material should always be sent for examination as asbestos has been found to occur when not expected. Fibre type and the condition of the asbestos-containing material are also important to determine as they may influence the risk assessment.

**How to sample asbestos-containing material**

- Discuss the purpose and approach to sampling with the laboratory.
- Note that asbestos in some materials may not be uniformly distributed and composite samples may be needed. Laboratory advice should always be obtained prior to sampling.
- Ensure your safety, from both asbestos fibres and accident, while taking a sample. Friable material easily damaged by sampling may release significant numbers of fibres — wear at least a half-face respirator.
- Wet the material to be sampled with water.
- Take a representative quantity of about 10 grams, say the size of a 10-cent coin or a teaspoonful, disturbing the sample as little as possible. (A core sample may be required for sprayed or trowelled insulation. Preferably use a single-use sampler that also acts as a container — such as an acrylic tube, about 12 mm width and 100 mm long, bevelled to a cutting edge at one end fitted with caps.)
- Label with a unique number and place in a clean plastic bag; seal and protect from physical damage by packing.
- Clean debris with wet cloth and discard in a plastic bag; seal material with paint or core hole with a sealant.
• Complete relevant information in the sample record using a unique sample number.

• Send to the laboratory.

**Information to be sought**

• Presence of asbestos
• Types of asbestos
• The methods used in examination.

The laboratory may be able to offer an opinion as to the approximate portions of asbestos in the sample if requested. If asbestos is 1 percent or greater by mass, consider material to be asbestos-containing material. The need for this determination is likely to be necessary only if there is some doubt about the type of asbestos-containing material.
Appendix 2

Report Sheets

How You Can Copy the Report Sheets and Adapt Them For Your Own Use

This document will be available on micro floppy disk in Microsoft Word format on request from the Information Officer, Corporate Communications, Ministry of Health, so that the Report Sheets may be easily reproduced and adapted if necessary to suit individual cases.

Users may also find it useful to copy parts of the text from the Graded Response Protocol and other material into the Report Sheets.
Report Sheets

Step 1 Initial Response and Preliminary Assessment

Reference number for this investigation:

Your name:

1.1 Gather and record information

Informant details

Date:

Contact person:

Address:

Phone:

Location of potential asbestos hazard and type of building and building use

The location (street address) of the suspected asbestos-containing material:

Person responsible at the site that is the subject of concern:

Address of this person:

Nature of concern:

Type of building — for example, dwelling:

Building use:

Other type of location — for example, a landfill, building or demolition site:

Spatial relationship to the site that is the subject of the concern — how far away, up-wind, overlooking, etc. Use description from concerned person at Step 1.

Provide sketch and add information at Step 2. Consider photograph or video recording.
Nature, condition, quantity and accessibility of potential asbestos hazard

Description of the suspected material:
Information on the date that the asbestos-containing material was installed — may be known by the concerned person for their own home:
Is it likely to be an asbestos-containing material from the description in the last two items?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
</table>

Is it likely to be a friable asbestos-containing material?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
</table>

If ‘Yes’ or ‘Maybe’ proceed to Step 2.

Is asbestos-containing material inside the home or building?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

If ‘Yes’ proceed to Step 2 unless very minor and a simple recommendation can be made; if ‘No’ consider in conjunction with later questions.

Note location and other information.

Is the suspect material easily accessible to children? Note that accessibility is a measure of future damage, not exposure.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
</table>

If ‘Yes’ proceed to Step 2 unless very minor and a simple recommendation can be made.

What is the potential for future damage, disturbance or erosion of the suspect asbestos-containing material?

<table>
<thead>
<tr>
<th>High</th>
<th>Low</th>
</tr>
</thead>
</table>

See table below which combines this factor with condition.

Quantity of the material: does it exceed about 15 square metres of surfacing material?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

If ‘Yes’ proceed to Step 2 unless very minor and a simple recommendation can be made.

Condition: is the suspect asbestos-containing material in a state of good condition, minor damage or deterioration, or poor condition?

<table>
<thead>
<tr>
<th>Good</th>
<th>Minor damage/deterioration</th>
<th>Poor</th>
</tr>
</thead>
</table>

See table below for recommendations on proceeding to Step 2.

Is the potential hazard airborne? (eg, visible dust or other assessment of the concerned person. May be from asbestos-containing material in the home or building, or from adjacent activity.)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
</table>

If ‘Yes’ evidence of it being asbestos needs to be confirmed. Proceed to Step 2.

Actions that may translate the potential hazard into a risk to health

Who is taking, proposing to take, or has taken the action? This may be the home owner or a neighbour (residential or commercial), or it may be work being done or proposed in a public building or school.

Name (add description, eg, owner, neighbour):

Address:
What is the action or disturbance? Is it affecting the suspected asbestos-containing material? Add comment on scale, violence and duration. Does it appear likely that asbestos will be (or has been) released by the actions?  

| Yes | No |
---|---|
If ‘Yes’ proceed to Step 2 unless release can be managed by simple advice and person has good understanding of the hazard and precautions.

When is the action or disturbance of asbestos-containing material proposed, or when did it happen?

|  |  |
---|---|
Date:  |
Time if relevant:  |

Is a change in building use proposed? Changes in use often require interior modification and disturbance of services and surfaces that may be use asbestos-containing material. This would normally apply only to public or commercial buildings.  

| Yes | No |
---|---|
If ‘Yes’ describe the change. Consider the need to proceed to Step 2 so that preventive action can be taken and make a note.

Is renovation or re-modelling proposed? Alterations to the concerned person’s home, or to that of a neighbour, may require the disturbance/removal of asbestos-containing material.  

| Yes | No |
---|---|
If ‘Yes’ describe the change. Consider the need to proceed to Step 2 so that preventive action can be taken and make a note.

Are there actions to do with an adjacent industry or business activity? There could be many other actions to asbestos-containing material either in buildings or to do with processes or work. Note any other actions.  

| Yes | No |
Persons at risk

Who may be at greatest risk?
Name(s):
Relationship(s) to concerned person or other description:
How could exposure occur to the persons at risk? For example, where are children’s bedrooms or play areas relative to the site of disturbance of probable asbestos-containing material?
Over what period may the persons have been, or will the persons be at risk?
Who is clearly not at significant risk of exposure?
What is the state of health of the persons or population at risk of exposure?

1.2 Identify and assess the potential hazard

Report Table 1.2: Actions or Potential for Damage, Disturbance or Erosion

<table>
<thead>
<tr>
<th>Current condition of asbestos-containing material</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Unnecessary to proceed to Step 2 unless other factors are significant</td>
<td>Proceed to Step 2</td>
</tr>
<tr>
<td>Minor damage or deterioration</td>
<td>Proceed to Step 2 unless simple advice can be safely given</td>
<td>Proceed to Step 2</td>
</tr>
<tr>
<td>Poor</td>
<td>Proceed to Step 2</td>
<td>Proceed to Step 2</td>
</tr>
</tbody>
</table>

1.3 Decide whether to proceed to Step 2 — Inspection and Hazard Evaluation

Enter your decision and date here. Note the other factors referred to in Step 1.3 before deciding.

Decision:
Date:

1.4 Identify and inform the agency most appropriate to take any further action
Does the asbestos hazard identified require the attention of OSH, the local authority or (less likely) the Regional Council?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
</table>

Names of agencies:

Date approached:

Outcome:

Should the health protection team continue to be involved with the regulatory agency?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Maybe</th>
</tr>
</thead>
</table>

Roles agreed for each:

What further inspections, assessments and action plans (which may follow a similar pattern to this graded response protocol) would you recommend to any other authority?

1.5 If not proceeding to Step 2, provide support and precautionary advice

Advice based on a preliminary assessment of the hazard should be simple: take nothing for granted, and be precautionary. Discourage do-it-yourself asbestos removal, and recommend that specialist firms are called in (OSH has names and details).

Enter the advice given.

Date:

Advice given to:

Advice should be based on simple precautions, for example:

- Do not attempt to do anything to, or handle, friable asbestos.
- Avoid do-it-yourself asbestos removal. Call in specialist firms (OSH has names and details).

Provide copy of Ministry of Health asbestos resource All About Asbestos (Code 7021) and, if appropriate, Removing Asbestos from the Home (Code 7022).

Other advice given (include information on other agencies to be involved):

Who else needs to be informed/involved? (eg, landlord, property owners, other):

Follow up on Step 1 if required

Date:

Result:
Follow-up, and/or action/enforcement by other agencies (including dates and action):

In all cases the capacity of the concerned person to understand the advice and take sensible action should be taken into account.

Step 2 Inspection and Hazard Evaluation

2.1 Co-ordinate action/enforcement with the regulatory agency as appropriate

Record dates and nature of contact and consultation with OSH, territorial authority, or other (eg, Regional Council).

2.2 Confirm initial information

Visit the site and confirm or amend all the initial information by working through all the points in 1.1 of Step 1, above. Complete a new Report Sheet only if absolutely necessary. (Keep the first copy as a record of the initial step.)

2.3 Obtain and record additional information to enable an adequate hazard evaluation

Identify any further suspect asbestos-containing material (see Graded Response Protocol 2.3 for further information).

Examine the condition of the suspect asbestos-containing material for deterioration (seeking comment from the laboratory if the sample includes deteriorated material).

Note main findings in words here.

Sample for composition of the suspected asbestos-containing material. Test for friable asbestos-containing material (if not evident from a visual inspection) on site by rubbing and observe production of dust and particles; wear at least a half-face respirator. Complete sample record sheet (over) which also provides a space for results. Note: discuss with laboratory prior to sampling (refer Appendix 1).
2.3.1 Asbestos sample record

Sample unique number:
Reference number of investigation:
Reference of sample:
Relationship to other samples and their unique numbers:
Examining laboratory and contact name:
Where collected: address
When collected: date
Type of premises and use:
Owner:
Occupier:
Purpose of sample:
Type of sample: air, or asbestos-containing material (describe)
Location: description and sketch in plan and elevation of sampling position — use following sheet.
Site plan: show other potential sources of asbestos fibres (eg, adjoining structures, roads where vehicles brake) — use following sheet. Mark north point.
Sampler configuration and detail (eg, size selective inlet, membrane type, pore size (µm), area (cm²))
Sampling duration: hours (from – to, using the 24-hour clock)
Air flow rate in l/minute:
Relevant activity at time of sample collection:
Describe ventilation in area sampled: natural (what) or mechanical or air conditioning.
Describe weather during sampling (especially for outdoor sample):
   wind direction
   approximate speed
   temperature
   precipitation
   comment (eg, fine, gusty, still)
2.3.2 Blank sheet for sketch of sample location and site plan
2.3.3 Results

fibres per litre or presence of fibres in asbestos-containing material:

type of fibres and proportions:

method used in examination:

sensitivity or detection limits:

other results, comments or queries:

(attach copy of laboratory report)

2.3.4 Sketch of building and location of asbestos-containing material

Make a sketch on the following sheet of locations, and note materials found and their condition. In the case of large buildings, try to obtain a copy of layout drawing from the local authority.

Note accessibility of the suspected asbestos-containing material on sketch on next page; assess as ‘easy’ or ‘difficult’ with children in mind. Note that accessibility is a measure of future damage, not exposure.

Assess the quantity of asbestos-containing material (see Step 2.2). Note areas of surfacing asbestos-containing material on sketch on next page and lengths of pipe or duct insulation in public areas.
2.3.5 Blank sheet for sketch of building and location of asbestos-containing material
2.3.6 Describe any disturbance of asbestos-containing material

Describe the actions proposed (or that have taken place) that could disturb asbestos-containing material and lead to the release of fibres. Write in words below and enter on sketch if helpful.

2.4 Identify and characterise hazards

From the complete information obtained, including the results of sample analysis, identify each opportunity for the release of asbestos fibres (including the likely potential release from further damage). It may be useful to mark the sketch with the main potential sources in colour. Describe below:

Report Table 2.4: Characterisation

<table>
<thead>
<tr>
<th>Where</th>
<th>Friable (F) or Not Friable (NF)</th>
<th>Asbestos type: C, A or M*</th>
<th>Releasability: Significant (S) or Not Significant (NS)</th>
<th>Hazard: High (H) or Low (L)</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

* C = chrysotile A = amphibole M = mixed

Rank hazards as ‘high’ or ‘low’ assuming that there is an open pathway for exposure to vulnerable persons.

2.5 Decide whether to proceed to Step 3 — Exposure Measurement, Risk Estimation and Assessment

Enter decision: proceed to Step 3

Yes  No
2.6 Provide advice to manage hazards and potential exposure, and ensure action is taken

Report Table 2.6: Potential for Future Damage, Disturbance or Erosion and Suggested Action

<table>
<thead>
<tr>
<th>Current condition of asbestos-containing material</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>No further action now beyond operations and maintenance.</td>
<td>Operations and maintenance measures to prevent damage. May require remediation to prevent further damage or deterioration.</td>
</tr>
<tr>
<td>Minor damage or deterioration</td>
<td>Operations and maintenance and local remediation required. Prevent further damage.</td>
<td>Remediation required as soon as possible to prevent further damage/deterioration. Operations and maintenance cleaning.</td>
</tr>
<tr>
<td>Poor</td>
<td>Remediation required as soon as possible. Prevent access to minimise further damage. Operations and maintenance cleaning.</td>
<td>Remediation required urgently. Evacuate persons and isolate affected space from rest of building. Operations and maintenance cleaning.</td>
</tr>
</tbody>
</table>

Discourage do-it-yourself asbestos removal and recommend that specialist firms are called in (OSH has names and details).

Enter the advice given.

Date:
Advice given to:

Provide copy of Ministry of Health asbestos resource All About Asbestos (Code 7021) and, if appropriate, Removing Asbestos from the Home (Code 7022).

Other advice given (include information on other agencies to be involved):

Who else needs to be informed/involved? (eg, landlord, property owners, other)

Enter action/enforcement co-ordinated with other agencies from Step 2.1.

Note if asbestos waste generated and if so, how, when and where waste was disposed of.
Step 3 Exposure Measurement and Risk Assessment

3.1 Co-ordinate action/enforcement with the regulatory agency as appropriate

Record dates and nature of contact and consultation with OSH, territorial authority, other (eg, Regional Council):

3.2 Sample and analyse to determine presence and type of asbestos

Discussed with laboratory:

Date:

With whom:

Decision:

Yes No

If ‘Yes’ record method proposed

Enter sample details and results on the sample record sheet(s) (see Step 2.3).

3.3 Measure the concentration of respirable asbestos fibres in air

Discussed with laboratory:

Date:

With whom:

Decision:

Yes No
If ‘Yes’ record
Strategy:
Personal (special circumstances)  Ambient (usually)  Source (rarely)

Why the results will be useful?

Enter sample details and results on the sample record sheet(s) (see Step 2.3).

3.4 Estimate the exposure under normal conditions

(See Graded Response Protocol Steps 3.3 and 3.4 for note on adjustments)

Report Table 3.4: Exposure Estimation

<table>
<thead>
<tr>
<th>Name of exposed</th>
<th>Age</th>
<th>Date(s) of exposure</th>
<th>f/ml</th>
<th>Adjusted exposure f/ml if appropriate</th>
</tr>
</thead>
<tbody>
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</table>

Note: Tables 5.1 and 5.2 make their own allowance for durations of exposure.

3.5 Estimate the risk

Consider the estimation of excess risk in Chapter 3 Section 3.5.

Low  High

3.6 Communicate the risk

Consider the factors on risk communication in Chapter 1 (and in the other references) and summarise below the key points you will make:
**3.7 Recommend actions to manage risk and ensure action is taken**

Reconsider the advice entered at Step 2.6 in the Report Sheets, taking into account the risk estimates now available.

Recommend actions to manage risk:

Date:

To whom:

Provide copy of Ministry of Health asbestos resource All About Asbestos (Code 7021) and, if appropriate, Removing Asbestos from the Home (Code 7022).

Other advice given (include information on other agencies to be involved):

Who else needs to be informed/involved? (eg, landlord, property owners, other)

Note if asbestos waste generated and if so, how, when and where waste was disposed of.

**Follow up on Step 3**

Visit to confirm advice:

Date:

Comments:

Enter action/enforcement co-ordinated with other agencies from Step 3.1.
<table>
<thead>
<tr>
<th><strong>Glossary</strong></th>
</tr>
</thead>
</table>

| **µm** | Micron (ie, one millionth of a metre — ie, $10^{-6}$ metres). |
| **Abatement** | The removal or significant reduction of a source of hazard, and intervention to reduce exposure to a hazard. |
| **ATSDR** | Agency for Toxic Substance and Disease Registry (USA). |
| **Certified contractors** | Contractors certified under the Asbestos Regulations to supervise and/or undertake ‘restricted work’. |
| **Dichotomisation** | Division into two, as sharply defined as possible. |
| **Domestic** | In or of the home environment. |
| **Epidemiology** | The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems. |
| **Exposure** | A measure of a factor to which a population is exposed. |
| **f/l** | Fibres per litre |
| **f/ml** | Fibres per millilitre |
| **fibre.year/ml** | The product of fibres per millilitre multiplied by years of exposure. |
| **Friable asbestos** | Defined in regulation 2(1) of the Asbestos Regulations (1983) in terms of releasability as ‘any material that contains asbestos and can be crumbled, pulverised or reduced to powder by hand pressure when dry, and non-bonded asbestos fabric’. |
| **Hazard** | A source or situation of potential harm. |
| **HEI** | Health Effects Institute (USA). |
| **IARC** | International Agency for Research on Cancer. |
| **Incidence** | The number of new cases or deaths that occur in a given period in a specified population. |
IPCS
International Programme on Chemical Safety.

ISO
International Standards Organisation.

l
litre, sometimes written as L or l.

Mean
The sum of all the values in a set of data divided by the number of values.

Median
The central value in a set of data.

Micron
One millionth of a metre (also known as a micrometre).

Neighbourhood
Vicinity.

OSH
Occupational Safety and Health Service of the Department of Labour.

Para-occupational exposure
Indirect exposure to a hazardous substance brought from the workplace to another place.

PCM
Phase contrast microscopy.

PHC
Public Health Commission.

PIM
Project Information Memorandum.

Public building
Any building that the public may enter.

Remediation
All measures to remedy the potential harm from a hazard including abatement and operation and maintenance.

Restricted work

- Work involving asbestos used as:
  - thermal or acoustic insulation or linings, or fireproofing, in buildings, vehicles or ships
  - lagging around boilers, ducts, pipes or furnaces.

- The demolition of buildings, or parts of buildings or things containing asbestos.

- The use of power saws (with any type of cutting blade or abrasive disc) on asbestos-cement pipe, except when used with certified dust control equipment.

- Any work specified as restricted work by the Director-General of Health or the Secretary of Labour by notice published in the Gazette.
**Risk**  
The probability of harmful consequences arising from a hazard together with a measure of the scale or severity of the harmful consequence. In qualitative terms the risk may be said to have a probability that is ‘high’ or ‘low’ or other chosen term. In quantitative terms, the probability can range from zero (no possible harm) to unity (certainty that harm will occur). The scale and severity of the harm may be characterised by the numbers of people affected and the sort of harm (eg, death, or serious injury).

**Risk assessment**  
The systematic acquisition and evaluation of information that enables the probability, scale and severity of the risk to be described.

**Risk management**  
All actions of a management nature that are designed to minimise risk to levels acceptable to the person(s) exposed to the risk.

**TEM**  
Transmission Electron Microscopy

**TSI**  
Thermal system insulation (eg, lagging around boilers, pipes and ducts) to improve (hot or cold) thermal insulation.

**US EPA**  
United States Environmental Protection Agency.

**WHO**  
World Health Organization.
Submissions Received on the Discussion Document “The Management of Asbestos in the Non-Occupational Environment: Guidelines for Public Health Services”

DL John, Senior Environmental Health Officer, Masterton District Council
Mary Neazor, Manager Property Operational Policy, Ministry of Education
Dr Christopher Bullen, Public Health Team, Northern Regional Health Authority
James Swindells, Te Puni Kokiri
Nigel Grant, Health Protection Officer, Healthcare Otago
Yon Cheong, Co-ordinator Environmental Health, Hutt Valley Health
Rebecca Fox, Health Protection Officer, MidCentral Health
Paul Lynch, Environmental Health Advisor, Community Health, Health Waikato
Terence Moody, Principal Environmental Health Officer, Christchurch City Council
John Campbell, Corporate Environmental Health, Auckland City
Jackie Horring, Capital Environmental Services