Guidelines for the Remediation of Clandestine Methamphetamine Laboratory Sites

Disclaimer

These guidelines have been developed using a pragmatic approach to the safe remediation of non-workplace sites that have been used in the illicit manufacture of methamphetamine. Users of this document should seek expert advice to determine if this guideline is applicable to their individual circumstances. The Ministry of Health and the author will not be held liable for any actual or potential economic or adverse effect(s) arising from the use of this information.

Ministry of Health. 2010. *Guidelines for the Remediation of Clandestine Methamphetamine Laboratory Sites*. Wellington: Ministry of Health.

Published in August 2010 by the
Ministry of Health
PO Box 5013, Wellington 6015, New Zealand
ISBN 978-0-478-36653-2 (print)
ISBN 978-0-478-36656-3 (online)
HP 5213

This document is available on the Ministry of Health's website:
http://www.moh.govt.nz

Preface

Clandestine methamphetamine (meth) laboratories or 'clan labs' have been a growing problem in New Zealand. In recent years the number detected by the New Zealand Police has increased dramatically from 9 in 2000 to 135 in 2009.

Typically after a lab is discovered by the New Zealand Police, the bulk of any lab-related debris, such as chemicals and containers, is removed. However, contamination may be left on surfaces and in absorbent materials (carpets, furniture), sinks, drains and ventilation systems. Though often found in small amounts, clandestine methamphetamine laboratory (clan meth lab) contaminants may pose health hazards to people exposed to them.

In response to growing concerns over the contamination left behind at clandestine methamphetamine labs, the Ministry of Health has put together the following guidance to assist public health staff of district health boards and other agencies such as territorial authorities in addressing public concerns and giving practical advice.

These guidelines are directed at non-workplace exposure to buildings contaminated from activities associated with the manufacture of methamphetamine. The risk to health from workplace exposure is a matter for the Department of Labour.

An electronic version of these guidelines is available on the Ministry of Health's website at http://www.moh.govt.nz.

Acknowledgements

The Ministry of Health gratefully acknowledges the many valuable contributions provided by experts from central and local government, the private sector and industry in the development of these guidelines.

The Ministry also gratefully acknowledges the peer reviewers Dr Nicholas Powell, Naomi Hosted and Elizabeth McKenzie of Forensic and Industrial Science Limited, Auckland; Dr Nick Kim, environmental chemist, Environment Waikato; and Dr Deborah Read, public health physician.

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Chapter 1: Introduction

1.1 Background

Methamphetamine, or crystal methamphetamine hydrochloride (pharmaceutically referred to as methylamphetamine or desoxyephedrine), is a powerful and highly addictive synthetic drug. Methamphetamine is synthesised or 'cooked' in makeshift laboratories, using precursor substances such as ephedrine or pseudoephedrine as key ingredients. In recent years the number of clandestine methamphetamine laboratories (referred to as clan meth labs throughout this document) dismantled by the New Zealand Police has increased significantly, from 9 in 2000 to 135 in 2009.

Both acute (short-term) and chronic (long-term) health effects can arise from the manufacture of methamphetamine. Acute exposure effects may come about through direct contact with the product or waste and inhalation of the product or waste. Burns, tissue irritation and rashes can be the consequence of chemical spills and skin contact. Other health effects such as nausea, dizziness and headaches can result from the inhalation of vapours and gases (Rusnak et al 2006). Refer to Chapter 9 for further information about the potential health effects of exposure to clan meth lab chemicals or by-products/residuals.

The illicit manufacture of methamphetamine in 'backyard' laboratories creates a number of risks in relation to both public health and environmental safety. During the methamphetamine-manufacturing process, chemical compounds become airborne (volatised) and settle out, depositing onto walls, ceilings, appliances, floors, carpets and other typical household items throughout the building's interior. In addition, chemicals used to make the illegal drug may be spilled during handling. The presence of these chemicals may create health hazards for building occupants and represent potential liability to property owners. Although the New Zealand Police has developed strategies and teams for cleaning up methamphetamine laboratories, people coming into contact with these places, during or after production, are exposed to potential health risks.

In the United States over 20 states have established clean-up (remediation) standards or guidelines specifically for methamphetamine and associated chemical residue. However it is important to note that; although set in the interest of protecting human health and the environment, these levels have not been set according to health-based criteria; rather remediation standards/guidelines have been set at what are believed to be conservative levels to account for scientific uncertainty while at the same time establishing a standard/guideline that site remediation contractors can meet (USEPA 2009).

1.2 Purpose and status of the guidelines

Although methamphetamine is not the only drug manufactured in clandestine labs,[1] methamphetamine labs are the most common among them and are the focus of this document. This document provides guidance to public health services, first responders to clan meth labs and other agencies such as territorial authorities that contribute to the management of risks to health from illicit methamphetamine laboratories. It raises awareness of the need for individual compliance with occupational health and safety legislation, and compliance with legislation relating to handling, transport, storage and ultimate disposal of associated hazardous material for non-workplace properties. Because the majority of clan meth labs have been located in residential dwellings it is not the intention of these guidelines to extend to vehicles including caravans and motor homes that have been used for 'living purposes'. In circumstances where such vehicles have been used for the illicit manufacture of methamphetamine leaving behind hazardous waste residue it is recommended that they are scrapped because any remediation (which would include the disposal of all upholstery and carpeting) is likely to exceed the value of the contaminated vehicle.

For the purposes of these guidelines there are two specific areas of methamphetamine 'clean-up' – removal and remediation. Removal occurs when a methamphetamine laboratory is identified and seized by the New Zealand Police and bulk chemicals, equipment and wastes are removed by a certified hazardous waste contractor who is an approved handler[2] under contract with the New Zealand Police. This guide addresses the remediation of residual contamination left behind after the New Zealand Police and emergency responders have left the property, or when the clan meth lab and associated chemicals and wastes are otherwise removed, for example by the 'meth' cook. There is an established process for the removal and disposal of the chemical wastes; therefore, these wastes are not the subject of the remediation guidelines.

In using this document, readers should be mindful of the variation among both clandestine laboratories and the processing methods. As noted throughout the literature and succinctly stated in this document, there are no absolute guarantees that chronic health effects will be completely eliminated by remediating these impacted sites.

These guidelines have no statutory effect and are of an advisory nature only. The information should not be relied upon as a substitute for the wording of the relevant legislation or for detailed advice in specific cases, or, where relevant, as formal legal advice. If advice concerning specific situations or other expert assistance is required, the services of a competent professional advisor should be sought.

[1] In addition to methamphetamine offenders manufacture a variety of illicit drugs in clandestine labs, including amphetamines, MDMA (ecstasy), methcathinone, LSD, and fentanyl.

[2] An approved handler is a person who holds a current test certificate certifying that the person has met the requirements of the Hazardous Substances and New Organisms Act (HSNO) regulations in relation to an approved handler for one or more hazard classifications or hazardous substances (HSNO Personnel Qualifications Regulations 2001).

1.3 Management of enquiries concerning illicit clan meth drug manufacturing sites

When members of the public make enquiries concerning the remediation of illicit clan meth drug manufacturing sites the relatively large number of agencies that are potentially involved often leads to confusion and frustration. The usual agencies involved are public health services of district health boards (DHBs), the New Zealand Police, the Institute of Environmental Science and Research Ltd (ESR), regional councils and territorial authorities.

This document provides guidance to public health services on how to advise the remediation of illicit clan meth drug manufacturing sites (clan meth labs) and how to manage interagency involvement. These measures will require co-operation and co-ordination at a local level by each agency and should involve formal agreements on how to proceed. Identifying a lead agency in any given set of circumstances may be required. The following questions need to be addressed:

- Is the issue about public health?
- Who is the lead agency in that particular instance?
- What role do other agencies have?

1.4 Is the issue about public health?

Under the New Zealand Public Health and Disability Act 2000 public health means:

> the health of all of –
>
> (a) the people of New Zealand; or
>
> (b) a community or section of people.

The public health role is managed by the public health services of the DHBs as contracted by the Ministry of Health and defined in the New Zealand Public Health and Disability Act 2000.

The issues or hazards associated with remediation of former illicit drug manufacturing sites such as clan meth labs have both a general and a specific component, as derived from sections 22 and 23 of the New Zealand Public Health and Disability Act 2000.

The general component is derived from section 22 of the New Zealand Public Health and Disability Act 2000, which sets out the objectives of DHBs.

> 22(1) Every DHB has the following objectives (amongst others)
>
> (a) to improve, promote and protect the health of people and communities.

For the remediation of former illicit drug sites such as clan meth labs this obligation will be met by:

- responding to public (non-occupational) enquiries
- providing technical information and advice on matters related to the remediation of former illicit drug manufacturing sites

- directing enquiries and complaints to an appropriate lead agency
- investigating former illicit drug manufacturing site situations that may have public health implications.[3]

The specific component is derived from section 23 (functions of DHBs) of the New Zealand Public Health and Disability Act 2000:

> (h) to promote the reduction of adverse social and environmental effects on the health of people and communities.

This specific public health role relates to the definition of public health as 'a community or section of such people'. These are people not covered by statutory responsibilities of other agencies in relation to the remediation of clan meth labs and public health.

Some other agencies that have public health responsibilities relating to the remediation of clan meth labs include:

- regional councils (Resource Management Act 1991; Hazardous Substances and New Organisms (HSNO) Act 1996)
- territorial authorities (Health Act 1956; Resource Management Act 1991; Building Act 2004; HSNO Act 1996)
- Environmental Risk Management Authority New Zealand and relevant agencies with delegated responsibilities for enforcing the HSNO Act 1996 (section 97).

Each of these agencies is the lead agency under its legislation. Public health service staff need to be careful to avoid taking the lead role in situations that are properly the responsibility of the affected person or of other regulatory agencies.

1.5 Identify the lead agency in any particular instance

These guidelines exclude places of work as these are covered by the Health and Safety in Employment Act 1992. The Department of Labour is responsible for the administration and enforcement of provisions under the Health and Safety in Employment Act 1992. In 1994 the Department of Labour published *Health and Safety Guidelines on the Clean-up of Contaminated Sites*. It should be noted that it is not the intention of this guide to provide complete occupational health advice including training on any particular situation such as the remediation of former clan meth lab sites; instead it gives general advice for controlling exposure to hazardous substances that may be present at contaminated sites which can be used to develop the appropriate safety procedures.

[3] For example, in 2008 the medical officer of health, Waikato District Health Board prepared a report for the New Zealand Police as part of its investigation into a case where an individual claimed that her illness was caused by living adjacent to a clan meth lab, which had been discovered at a house in Hamilton in July 2007.

Section 13 of the Health and Safety in Employment Act 1992 places clear requirements on employers in respect to training and supervision of employees. The scope of these guidelines does not include specific recommendations for training necessary to control exposure to hazardous substances in situations such as the remediation of former clan meth labs.[4]

Ambient (outside) air is addressed through the Resource Management Act 1991 and its amendments. The Ministry for the Environment administers the Resource Management Act 1991, and it is implemented by regional councils and unitary authorities. It applies to the remediation of clan meth labs in so far as it relates to the discharge of contaminants into air, water or onto land from the illicit manufacture of methamphetamine.

1.6 Risk analysis

In most cases, remediating former clan meth labs will be concerned with personal health issues and will be related to a single person, or a family. Public health service advice can be given in these cases if workers are not involved.

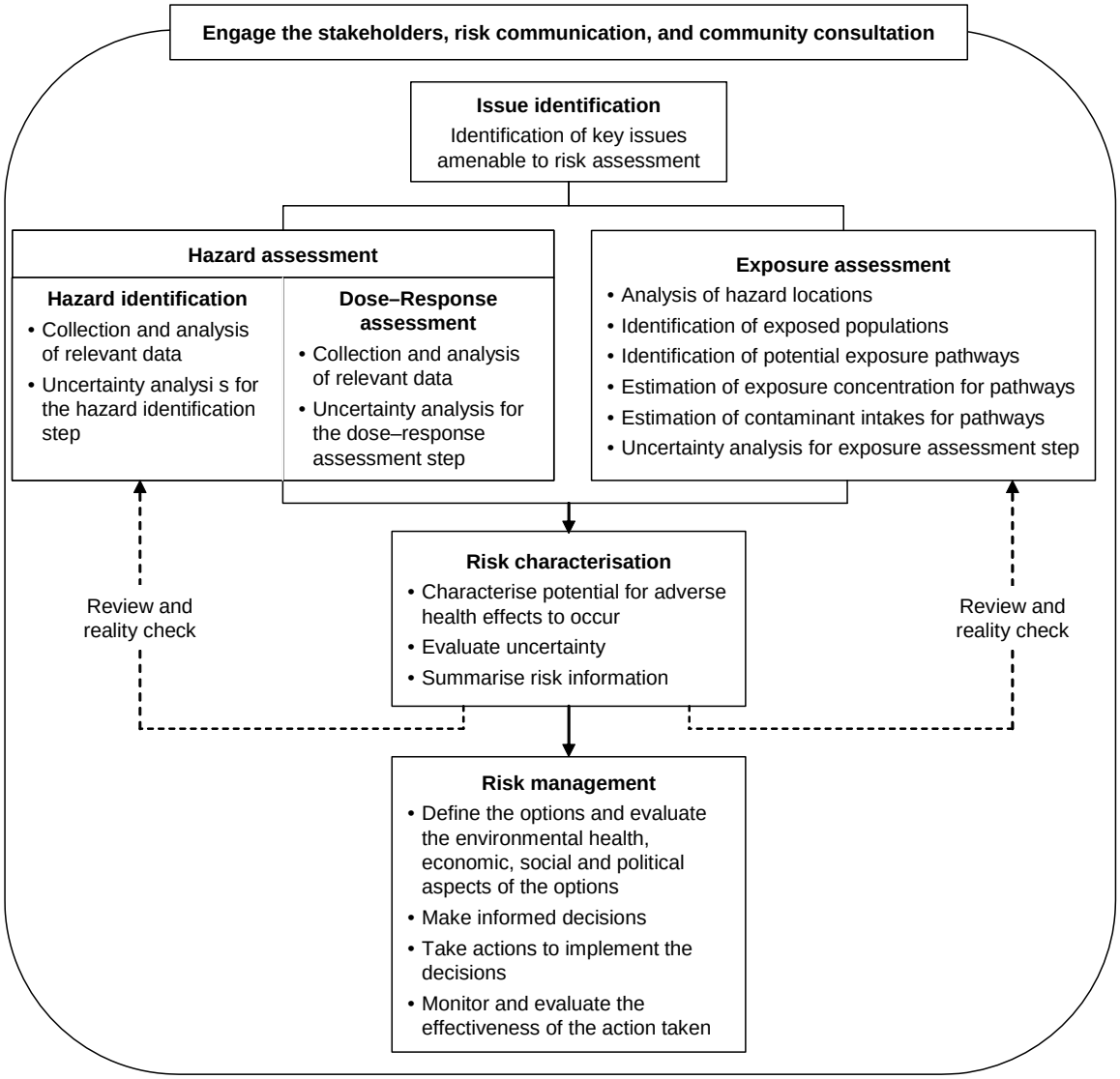
If it is considered that the public health service should be involved, a risk analysis may assist decision-making.

A public health risk analysis model is outlined in *Health Impact Assessment Guidelines* (enHealth Council 2001) (Figure 1) and *A Guide to Health Impact Assessment* (Ministry of Health 1998) and forms the basis for these guidelines. There are stages steps in the process of decision-making regarding risk:

1. Risk assessment
2. Risk communication (continuous throughout the process)
3. Risk management.

[4] At the time of writing the New Zealand Building Service Contractors Industry Training Organisation was developing two unit standards for clan meth lab remediation: 'Clandestine methamphetamine laboratory clean-up and remediation operations' and 'Follow safe work practices during and after clandestine methamphetamine laboratory clean-up and remediation'. The intention of these unit standards is to provide national consistency for all site remediation contractors that undergo training and certification in both decontamination processes and health and safety. From this basis, all properties regardless of location can be remediated in accordance with national guidelines and processes.

Figure 1: Risk assessment model



Source: enHealth Council 2001

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

As a first step in the risk assessment process, hazards have to be identified. If the assessment of the hazard suggests the likelihood of a risk is small, or that control is straightforward and safe, it may not be necessary to proceed to the quantification of risk.

The second step in risk assessment is the consideration of dose-response of the health effects of exposure to the chemicals used to manufacture methamphetamine.

The third step in risk assessment considers who might be exposed and their characteristics, the routes of exposure and the extent, duration and frequency of the exposure to the hazards identified.

The information from these three steps is used in risk characterisation, the final step of risk assessment.

The acceptability of risk is a decision for either individuals, or for 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 pursuit of some activity in which they see benefits. Various scientific and regulatory bodies have set levels of what they consider to be acceptable risks, but it is uncertain whether these levels will be understood or accepted by individuals.

The use of a risk-based approach leads to site assessment and management actions that are appropriate for each site. Applying the risk-based approach ensures that all actions are focused on achieving the desired level of protection for human health and the environment.

Although risk assessment and risk communication are discussed separately (Chapter 9), these two stages in risk analysis need to be integrated in the delivery of services. 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?'.

1.7 Layout

These guidelines are organised as follows:

- Chapter 2 provides a profile of methamphetamine including forms and use patterns as well as its history. Background information is also provided on what constitutes a clan meth lab and how they are graded in New Zealand.
- Chapter 3 discusses the development of remediation guidelines drawing on available information from overseas remediation processes.
- Chapter 4 sets guideline values for key contaminants necessary for site remediation to enable re-occupancy of a property.
- Chapter 5 provides guidance for the sampling and analysis of chemical contaminants.
- Chapter 6 sets out the process necessary for site remediation.
- Chapter 7 describes the roles and responsibilities of agencies involved in the pre and post remediation of clan meth labs. It also documents the legislative and regulatory environment relevant to clan meth lab site remediation in New Zealand.
- Chapter 8 identifies the hazards associated with the illicit manufacture of methamphetamine.

- Chapter 9 describes the health effects of methamphetamine and potential sources of human exposure. An exposure assessment is also discussed.
- Chapter 10 sets out priorities for managing risk and has been written mainly from the perspective of managing the risk particularly for public health services.

A glossary of terms and abbreviations used throughout the document is also included.

Chapter 2: Background Information

2.1 Profile and forms of methamphetamine

Methamphetamine (Figure 2) is a member of a 'group of synthetic drug' (ie, drugs that are not derived from plants) called amphetamines (Figure 3). It is typically manufactured from over-the-counter pharmaceuticals (predominantly cough and cold medications) containing ephedrine and pseudoephedrine, in addition to chemicals and reagents available in hardware stores.

Figure 2: Methamphetamine molecule ($C_{10}H_{15}N$)

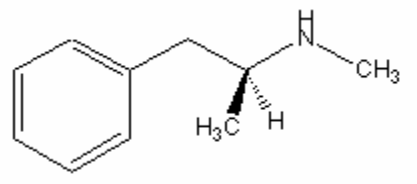
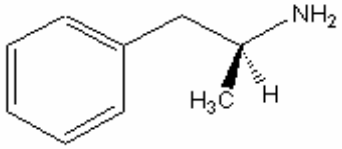


Figure 3: Amphetamine molecule



The drug can be snorted, injected, swallowed or smoked. Methamphetamine is readily absorbed into the bloodstream and the duration of effects varies. The effects of powdered methamphetamine can last for several hours, while the effects of crystal methamphetamine can last for up to 24 hours (Castro et al 2000).

In general, methamphetamine comes in a powder form: white (some grades may be yellow/brown due to incomplete manufacturing processes or impurities), odourless, bitter tasting powder that is alcohol and water-soluble. The drug is also available in a clear crystal form high in purity.

Commonly known as 'speed' or 'meth' 'P', 'pure' or 'burn', methamphetamine is a powerful psychostimulant whose pharmacological characteristics and effects broadly resemble cocaine (except that the onset is slower and duration is longer) (Wilkins 2002).

2.2 History of methamphetamine

Methamphetamine is not considered a new drug because it was first synthesised in 1887 by a German chemist, Lazar Edeleano. During the 1930s methamphetamine first appeared on the licit market as Benzedrine in an over-the-counter inhaler to treat nasal congestion. It is still legally produced in the United States as a prescription medicine (but classified as a controlled substance)[5] under the trade name Desoxyn (methamphetamine hydrochloride). Desoxyn is used to treat attention deficit hyperactivity disorder. It is also used for short-term weight loss and is produced in 5 mg tablets.

[5] Controlled substances in the United States are medications or drugs that are very habit-forming or are very likely to be abused. Prescriptions for methamphetamine must be in the written 'hard copy' form (they cannot be phoned or faxed to a pharmacy). Also, methamphetamine prescriptions cannot have any refills (one must get a new prescription each month).

During World War II methamphetamine was distributed by the Nazis as well as the Allies and the Axis to troops to fight fatigue (Sabin 2008). Suwaki (1991) has documented how methamphetamine abuse reached epidemic proportions in Japan post-World War II once stockpiles that had been reserved for military use were released to the general public, until the Japanese Ministry of Health banned it in 1951.

The 1950s saw a sharp rise in the legal prescription of methamphetamine to the American public which eventually led to its listing as a Schedule II drug under the United States Controlled Substances Act in the 1970s (Bialer 2002). One result of this legislative change was the emergence of the illicit manufacture of methamphetamine for personal use and by organised criminal enterprises. Such activity was motivated by the immense profits that could be generated and facilitated by the availability of many of the precursor substances necessary to manufacture it (Sabin 2008). In recent years illicit manufacture and use of methamphetamine has become a particular concern in the Asia-Pacific region including New Zealand (Ministerial Action Group on Drugs 2003).

2.3 Methamphetamine in New Zealand

Under the Misuse of Drugs Act 1975 methamphetamine[6] in New Zealand is classified as a Class A controlled drug – **a drug that poses a very high risk of harm** with significant penalties for offenders importing, manufacturing, distributing and possessing the drug without lawful authority. The amount of methamphetamine over which the drug is presumed to be for supply is 5 grams (Schedule 5), whether or not this amount is contained in a substance, preparation or mixture (Misuse of Drugs Amendment Act 2005, Schedule 5).

In 2003, fuelled by media coverage of several isolated yet dramatic events involving people under the influence of the drug, the New Zealand Government launched the *Methamphetamine Action Plan* (Ministerial Action Group on Drugs 2003). The plan sets out a series of steps to reduce both drug market supplies and demand, including by making substantial investments in clan meth lab identification and clean-up teams. In October 2009 the Government unveiled a new action plan to combat domestic manufacture, trafficking and use of methamphetamine, including through controls on precursor chemicals (Department of the Prime Minister and Cabinet 2009).

In New Zealand, methamphetamine is generally obtainable as powder or crystals (translucent to white crystalline appearance). This form of the drug is colloquially referred to as ‘P’ or ‘Pure’, although both these terms are also loosely used to cover all forms of methamphetamine, at least in the media (Bennett et al 2004).

National household drug surveys and other population surveys suggest that the use of methamphetamine ‘peaked’ in 2001 when around 5 percent of the 15- to 45-year-olds used it (Department of the Prime Minister and Cabinet 2009). A 2009 Massey University survey backs up the picture of declining methamphetamine use since that time. Its results indicate that use in the population aged 15 to 45 years fell from

[6] In New Zealand the rate of methamphetamine use is now second only to that of cannabis among illicit drugs (Sabin 2008).

4.3 percent in 2006 to 1.4 percent in 2009. However it should be noted that the use of telephone-based interviewing may have resulted in the under-representation of frequent users in this survey (Wilkins and Sweetsur 2009).

Methamphetamine is generally locally manufactured in clandestine laboratories, although there have been reports of more potent forms of the drug, namely base and crystalline forms, being imported (Ministerial Action Group on Drugs 2003). The local labs are often discovered in houses, garages, apartments, motel rooms, sheds and even motor vehicles.

Clandestine drug laboratories established to produce hash oil and homebake heroin have existed in New Zealand since the 1980s (Horne 1997; Newbold 2000). New Zealand's first clan meth lab was discovered in 1996. The annual number of methamphetamine laboratories detected by the New Zealand Police each year has increased dramatically from 9 in 2000, to 135 in 2009.

Methamphetamine is manufactured from chemical precursors, including ephedrine and pseudoephedrine. Ephedrine is currently a prescription medicine in New Zealand while pseudoephedrine is a common ingredient in many over-the-counter remedies for coughs and cold symptoms (Expert Advisory Committee on Drugs 2003). In October 2004 all products containing pseudoephedrine and ephedrine were classified as a Class C, Part III Controlled Drug under the Misuse of Drugs Act 1975, with the aim of maintaining tighter control over the manufacture of products and their distribution onto the illicit market (Medsafe 2004). As well as these legislative changes, through the 2004 Budget the New Zealand Government made available funding for a third Police response team to target clandestine drug-making laboratories. A new national 'clan lab' co-ordinator role was also established to help guide the New Zealand Police's work in this area, ensuring that best practice responses are followed across the country.

The number of border seizures of the precursors pseudoephedrine and ephedrine by the New Zealand Customs Service has continued to increase in the last few years. For the 2008 calendar year, the New Zealand Customs Service seized over 3,289,233 precursor tablets at New Zealand's border in 766 cases, compared with 1,313,179 tablets in 576 cases for the 2004 calendar year (Department of the Prime Minister and Cabinet 2009). The predominant source of pseudoephedrine is in the form of ContacNT© cold medicine from China although there are signs of an increasing divergence of sources and trafficking routes for methamphetamine precursors to account for changes in domestic legislation which has made domestic sources of the chemical more difficult to obtain (United Nations Office on Drugs and Crime 2010).

The amount of methamphetamine seized at the border by the New Zealand Police and New Zealand Customs Service increased from 1370 grams in 2000 (Wilkins et al 2005) to 23,971 grams in 2008 (Department of the Prime Minister and Cabinet 2009). To date New Zealand's largest seizure of methamphetamine has been approximately 95 kg (New Zealand Customs Service 2006).

2.4 What is a clandestine methamphetamine laboratory?

Sites that produce methamphetamine may be called laboratories, but they bear little resemblance to legitimate pharmacologic laboratories. The AS/NZS 4757: 2002 *Handling and Destruction of Drugs* defines a clandestine laboratory as 'an illicit operation consisting of apparatus and/or chemicals that either have been or could be used in the manufacture or synthesis of drugs. This includes premises and/or sites.'

Laboratories manufacturing methamphetamine range from rudimentary operations using fairly simple chemical techniques to large-scale, highly sophisticated operations that are technically and chemically complex. They can be located virtually anywhere – in private residential dwellings, motel and hotel rooms, apartments, boats, vehicles, campgrounds and commercial establishments. They are usually readily portable. Some clandestine laboratories use very simple processes such as extracting cannabis oil from plants using solvents; others use complex processes involving a number of chemicals and a range of equipment to manufacture illicit drugs such as methamphetamine.

2.5 Clandestine methamphetamine laboratories in New Zealand

In view of the increase in the number of clandestine laboratories manufacturing methamphetamine detected in Australia and New Zealand, it was determined that there was a need for better exchange of information among the various jurisdictions involved. As a result, in August 1997 the first Chemical Diversion Conference was held at the Australian Bureau of Criminal Intelligence; among other outcomes, it led to the development of a categorisation of the various types of clandestine laboratories. Although the New Zealand Police has also developed a categorisation, it grades the laboratory in terms of its set-up or defining features rather than being based on contamination levels. For example, Grades A and B both represent 'complete' labs and together represent just under one-third of all labs detected. The grades are described in Table 1.

Table 1: Clan meth lab gradings

Level	Description of clan drug labs	Defining features
A	'Active'	• Either drug manufacture or precursor production • Presence of activated heat source, pressure, running water • Combination of chemicals/materials to cause or instigate drug manufacture or precursor production • Sufficient activity, material, chemicals, equipment to support charges under the Misuse of Drugs Act 1975 section 6(1)(b) or to support precursor material/substance charges

B	'Inactive'/non-active	• Either drug manufacture or precursor production • Minus the presence of activated heat source, pressure, running water • All or close to all chemicals, materials, equipment required for manufacture methamphetamine or extract precursors • Sufficient material clearly justify charges under the Misuse of Drugs Act 1975 section 6(1)(b) or to support precursor material/substance charges
C	'Clan lab kit or chemical store'	• Neither set up nor active • Equipment and/or chemicals, or materials with application in drug manufacture or precursor production/manufacture
D	'Chemical equipment store or cache' (partial kit)	• Equipment, chemicals, materials with application in drug manufacture or precursor extraction • Clearly short of required range of equipment and or chemicals, and or materials necessary to complete production/manufacture process

It is important to note this grading is for New Zealand Police purposes only and is not intended to be used to gauge contamination levels for site remediation. Refer to Appendix A for further information on detected clan meth labs in New Zealand and overseas.

Chapter 3: Development of Remediation Guidelines

3.1 Introduction

In an attempt to gain information pertaining to any remediation (clean-up) processes in place in Asian or European countries extensive literature searches were carried out. Unfortunately no results were obtained despite the considerable efforts made through electronic searches and where appropriate through contacts in key agencies. As a result available information about overseas remediation processes comes from the United States and Australia only.

3.1.1 United States

In the United States there is currently no federal standard for the clean-up (remediation) of former clan meth labs.[7] As a result over 20 states have established clean-up levels for methamphetamine that range from <0.05 µg/100 cm^2 to 1.5 µg/100 cm^2. Most states have chosen a level of 0.1 µg/100 cm^2 (United States Environmental Protection Agency, 2009). These levels are based on toxicological information but are at levels that can be scientifically measured and are '*believed to be set at sufficiently conservative levels to still be health-protective*' (United States Environmental Protection Agency 2009 p 6).

In California, the Office of Environmental Health Hazard Assessment (OEHHA) and Department of Toxic Substances Control (DTSC) have developed a risk-based target remediation standard/guideline (clean-up standard) for methamphetamine in residences used to illegally manufacture methamphetamine. On 1 January 2010 the statute was amended to less than or equal to 1.5 µg/100 cm^2 when legislation was passed by AB 1489[8] (Health and Safety Code section 25400.16) replacing the standard 0.1 µg/100 cm^2 on the grounds that extensive research found the standard (0.1 µg/100 cm^2) to be overly conservative and that a standard of 1.5 µg/100 cm^2 would be sufficiently protective to make properties safe for human occupancy.

[7] The Methamphetamine Remediation Act 2007 requires the United States Environmental Protection Agency (USEPA) to develop model, voluntary, health-based clean-up guidelines for use by states and localities. In August 2009, the USEPA published *Voluntary Guidelines for Methamphetamine Laboratory Clean-up* http://www.epa.gov/oem/meth_lab_guidelines.pdf. However in developing this document the USEPA did not intend it to set, establish or promote quantitative clean-up standards; instead the document provides technical guidance for state and local personnel responsible for clan meth lab remediation. Based on an extensive review of the best available science and practices, the guidelines address general remediation activities, identify best practices for specific items or materials, discuss sampling procedures, and provide additional technical resources.

[8] http://info.sen.ca.gov/pub/09-10/bill/asm/ab_1451-1500/ab_1489_cfa_20090819_214125_sen_floor.html.

The risk-based standard which was finalised in 2009 was derived from two OEHHA documents concerning (1) the methamphetamine reference dose (RfD) (Salocks et al 2009); and (2) the identification of a risk-based remediation standard for surface methamphetamine contamination (Salocks 2009). It is important to note that the results of Salocks et al (2009) study remain controversial and have not been widely adopted. One reason for the disagreement relates to Salock's assumption that methamphetamine base rapidly evaporates and dissipates. To some extent, this assumption has support from the research findings that methamphetamine showed significant volatility in free base (Abdullah and Miskelly 2010); it is on this basis that Salocks (2009) suggests that methamphetamine base is unlikely to be a persistent contaminant. However methamphetamine base (and other problematic compounds) are known to penetrate building materials from which they are only slowly emitted (N Powell, Forensic and Industrial Science, personal communication, 2010). In other words, Salocks (2009) appears to have considered only absorbed (or surficial) rather than absorbed (within the substrate) methamphetamine. Because devolatilisation of methamphetamine from absorbent materials can be protracted the result is several important corollaries (N Powell, personal communication, 2010):

- The total exposure to methamphetamine with a contaminated structure such as a house (comprising exposure to surface and airborne methamphetamine) may be much higher than that due to surface methamphetamine alone.
- The duration of exposure for vulnerable population groups such as children living in methamphetamine contaminated properties could be longer than Salocks (2009) suggests.
- Children outside the age group range considered by Salocks (2009) as being the most vulnerable (6–24 months), could be exposed to problematic levels of methamphetamine.

Appendix B summarises regulations and remediation (clean-up) standards/guidelines for re-occupation of former illicit methamphetamine laboratories for over 20 US states. These numeric guidelines focus on a limited range of hazardous substances mainly methamphetamine, total volatile organic compounds, lead and mercury.

Uncertainties in the development of remediation guidelines for methamphetamine and other chemical compounds commonly found in clan meth labs are further confounded by potential inconsistencies in sampling and analytical methodologies. Generally remediation guidelines (both qualitative and quantitative) are feasibility-based rather than risk-based for the predicted exposure scenarios for most cases. Quantitative remediation guidelines may be based on the ability of the analytical equipment to detect the chemical. Qualitative remediation guidelines may be limited by the impracticality of removing contaminated materials that affect the structural integrity of a building, or by remediation costs that exceed the value of the property (ASTSWMO 2006).

3.1.2 Australia

In 2009 the Australian Crime Commission released a draft document titled *Derivation of Risk-based Investigation Levels – Clandestine Drug Laboratory, Site Investigation Guidelines* (Environmental Risk Sciences 2009) as part of its development of national guidelines on this issue. These guidelines provide investigation levels for methamphetamine (0.5 µg/100 cm^2) and iodine (20 µg/100 cm^2).

According to Sutherland (2006) each jurisdiction seems to have reasonably adequate environmental protection (or contaminated sites) legislation to enable appropriate remediation of clan meth laboratory sites where there is a risk to the environment. However the major problem with such legislation is that it tends to be focused on large-scale, industrial sites. Consultation with agencies that administer environmental protection Acts reveals that they tend not to get involved in small-scale contamination, especially on private property (which tends to be where the majority of clan meth labs are found). At the national level, some attempts have been made to standardise some environmental protection arrangements and improve co-ordination across different sectors. For example, the National Environment Protection (Assessment of Site Contamination) Measure 1999 seeks to:

> establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices ... the desired environmental outcome ... is to provide adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination.

3.2 Existing standards and guidelines for human exposure to chemicals

There are a number of New Zealand and overseas guidelines and standards for the management of chemicals and contamination in different scenarios, albeit not directly associated with clan meth labs. Appendix C highlights several sources, including the basis of the guidelines and brief commentary on their relevance to the remediation of clan meth labs.

Chapter 4: Guidelines for Site Remediation

4.1 Introduction

In the absence of New Zealand human health guidelines or chronic low-level exposure limits, the Ministry of Health has focused on reducing the potential exposure to a level that is as low as practicable and has looked to the experience and expertise of other jurisdictions with similar problems. As noted in section 3.1.1 while a number of US states have developed standards (guidelines) that are associated with the site remediation of former clan meth labs, these guidelines focus on a few hazardous substances only. A number of the guidelines are based on analytical limits of detection rather than the protection of human health. Therefore a more detailed review of clan meth methods in New Zealand and key hazardous substances associated with these methods has been undertaken.

Although a large number of premises used as clan meth labs are residential the remediation guidelines have been developed for indoor and outdoor areas (soil and water environments) separately and hence can be applied to other premises such as apartments or hotel/motels for the areas affected as required.

4.2 Chemicals associated with the illicit manufacture of methamphetamine

The two most common chemical forms of methamphetamine, the free base (methamphetamine base) and the hydrochloride salt (methamphetamine hydrochloride), are produced in clan meth labs. Because methamphetamine is not very water soluble and is volatile, it is usually converted to a methamphetamine salt by bubbling hydrogen chloride gas into a solution of the methamphetamine base in an organic solvent (Abdullah 2007). As a result, methamphetamine hydrochloride is the illicit drug most commonly manufactured in clan meth labs in New Zealand. It is usually found as a yellow or white crystalline powder, although other colours such as brown, grey and pink have been observed (Topp et al 2002).

The most common methamphetamine synthesis routes encountered involve reaction of an ephedrine or pseudoephedrine precursor with hydriodic acid or iodine plus water and red phosphorus, hypophosphorous acid or phosphorous acid. Hazardous or problematic chemicals likely to be associated with the manufacture of methamphetamine include chemicals used in and by-products generated from the HI Reduction, anhydrous ammonia and P2P methods. Table 2 lists some of the chemicals involved; however, this list should not be considered exhaustive as there are other synthesis routes as well as by-products that are yet to be identified.

Table 2: Methamphetamine production process, chemicals used and by-products

Procedure	Process	Chemicals used	Products and by-products
Step 1 Precursor extraction	**HI reduction and anhydrous ammonia methods** Pharmaceutical products containing ephedrine or pseudoephedrine are crushed and dissolved in solvent (eg, alcohol, methanol). The solvent containing ephedrine or pseudoephedrine is filtered. The solvent containing the precursor is evaporated. **P2P (phenyl-2-propanone) method** There is no precursor extraction but P2P can be synthesised using phenylacetic acid reacted with acetic anhydride acetate/acetic acid.	Acetone (propanone) An ether An alcohol eg, methanol, isopropanol Mineral spirit Phenylacetic acid Acetic anhydride Lead acetate Acetic acid Sodium acetate Pyridine	Solvent vapour Ephedrine Pseudoephedrine Antihistamine (various) Pill tailings P2P Lead compounds (solid waste)
Step 2 Synthesis	**HI reduction method** The ephedrine/pseudoephedrine mixture is mixed with either hydriodic acid and red phosphorus or red phosphorus, iodine and water or iodine and hypophosphorous acid and heated for several hours to form methamphetamine in an acidic mixture. Mixture is filtered to remove the red phosphorus. **Anhydrous ammonia method** Lithium or other metal reductant is dissolved in anhydrous ammonia and ephedrine/ pseudoephedrine is added.	Ephedrine Pseudoephedrine Iodine Red phosphorus Hypophosphorous acid Hydriodic acid (iodine crystals combined with red phosphorus generate hydriodic acid) Yellow phosphorous White phosphorous Ephedrine Pseudoephedrine Lithium/sodium/potassium metals Ammonia	Methamphetamine vapour Hydriodic acid aerosol Hydrogen iodide Phosphorous acid aerosol Phosphine Oxazoladine 1,2-dimethyl-3-phenylaziridine P2P methylnaphthalenes

Procedure	Process	Chemicals used	Products and by-products
	P2P method Aluminium amalgam is formed by reaction of mercuric chloride and aluminium metal (eg, foil). P2P is reacted with methylamine (or n-methylformamide) and formic acid.	Methylamine Mercuric chloride N-methylformamide Formic acid	Mercury
Step 3 Extraction of meth base	**HI reduction method** Sodium hydroxide is added to make the mixture base. An organic solvent (eg, toluene) is added to extract the methamphetamine from the basic solution. The top layer (containing the methamphetamine base) is separate and removed, **Anhydrous ammonia method** The mixture is quenched with water. The reaction of the residual metal forms hydroxide so that the solution is basic. An organic solvent (eg, toluene) is added to extract the methamphetamine from the basic solution. **P2P method** The methamphetamine base is separated from the reaction mixture and/or extracted with a solvent.	Sodium hydroxide (used to raise the pH of the methamphetamine reaction solution) Organic solvent: toluene or ether (benzene is sometimes present in commercial toluene) Organic solvent eg, toluene (benzene is sometimes present in commercial toluene) Organic solvent	Methamphetamine base Strongly basic waste Methamphetamine salt Strongly basic waste Lead (in waste reaction mixture) Strongly basic waste
Step 4 Salting out	**HI reduction and anhydrous ammonia methods** Hydrogen chloride gas is introduced into the methamphetamine solution to precipitate methamphetamine hydrochloride. Methamphetamine hydrochloride settles to the bottom and is filtered from the solvent. An ether or acetone (propanone) may be used to remove impurities.	Hydrogen chloride gas Sulphuric acid Hydrochloric acid Sodium chloride Acetone (propanone) An ether	Methamphetamine hydrochloride Methamphetamine salt Hydrochloric acid Hydrogen chloride gas Discarded solvent Sodium sulphate 1,3-dimethyl-2-phenylnaphthalene 1-benzyl-3-methylnaphthalene

Procedure	Process	Chemicals used	Products and by-products
	P2P method Hydrogen chloride gas is bubbled through the methamphetamine base (or solvent solution) to precipitate methamphetamine hydrochloride. The methamphetamine base can be converted to the hydrochloride salt with hydrochloric acid.	Hydrogen chloride	Methamphetamine hydrochloride

Source: Adapted from Abdullah (2007); Houston Fire Department Continuing Education (2010)

Pseudoephedrine has been included because it is a precursor to manufacturing methamphetamine. Hydrogen chloride is used at the salting out stage of methamphetamine production. Hydrogen chloride gas is often generated by 'cooks' at clan meth labs by combining sulphuric acid (eg, drain cleaner) with sodium chloride (rock salt) in a hydrogen chloride gas generator.

Phosphine is a by-product generated during the synthesis of methamphetamine using the HI reduction method (Abdullah 2007). However, it has a high vapour pressure and therefore does not persist for long periods in air that is not completely dry (N Powell, personal communication, 2010).

There are a variety of solvents involved in the manufacture of methamphetamine. Among them are acetone and toluene both of which are used in the manufacturing process and are commonly found in New Zealand clan meth labs (Abdullah 2007).

4.3 Review and identification of key chemicals

In identifying key chemicals in the assessment and potential remediation of clan meth labs the following characteristics were considered for each chemical compound:

- acute toxicity associated with the chemical;
- feasibility of sampling and analysis on a commercial basis in New Zealand; and
- actual or potential chronic toxicity to humans.

For the purposes of deriving these guidelines the following classes of compounds have also been considered important (Environmental Risk Sciences 2009):

4.3.1 Indoor areas

- **Surface residues:** non-volatile and semi-volatile chemicals that have the potential to remain on surfaces as a residue or dust.
- **Volatiles in indoor air:** volatile compounds including those that are absorbed into household materials (eg, upholstered furniture, curtains, carpet and plasterboard) and from which they may re-volatilise.

4.3.2 Outdoor areas

- **Soil and water contaminants:** compounds that persist in soil or that may contaminate groundwater. For example, Janusz et al (2003) found that methamphetamine (methylamphetamine sulphate) persisted unchanged in soil after six weeks. This persistence along with the high solubility of methamphetamine in water would suggest that it could migrate into shallow groundwater. Studies have shown that residues from the illicit manufacture of drugs such as methamphetamine can end up via the sewage system in surface water of populated areas with whole-method limits of detection at 1.18 ng/L (Zuccato et al 2008).

4.4 Remediation guidelines for New Zealand residential properties

Key chemical compounds identified are listed in Table 3 together with proposed guideline values. The development of these guideline values entailed the use of a hierarchy developed by the Ministry for the Environment to determine the order in which guideline values contained in reference documents are appropriate for the site remediation of clan meth labs. The hierarchy utilised by the Ministry for the Environment (2007, p vi) is as follows:

1. New Zealand documents that derive risk-based guideline values
2. rest-of-the-world documents that derive risk-based guideline values
3. New Zealand documents that derive threshold values
4. rest-of-the-world documents that derive threshold values.

Table 3: Summary of remediation guidelines for New Zealand residential properties

Key chemical	Indoor criteria		Outdoor soil (mg/kg)	Potable water (mg/L)
	Surface (µg/100cm^2)	Air[9] (mg/m^3)		
Benzene	a	0.0036◊	1.1#	0.01*
Hydrogen chloride	a	0.009^	b	x
Iodine	20Δ	0.0008Δ	780±	x
Lead	2+	0.0002◊	☒	0.01*
Mercury (inorganic)	35Δ	0.0033◊	☒	0.007*
Methamphetamine	0.5Δ	b	5Δ	x
Phosphine	a	0.0004Δ	c	x
Toluene	a	0.3^	68#	0.8*
Xylenes (total)	a	0.7^	48#	0.6*
pH	6-8	NA	4.5–8 (typical range)	6–8*

Notes:

a No surface residue guideline has been provided for this chemical as it is considered volatile and would not be present as surface residues (or dust) for a sufficient period to be of concern.

b No guideline has been derived for these key chemicals. Only volatile chemicals (or gases) have been considered as they may continue to off-gas from porous surfaces over time. For example, anhydrous hydrogen chloride will readily combine with soil moisture and infiltrate the soil, dissolving some of the soil material, especially carbonates. Neutralisation of the acid will occur (OEHHA 2008).

c It is not considered necessary to attempt to measure for phosphine in soil because phosphine gas is not expected to be present in soil for a sufficient period of time to be of concern.

X At the time of writing no relevant guideline values for these chemicals were available from peer-reviewed sources of relevance for the protection of human health.

☒ At the time of writing the Ministry for the Environment's proposed *National Environmental Standard for Assessing and Managing Contaminants in Soil* was still under development and confirmation of these numbers was awaiting finalisation. The Ministry for the Environment should be consulted to ensure that these soil guideline values are consistent with the gazetted NES. In practice, the NES is treated like a rule in a plan, and it will override any existing rule that is more lenient. In some circumstances, councils can impose a rule or consent that is more stringent than the NES but only if the standard expressly states that they can.

\+ Derived from some states within the United States that have adopted regulations or numeric decontamination guidelines for clan meth labs.

NA Not applicable as pH is not a chemical compound.

^ Derived from the OEHHA (2008).

Δ Derived from Environmental Risk Sciences (2009).

◊ Derived from the New Zealand ambient air quality guidelines (Ministry for the Environment 2002).

\# Derived from the *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand* (Ministry for the Environment 1999). Values for residential soils have been applied and within those, sandy soils and soils less than 1 metre in depth, as a default. Refer to Table 4.10 – Tier Soil acceptance criteria *Residential use* (Ministry for the Environment 1999).

± Derived from USEPA Regional Screening Levels (formerly called Preliminary Remediation Goals).

* These guideline values for contaminants relating to potable water use have been derived from the health-based determinants (maximum acceptable values) set out in the *Drinking–water Standards for New Zealand 2005 (revised 2008)* (Ministry of Health 2008). These guideline values have been developed with a particular reference to the protection of public health, giving consideration to exposure via the ingestion of water, the inhalation of volatile compounds and absorption following direct contact.

[9] These guidelines do not consider ambient air; however, any discharges to outside air during remediation should not exceed air quality guidelines described in the Ministry for the Environment's 2008 publication, *Good Practice Guide for Assessing Discharges to Air from Industry*. This publication is available on the Ministry's website http://www.mfe.govt.nz/publications/air/assessing-discharges-air-industry-jun08/assessing-discharges-air-industry-jun08.pdf.

A value for total volatile organic compounds (TVOCs) has not been considered in these guidelines. Although measurements of TVOCs are often made – for example, as an indicator of the likelihood that there will be effects on health – their use for this purpose is declining. This is because little data is available on the interactions among more than two chemicals that do not usually address issues of chronic toxicity at concentrations representative of actual human exposure (European Commission 2007). For the purpose of these guidelines it was seen as preferable to consider individual VOCs rather than TVOC and consider several examples of contaminants likely to be found in a former clan meth lab. Therefore guideline values for xylenes (total) and benzene (as well as toluene) have been included because these chemical compounds are important common impurities in commercial grades of toluene.

Iodine has been documented in the literature as an important element for human beings. This is because it is involved in the composition of the thyroid hormone and its absence causes goitre (Aubert and Pinta 1977). In clan meth labs iodine is combined with red phosphorus to make hydroiodic acid, an essential ingredient in the manufacture of methamphetamine from ephedrine. Elemental iodine readily volatilises at room temperature. However, it is likely there will be circumstances where iodine compounds may remain on surfaces long enough to require consideration with respect to long-term exposure. Iodine also has the potential to stain surfaces, which means that visual issues should be addressed in the remediation of iodine on surfaces in any premises (Environmental Risk Sciences 2009). In soil, iodine is oxidised to iodate (IO_3^-) and reduced to iodide (I-) ions which have a relatively low order of toxicity as well as being essential micronutrients in the human diet (Environmental Risk Sciences 2009). New Zealand's soils may be low in available iodine so that vegetables, fruits and grains grown in New Zealand are likely to have very low levels of iodine compared with food produced in other parts of the world. However, while 2–3 mg/kg is not uncommon for many mineral soils, significantly higher concentrations in clay-rich and some organic-rich soils varying from 25 mg/kg to 100 mg/kg have been reported (N Kim, Environment Waikato, personal communication, 2010). In New Zealand the recommended daily intake for adults is around 150 µg/day. Requirements are higher for pregnant and breastfeeding women and lower for children, infants and toddlers (Australian National Health and Medical Research Council and the New Zealand Ministry of Health 2006).

A number of corrosives are used in the manufacturing process. These agents cause surface contamination through accidental spillage during handling and cooking and the accumulation of these hazardous substances from their aerosols or vapour. Therefore, the acceptable range for pH has been set between 4.5 and 8 in soil or surface residues. Extreme values (< 4 and > 11) may adversely affect health.

The Ministry of Health's rationale for the remediation guidelines assumes that if decontamination activities are sufficient to remove methamphetamine and VOCs (also iodine, lead and mercury if the amalgam/P2P method is used) to acceptable levels, other chemicals for which a remediation guideline value has not been given will have been sufficiently removed as well.

The following factors need to be considered when remediation guidelines for lead and mercury are applied:

- the amalgam (P2P) method (although rare) has been found to be used in New Zealand
- the possibility of obtaining false positives for lead and mercury exists
- lead (in particular) and mercury were commonly added to paints in past years and are present in many such homes where illegal drug labs are found
- previously used lead in petrol additives (tetraethyllead and tetramethyl resulted in generally elevated concentrations of lead in urban soils (although this elevated baseline is usually below the remediation guideline provided in Table 3)
- in some mineralised areas such as parts of the Coromandel Peninsula, lead and mercury may be present in natural (mineralogical) sources. Mercury may also be higher in some geothermally influenced soils.

In New Zealand lead absorption from other than occupational sources is a condition that is notifiable to the medical officer of health under the Health Act 1956. In 2007 the Ministry of Health released a revised edition of the 1998 guidelines titled *The Environmental Case Management of Lead Exposed Persons: Guidelines for Public Health Units* (Ministry of Health 2007a). These guidelines provide practical advice for the investigation and environmental case management of people with elevated levels of lead, and are particularly aimed at risks arising from lead-based paint. The guidelines include recommendations for protecting children from lead in soil, and are principally taken from United States guidance. Guidance is also provided on dust and soil sampling techniques for residential settings.

Chapter 5: Sampling and Analysis

5.1 Introduction

The purpose of this chapter is to provide guidance for the sampling and analysis of chemical contaminants. Generally as part of site remediation process, sampling and analysis of contaminants would be a requirement for the property owner at the direction of a district/city council to ensure the dwelling is safe for re-occupation.

Professionals undertaking assessment and testing must operate independently of commercial decontamination (clean-up) companies.

The sequence of events should be as follows:

- occupants vacate the property
- notification of possible hazardous contamination is placed on the outside of the dwelling by the local authority
- the property is secured to prevent unauthorised entry or occupation
- pre-remediation sampling is carried out
- if contamination is detected, remediation recommendations are issued
- remediation (clean-up) contractors carry out remediation
- post-remediation sampling is carried out
- further remediation and sampling is carried out if required
- if post-remediation sampling indicates levels of contaminants are below those currently acceptable, a report is issued stating that the property is fit for re-occupation.

5.2 Pre-remediation assessment and testing

The intention of pre-remediation assessment and testing is to determine the presence, level and extent of contamination.

Information collected prior to the initial site visit:

- Assessment and testing on site should include:
  - a record of number and type of structures/dwellings present
  - description of grounds and outbuildings
  - photographs or video footage
  - air screening for total volatile organic compounds (such as the use of photoionisation detector (PID))
  - air screening for individual volatile organic compounds (such as via sorbent tubes)
  - screening tests for drug residues including methamphetamine (immunoassay tests or collection of swabs for gas chromatographic analysis)
  - pH testing

- Additional testing may include:
  - screening tests for iodine
  - screening tests for hydrogen chloride
  - testing for asbestos which generally would involve sending a small sample in a sealed plastic bag to the laboratory, with the requisite fee. Accredited laboratories are listed in the New Zealand Yellow Pages – under Asbestos.
  - testing for mercury and lead.
- Particular attention should be paid to:
  - chemical spillage
  - chemical odours
  - presence of bulk or non-household chemicals
  - presence of hazards such as needles, broken glass, makeshift electrical wiring
  - structural hazards such as fire damage
  - signs of contamination such as staining, corrosion and etching
  - ventilation, on-site effluent treatment systems (septic tanks), electrical appliances such as heat pumps and plumbing systems
  - signs of soil/water contamination such as dead vegetation, fire pits, soil disturbance, discolouration of soil and dumping of chemicals.

5.3 Sampling and analytical methods

The aim of sampling is to determine whether site remediation guidelines have been met. In designing a sample plan for the interior of a building the following guidelines are provided:

- no less than five samples should be taken inside the building
- samples should be taken in areas that show evidence of contamination
- surfaces used in the illicit drug manufacturing process should be sampled
- any room or area occupied by a child under the age of 16 years should be sampled at least once
- for areas of non-porous surfaces such as bench tops, mirrors or metal surfaces sampling may be achieved through the collection of wipe or swab samples of 100 cm^2
- any wipe must be free of interring substances and capable of absorbing the suspected analyte so as to provide a true representation of any surface contamination that may be present. Consultation with the certified analysing laboratory is advised. Analytical laboratories may assist in providing information of 'Ghost wipe' samples kits. Such test kits generally come with a template for the wipe area, directions and the required materials.
- the technique by which the wipe is manipulated to collect the sample should be consistent so as to provide reproducible recoveries of the analyte

- ventilation ducts (if present) that are in close proximity to the area where the illicit manufacture of methamphetamine has occurred should be sampled
- chain of custody protocols should be followed. Each sample must be uniquely labelled and sealed in an appropriate bag or container and submitted to a laboratory for analysis.

Table 4 summarises suggested sampling and analytical methods. Gas chromatography-mass spectrometry (GC-MS) is the method most commonly used in the routine analysis of methamphetamine (Abdullah et al 2010). The National Institute for Occupational Safety and Health (NIOSH) has developed analytical methods for hydrogen chloride – Method 7903 (NIOSH 1994c),[10] lead – Method 7303[11] (NIOSH 2003a) or 9102[12] (NIOSH 2003b) and mercury (Method 6009, NIOSH 1994b)[13] which are recommended for indoor areas.

For information relating to the site investigation and analysis of soils refer to the Ministry for the Environment's publication *Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils* (2004). Its Appendix G summarises a number of different instrumental methods that can be used for analysing substances in soils including methods for metals such as mercury and lead.

Table 4: Sample type and analytical methods

Contaminant	Sample type	Analytical methods
Methamphetamine	Surface wipe	Laboratory-specific methods, gas chromatography or immunoassay type test
Hydrogen chloride	Air sample – silica gel sorbent tube	NIOSH 7903; SKC-226-10-06 solvent extraction with ion chromatography
VOCs	Air sample active sampling with sorbent tube	USEPA Method TO17; NIOSH
		Some passive sampling techniques may also apply where validated
Lead	Surface wipe	NIOSH 7303 or 9102
	Soil	USEPA 200.2 or equivalent
Iodine (if stained surfaces are to be retained)	Air sample – sorbent tube	Ion chromatography NIOSH 6005 (NIOSH 1994a) – modified for ICP – MS analysis
	Surface wipe	At the time of writing there was no standard method
Mercury	Air sample – sorbent tube	NIOSH 6009
	Soil	USEPA 200.2 or equivalent
	Surface wipe	At the time of writing there was no standard method

[10] http://www.cdc.gov/niosh/docs/2003-154/pdfs/7903.pdf
[11] http://www.cdc.gov/niosh/docs/2003-154/pdfs/7303.pdf
[12] http://www.cdc.gov/niosh/docs/2003-154/pdfs/9102.pdf
[13] http://www.cdc.gov/niosh/docs/2003-154/pdfs/6009.pdf

5.3.1 Methamphetamine sampling

Sampling for methamphetamine has been regarded as the principal means of determining which aspects of a dwelling are contaminated and need remediation.

General guidance on methamphetamine sampling is as follows:

- For methamphetamine surface wipe methods as described by the National Institute for Occupational Safety and Health based in the United States NIOSH are:
  - NIOSH draft method 9106: Methamphetamine and illicit drugs, precursor and adulterants on wipes by liquid-liquid extraction (NIOSH 2009a)
  - NIOSH draft Method 9109: Methamphetamine and illicit drugs, precursors and adulterants on wipes by solid phase extraction (NIOSH 2009b)
  - NIOSH draft Method 9111: Methamphetamine on wipes by liquid chromatography – mass spectrometry (NIOSH 2009c).
- Methamphetamine sampling should be carried out using a methanol-wetted gauze or filter paper wipes. Materials recommended by the United States Environmental Protection Agency (USEPA 2009) for methamphetamine sampling are:
  - rayon/polyester or cotton general-purpose medical sponges
  - 11 cm filter paper (Whatman^{TM} 40 ashless or equivalent)
  - filter paper, including Whatman^{TM} 40, 41, 42, 43, 44, 540, 541, Ahlstrom 54, VWR 454, S&S WH Medium, or other filter paper with equivalent performance
  - cotton gauze pad, including Johnson & Johnson cotton squares or equivalent.

5.3.2 Lead and mercury sampling

If there is evidence that lead or mercury was used in the manufacture of methamphetamine, sampling and testing for the presence of these elements are required.

Evidence for the use of lead or mercury includes:

- the presence of batteries
- information from the New Zealand Police or other sources
- evidence of the phenyl-2-propanone (P2P) method of methamphetamine manufacture being used (note that synthesis methods for other substituted phenethylamines also utilise mercury or its compounds).

While Pb (lead) analysis can follow Method 7303, lead sampling should follow NIOSH Method 9102. The wipe should be wetted with reagent-grade nitric acid rather than with methanol. The same surface area should not be wiped with both methamphetamine and lead wipes but wipes in the same location should be adjacent to each other.

For air samples of mercury one should follow the NIOSH Method 6009. This method involves the use of a sample pump to draw air through a sorbent tube that is subsequently analysed by a laboratory via atomic absorption.

At the time of writing a standard surface wipe method for mercury currently does not exist although inductively coupled plasma mass spectroscopy (ICP-MS) has been used for detecting low-level method which could be utilised with the same wipe sampling method specified in NIOSH 9102 for lead. There are presumptive mercury swab/wipe kits commercially available for evaluating surface mercury contamination and are available from SKC.[14] It is important to note that any results are used only to determine the presence or absence of mercury on various surfaces.

5.3.3 Iodine

Sampling of iodine has generally not been considered necessary because these chemicals leave visible stains that should be detected at the pre-remediation stage. In most cases where surfaces or appliances show visible signs of staining they will typically be removed and will not need to be sampled (USEPA 2009).

Most standard collection and analysis methods for iodine use a sorbent tube and air sampling pump followed by solvent extraction and analysis by ion chromatography (NIOSH 1994a). These methods have detection limits in the range of 0.002 to 0.2 mg/m^3 (McKenzie 2008).

If there is evidence of iodine contamination on materials or surfaces that will **not** be removed, it is recommended that surface wipe samples for iodine do not exceed a concentration of 20 $\mu g/100\ cm^2$. At the time of writing there was no recognised standard surface wipe method for iodine. Standard methods for testing surface mercury and iodine are inadequate for the required detection limits and research and development of more sensitive standard methods using ICP-MS is required.

For information relating to outdoor contaminants such as iodine, mercury and lead in soils refer to the Ministry for the Environment's publication *Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils* (2004). This publication refers to the USEPA Method 200.2 which is applicable for analytes including mercury and lead.

Appendix 2 in the Ministry of Health's *Drinking-water Standards for New Zealand 2005 (revised 2008)* sets out sampling requirements and referee methods of analysis for the key chemicals listed in Table 3 of these guidelines as they relate to potable water.

5.3.4 pH sampling procedure

pH is a term which is used to indicate the corrosiveness of a substance as ranked on a scale from 1.0 to 14.0 (USEPA 2009). Food preparation areas and any surfaces with visible staining, etching or corrosion should be pH tested. The United States Environmental Protection Agency also states that anything that leads to on-site effluent treatment systems (septic tank system) should be pH tested. In addition, the USEPA also states that pH testing should also occur with the on-site effluent treatment system, on at least three locations in each room with areas of visible contamination and within areas known to have been used for storage or handling of chemicals (USEPA 2009).

[14] http://www.skcinc.com/index.asp. Note that this not an endorsement for SKC.

As stated in the Minnesota Department of Health's *Clandestine Drug Lab General Clean-up Guidance* (2007 p 49):

> *For **horizontal surfaces**, deionised water shall be applied to the surface and allowed to stand for at least three minutes. The pH test strip shall then be placed in the water for a minimum of 30 seconds and read.*
>
> *For **vertical surfaces**, a Whatman 40 ashless filter paper or equivalent filter paper shall be wetted with deionised water and wiped over a 10 cm x 10 cm area at least five times in two perpendicular directions. The filter paper shall then be placed into a clean sample container and covered with deionised water. The filter and water shall stand for at least three minutes prior to testing. The pH test strip shall then be placed in the water for a minimum of 30 seconds and read.*

5.3.5 Volatile organic compounds (VOCs)

Volatile organic compounds (VOCs) which include a variety of chemicals are emitted as gases from certain solids or liquids.

Techniques such as photoionisation detection (PID) screening should be carried out at both the pre-remediation assessment stage to assess total levels of volatile organic compounds present and at the post-remediation stage to assess whether remediation undertaken has been successful. PIDs are ideal for field screening potential 'hot spots' before any pre-remediation testing is carried out. However users should be aware of their limitations.

The method of analysis recommended for individual VOCs is the USEPA Method TO-17 *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air* (Centre for Environmental Research Information Office of Research and Development 1999). This document explains sorbent tube/thermal desorption/gas chromatographic-based monitoring methods for VOCs (Table 5) in ambient air at 0.5 to 25 parts per billion (ppb) concentration levels.[15]

More recently, methods based on the passive sampling approach have been validated against the USEPA Method TO-17. These may be applicable in some cases for example, with benzene (Plaisance et al 2008).

Table 5: VOC analytical methods

VOC analysis method	Indicative detection limit	Sampling device
GC-FID/FID	2 µg/sample	SKC 226-01 CSC tube
GC-MS	0.1 µg/sample 0.2 µg/sample	As above
ATD-GC-MS	0.005 µg/sample	Passive sampler (eg, SKC 575–100)

[15] http://www.epa.gov/ttnamti1/files/ambient/airtox/to-17r.pdf

5.3.6 Hydrogen chloride

Standard methods for sampling and analysis of hydrogen chloride in air are detailed in Inorganic Acids Methods 7903 (NIOSH 1994c).

Hydrogen chloride may also be detected using a real-time ppb-range portable gas analyser such as those produced by Interscan Corporation. However the use of these analysers would be subject to verification testing in New Zealand.

5.4 Preparation of report

The report should be prepared by the qualified professional (remediation contractor) employed to undertake the site remediation before the dwelling is considered safe for re-occupation. The United States Environmental Protection Agency (USEPA 2009) recommends as a minimum that the report should include the following information:

5.4.1 Introduction

This section of the report should include a case narrative, site description and site assessment which should have been collated before remediation begins. This information should include:

- physical address of the property, number of structures/buildings on the site and a description of any adjacent properties
- documented observations including photos of the condition of the building at the pre- and post-remediation stages, pre-remediation sampling results that provide information on the manufacturing method, chemicals present, 'hot spots' (ie, cooking areas), chemical storage, observed areas of contamination or waste disposal
- details of the site remediation contractor including certification and description of experience in assessing contamination associated with the manufacture of methamphetamine.

5.4.2 Methods

The purpose of this section is to document the site remediation and disposal activities. The type of information and documentation in this section should include:

- decontamination procedures (such as removal of contaminated materials and encapsulation) for each area that was decontaminated
- waste management procedures, including handling and final waste disposal.

5.4.3 Results

The purpose of this section is to document that the building has been remediated to an acceptable level. The type of information and documentation in this section should include:

- a description of the analytical methods used
- a description of the results of post remediation samples including the location and results of post-decontamination samples including written descriptions of individual sample locations
- sampling results, in writing certified by the laboratory that performed the analyses.

The final report for the property owner should be signed by the remediation contractor. It is important that a copy of this report is forwarded to the relevant agency such as the territorial authority who is responsible for deeming the property suitable for re-occupancy (USEPA 2009).

5.5 Summary

In an effort to determine a level of methamphetamine at or below which the site remediation process could be considered adequate for the protection of people who would subsequently reoccupy a dwelling, the Ministry of Health has evaluated the current remediation guidelines used overseas, in particular in the United States. The Ministry of Health currently recommends that surface wipes for methamphetamine not exceed a concentration of 0.5 µg/100 cm^2 as the acceptable post-remediation re-occupancy level for a dwelling that has been used as a clan meth lab.

If there is evidence of iodine contamination on materials or surfaces that will not be removed, it is recommended that surface wipe samples for iodine not exceed a concentration of 20 µg/100 cm^2. If the preliminary assessment indicates the phenyl-2-propanone (P2P) method of methamphetamine manufacture was used, surface wipe samples for lead should not exceed 2 µg/100 cm^2.

Chapter 6: Remediation

6.1 Introduction

According to the Australian Crime Commission (2010) remediation involves:

> 'the treatment, containment, removal or management of chemicals substances or wastes with the aim of ensuring they no longer represent an actual or potential risk to human health or the environment or an environmental value taking into account the current and intended future land use'.

The objective of these guidelines is to minimise any adverse effects of clan meth labs on the natural or built environment through the development and implementation of a nationally consistent approach for dealing with these sites which also includes a consistent approach to remediation.

The Ministry of Health recognises that it is also important that any hired decontamination contractor undergoes independent training and certification in both decontamination processes and health and safety to ensure national consistency for all properties regardless of location and decontamination in accordance with international accepted and recognised standards, guidelines and processes. However, certified remediation (clean-up) contractors should not be allowed to do both sampling and decontamination at the same site; instead third-party sampling is required.

6.1.1 Safety during decontamination activities

Safety during decontamination activities is paramount given that activities entail the risk of exposure to hazardous substances and chemicals. Property owners should only employ contractors who are trained and equipped to perform hazardous chemical remediation for the decontamination of former clan meth labs. Hiring a qualified contractor provides the assurance that the appropriate safety precautions will be implemented, as well as providing a stronger demonstration that the property has been adequately decontaminated.

For the safety of personnel undertaking decontamination, the premises must be thoroughly ventilated for a minimum of 24 hours prior to remediation. Windows and doors are to be kept open during remediation.

The following measures are recommended to ensure contractors are not exposed to potential hazardous substances and chemicals (N Powell, personal communication, 2010):

- Decontamination personnel must wear protective clothing, impermeable gloves, impermeable overalls, gumboots and respirators fitted with activated charcoal filters to remove volatile organic compounds.
- Cleaning solutions containing ammonia or hypochlorite ion must not be used.

- Decontamination personnel should be aware of the possibility that undiscovered biohazard material such as syringes with hypodermic needles may be present at clan meth lab scenes and should observe appropriate precautions when handling items at such scenes.
- Disposable overalls and gloves should be discarded after each use. Wash or wipe down other gear with cleaning compound after each use.
- Respirator filters should be changed at intervals in accordance with the manufacturer's instructions. Filters should be discarded and replaced if air drawn through filters has any perceptible odour.

6.2 Ventilation

Venting of the clan meth lab before, during and after the remediation process has been recommended by opening windows, using fans, blowers and or a negative air unit with a HEPA filtration system (USEPA 2009). In circumstances where a clan lab site may have already been ventilated by the New Zealand Police and ESR as part of their criminal investigation including the gross removal of bulk chemicals but sealed after these activities, the site should be ventilated again before remediation occurs.

Some overseas guidelines recommend closing the windows and door and increasing the temperature for a few days to promote the volatilisation of certain chemicals, a practice sometimes referred to as 'baking'. However, the effectiveness of this practice has not been documented and it has been suggested that heating the dwelling may mobilise and redistribute chemical compounds thereby spreading contamination. It is for this reason that 'baking' is not recommended until further research is conducted (USEPA 2009).

While recognising that it can be difficult to ventilate a property and keep it secure prior to remediation, the USEPA recommends that ventilation should be performed for a minimum of 24 hours prior to remediation personnel entering the site.

Immediately prior to air sampling (eg, a minimum of 24 hours before) the premises should be completely closed to ensure that air sampling reflects stagnant air and therefore 'worst case scenario' levels.

It is important that ventilation is continued throughout the remediation process.

The following ventilation protocol is recommended:

- Ventilate before pre-remediation testing (without compromising property security).
- Close up the premises no less than 24 hours prior to air sample/testing.
- Ventilate during remediation.
- Ventilate after remediation has been completed.
- Close up premises no less than 24 hours prior to post-remediation air sampling/ testing.

6.3 High efficiency particulate air vacuuming

Vacuuming using a commercial-grade vacuum cleaner should be undertaken prior to any other remediation.

High efficiency particulate air (HEPA) vacuuming should also be undertaken once any flooring materials such as carpet or lino/vinyl have been removed.

A commercial-grade vacuum cleaner with a HEPA filter must be used as without the filter fine particles will simply circulate again and (depending on building ventilation patterns) may subsequently settle in more accessible locations.

HEPA filter vacuuming may also be suitable in circumstances where an existing item of intrinsic or emotional value cannot be washed in a detergent solution.

6.4 Removal and remediation of contaminated materials

In most circumstances it is unlikely that all the chemicals used or generated during the manufacture of methamphetamine will be identified. Therefore a precautionary approach to remediation must be taken.

Items that should be removed and properly disposed of at an approved facility are any:

- materials that are visibly stained, emitting odour, damaged or thought to have been used in the manufacture process (eg, refrigerator used for chemical storage)
- materials that are absorbent and difficult to clean including as carpeting, wallpaper, soft board building materials, paper materials (books, documents) and soft furnishings such as couches, mattresses and thermal backed curtains
- items that could come into contact with young children or babies.

Items to be disposed should be made un-usable so they cannot be recycled that is, inadvertently land up in the hands of second hand or social service agencies such as the Salvation Army and thus transfer contamination.

If an item is of significant sentimental, monetary or legal value, professional judgement should be used to gauge whether to discard the item or attempt remediation.

Items where remediation may be appropriate are:

- fabric items that can be placed into a washing machine
- ‘hard surface’ items that are non-porous
- metallic items and surfaces, eg, stainless steel kitchen surfaces
- glass items and surfaces.

6.5 Heating, ventilation and air conditioning

In circumstances where a clan meth lab has been located with a heating, ventilation and air conditioning (HVAC) system or other residential forced air system, it is possible that fumes, dust and other contaminants may have collected in areas such as vents, ductwork, filters and on walls and ceilings near the ventilation ducts. Because a single HVAC system can service multi-unit structures such as apartments and therefore can spread the contamination, the system should be shut down and remain off until the remediation of the site is complete. It is recommended that sampling in all areas serviced by the HVAC is conducted as part of the preliminary assessment so that the spread of contamination can be determined.

It is important to note that some ventilation system ducts cannot be remediated because of the nature of the material they are lined with, for example fibreglass. In addition, flexible ductwork often contains a porous inner surface such that in most cases remediation is uneconomic. It is for this reason that the ductwork should be discarded and replaced after the ventilation system has been remediated (USEPA 2009).

Where dwellings have heat pumps, the remediation of these appliances should be assessed on a case-by-case basis with a focus on their proximity to where the cooking was conducted. Because the heat pump manufacturer cannot quantify the risk associated with remediating a heat pump appliance, it is likely that they may assume a 'worst case' scenario which could mean total replacement of the product. It is possible that, given the corrosive nature of some of the chemicals used in the illicit manufacture of methamphetamine, the manufacturer's warranty will not cover damage caused by corrosive substances. Where the risk of contamination (toxicity) from a heat pump is low and removal of the item is not cost-effective, it is possible that replacing the entire indoor unit may be an acceptable solution. However, in respect of any goods including heat pumps supplied under a contract, it is the owner's responsibility for the correct operation and regular maintenance of the equipment listed on a warranty. Before any remediation is carried out on a heat pump appliance, it is important that the owner consults the manufacturer about any proposed remediation.

6.6 Plumbing systems, sewers and on-site effluent treatment systems

Liquid waste and sludge produced during the illicit manufacture of methamphetamine are frequently dumped into sinks, bathtubs and toilets.

All drains should be checked for staining, corrosion of pipe work and the presence of high levels of VOCs all of which are indicative of dumping of chemical waste. Remediation options are flushing of plumbing and removal of corroded/damaged piping.

If the dwelling is connected to a municipal sewer system, it is unlikely that the disposal of the clan meth lab waste will pose a health risk, due to the high level of dilution involved. In such cases, however, the relevant territorial local authority should be informed that chemicals associated with the manufacture of methamphetamine may have been disposed of down the sanitary sewer (National Collaborating Centre for Environmental Health 2008).

In circumstances where the dwelling is not connected to a municipal sewer sampling of the on-site effluent treatment system (septic tank) should be conducted, using pH testing procedures, to determine the extent of contamination. However, any remediation of the on-site effluent treatment system should happen at the end of the remediation process so that any chemicals disposed of into the system are appropriately removed. Nevertheless in situations where the disposal field is not functioning, the system should be remediated as soon as possible and no wash water or waste should be added to the system (USEPA 2009).

6.7 Detergent-water surface solution washing

It is recommended that surface washing be performed three times using a standard detergent solution at a concentration that accords with the manufacturer's specification. It is important to ensure that cleaning is carried out thoroughly over the entire surface rather than just spots.

Most guidance documents recommend cleaning from the ceiling to the floor. The wash water need not be hot, as hot water has not been proven to be more effective for cleaning than cold water (USEPA 2009).

Before each wash, the surface should be rinsed thoroughly using clean water and a clean cloth. The cloth should then be disposed of appropriately.

The use of harsh chemicals such as bleach, trisodium phosphate (TSP) and methanol should be avoided. The interaction of bleach and methamphetamine is not fully understood and their by-products currently remain unknown. It is thought that a reaction between bleach and iodine (used in the most common New Zealand method: red phosphorus) could produce a toxic gas (USEPA 2009). The use of TSP has been recommended in some guidance documents. However while it is a strong cleansing agent it has also the potential to irritate the person using it. Methanol is not recommended because it produces flammable vapours and has a low flash point (USEPA 2009).

6.8 Encapsulation

The purpose of encapsulation is to create a physical barrier between humans and any residual contaminants that were not removed through cleaning and human contact. Encapsulation should never be considered as a substitute for cleaning; instead it should occur after surfaces (eg, ceilings, floors, walls) have met remediation guidelines – that is, after post-remediation sampling has been completed (USEPA 2009).

Most guidance documents stipulate that walls, ceilings, floors and woodwork must be coated with oil-based paint, epoxies or polyurethane to encapsulate interior surfaces. Ceramic or stone-filled surfaces that are not removed should be cleaned and re-glazed if appropriate. Grout should be stained using an epoxy-based stain following cleaning (USEPA 2009).

For complete coverage, it may be necessary to apply more than one coat of primer, oil-based paint or sealant. It is important to allow primers, paints or sealants to dry before additional coats are applied. In addition it is also recommended that encapsulated areas are ventilated thoroughly prior to sampling for VOCs remaining from the methamphetamine cooking process (USEPA 2009).

In some circumstances guidance documents have recommended that products applied to encapsulate surfaces be sprayed on rather than hand-rolled. However, to date there is no available data to suggest that the physical motion of using a roller brush is likely to agitate residual methamphetamine on smooth surfaces (USEPA 2009). For the purpose of these guidelines it is recommended that products applied to surfaces be sprayed, which the United States Environmental Protection Agency states '*is a valid recommendation especially for textured surfaces that cannot withstand physical agitation*' (USEPA 2009 p 16).

6.9 Demolition

Where contamination is extreme and adequate remediation through washing, stripping or encapsulation may not be achieved, it may be necessary to demolish the contaminated building. For any demolition of a building, a building consent under the Building Act 2004 is required. All demolition materials must be legally disposed of according to the nature of the material and degree and type of contamination. Thus, for example, it is not recommended a clan meth lab structure be burnt for fire service training in lieu of remediation. In circumstances where demolition is required, extensively contaminated materials must be disposed of to an approved waste facility (landfill) with acceptance criteria that match waste of this nature. Such waste acceptance criteria are determined during the resource consent process under the Resource Management Act 1991 based on landfill siting and design of retention, leachate collection and treatment/disposal systems (Centre for Advanced Engineering 2000).

A recommendation for demolition should be justified and reported in detail to the appropriate territorial authority. The report should include appropriate analytical data to justify the decision based on a risk assessment model. In most circumstances this process will require a territorial authority officer or a medical officer of health to declare the dwelling unfit or insanitary for habitation and condemned by exercising their powers under the Health Act 1956 or Building Act 2004.

6.10 Outdoor remediation

The dwelling grounds should be inspected for evidence of contamination such as dead vegetation, soil disturbance and soil discoloration.

Assessment of possible contamination may include soil or water sampling.

Where there are threats to soil and groundwater, the regional council/unitary authority should be consulted regarding appropriate remediation of the site.

Chapter 7: Roles and Responsibilities for Site Remediation

7.1 Introduction

Individuals and agencies with roles and responsibilities in the remediation of sites used for the illicit manufacture of methamphetamine include:

- central government agencies
- local government agencies (city, district, regional councils or unitary authorities)
- non-government agencies such as the Chemical Industry Council
- public health services of District Health Boards
- property owners, managers and occupiers.

Roles and responsibilities must be considered in three contexts:

1. the regulatory agency with statutory authority to act and 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.

> Hazards associated with the remediation of illicit drug manufacturing sites such as methamphetamine labs need to be managed collaboratively to avoid duplicated effort, wasted resources and the perception of 'buck passing' and to ensure the most effective statutory response. Thus it is important to determine who has jurisdictional responsibility as a first step, then to address the issues.

An understanding of the roles and responsibilities of other central and local government agencies as well as non-government agencies is important in order to facilitate efficient and effective local remediation of former clan meth labs prior to re-occupation.

Good communication links among key agencies are important. Such links should be established or reinforced and regularly maintained to allow for efficient and effective dissemination of information and resolution of issues. For further information on roles and responsibilities of agencies, refer to sections 7.5 to 7.8.

7.2 Pre-remediation considerations – 'clan meth lab bust'

Figure 4 outlines the process for remediating a clan meth lab site located in a building used for residential purposes in New Zealand. Initially, a clan meth lab bust is made by the New Zealand Police. The main sources of information for clan meth labs to date has been: informants, chemical diversion desk information (companies advise the New Zealand Police of suspicious activity which is then investigated), public concern over unusual or suspicious events and Police discovery during other enquiries or action.

Entry into the dwelling is gained either through a search warrant or by declaring an emergency under the Hazardous and New Organisms (HSNO) Act 1996. Information is collected on-site by the clan lab team who sample and remove all the bulk chemicals for evidence. Once a chain of custody is established the site effectively becomes a designated crime scene and those with the area of expertise move in.

The Institute of Environmental and Science Research (ESR) affords 24-hour assistance to the New Zealand Police in processing illegal and extremely hazardous clandestine laboratories. During the initial assessment, scientists from ESR provide safety information and advice on the level of personal protection required for people entering the clan meth lab site. They examine the laboratory, shut down chemical reactions and render the scene as safe as possible. They work in with the exhibit officer to process exhibits and determine what items will be sampled and what literature and documentation should be seized. In addition ESR may: assist hazardous waste contractors in sorting and attempting to identify unknown liquids and powders during the destruction phase; where possible provide information about the laboratory including the method and production capabilities of the laboratory; prepare statements for court; and prepare unusual aids to assist the court in understanding the procedures used at the clan meth lab site.

The New Zealand Police have developed National Clandestine Laboratory Response Team (NCLRT) Standard Operating Procedures. The aim of these procedures is to provide a practical guide on how to minimise the risk of accident or injury that can arise from dealing with clan meth lab investigations. The procedures also acknowledge the critical need for organisations and individuals to comply with the HSNO Act 1996.

Trained members of the NCLRT undertake the processing of a clandestine scene. They are responsible for identifying, collecting and recording of all items related to the clan meth lab. This work includes overseeing the removal of the illegal drug laboratory and associated chemicals – a process commonly termed ‘gross chemical removal’, although it is often mistakenly referred to as remediation or ‘clean-up’.

In the event that a child or young person is living at the address of the clan meth lab, social services such as Child, Youth and Family (CYFS) may be required to attend upon request, often at short notice. CYFS accepts custody of the child and ensures that ambulance staff give the child/young person a medical check at the scene. They also transport the child/young person to a new caregiver and/or medical facility as required.

The New Zealand Police will still continue with the observation of the property until their investigation is completed and handover is arranged.

It is not the role of the New Zealand Police or ESR scientists to decontaminate the site of the clan meth lab. However, the site remediation process is assisted if the information about a site is shared with the other agencies involved. It is not ESR’s policy to divulge specific information to a third party regarding a possible crime scene or a New Zealand Police investigation, because doing so may adversely affect that investigation or subsequent court processes, or conflict with privacy requirements (ESR 2007b). However, NCLRT members are required to contact the appropriate territorial authority. When it is safe to do so, a NCLRT member will give the territorial authority

representative the opportunity to view the site first hand and exchange relevant information necessary for remediation such as the clan lab grade or classification the Police have allocated to the site.

Without such information relating to the methods of manufacture and chemicals found at the site, a remediation assessor may lack the full picture which may reduce the effectiveness of the remediation process. For example, if information that amalgam/ P2P method was suspected is not passed on, the remediation assessor may not test for lead and mercury.

7.3 Notification

Figure 5 sets out an example of a procedure that territorial authorities have generally adopted in regard to clan meth labs notifications received from the New Zealand Police or a member of the NCLRT. Appendix D sets out a site inspection form that has been developed by the Gisborne District Council for clan meth labs. The following case study illustrates a territorial authority's policy as it relates to notifications.

Case Study – Hamilton City Council

The Hamilton City Council's policy is to respond to all notifications the New Zealand Police make to the Council. Notifications received from members of the public, landlords, real estate agents, etc, may be considered by the council on a case-by-case basis.

When the New Zealand Police notify the council of a clan meth lab, a service request is entered into the council's complaint management database. The job is given a unique service request number, which is automatically allocated to the environmental health officer (EHO) assigned to deal with clan meth labs. All details of the EHO's investigation and actions in the matter are recorded against the allocated service request number in this database. The council's database is a property based system, so that the complaint is linked to the location of the clan meth lab.

A requisition is also raised in the council's land information memoranda (LIM) database which notes that the property in question has been identified as a clan meth lab.

The EHO will contact the New Zealand Police for further information in relation to what was found and where, and the likelihood that drugs had been manufactured at the property. If possible a list of chemicals and equipment that were found at the property is obtained. A precautionary approach is used when considering likely contamination. A Cleansing Order, that is a requisition, pursuant to the Health Act 1956 will then be issued to the owner of the property (refer to Appendix E for 'letter to owner' and 'cleansing order' templates). This step is taken because the Hamilton City Council has had cases where properties graded 'C' or 'D' by the New Zealand Police have been found to be severely contaminated.

Once the requirements contained in the requisition have been satisfactorily complied with, the service request will be updated with the details and the job will be completed (closed). Hard copies of the initial testing report and validation report plus other relevant information must be provided to the council before the Cleansing Order can be closed off.

However, the LIM database will always record that a P-lab requisition has been issued against the property in question. The satisfactory completion of any requirements contained in a requisition will merely change the 'status' of that requisition, as noted on the LIM. A requisition that has not been complied with will have a status of 'current' (ie, requisition is outstanding) while a requisition that has been fully complied with will have a status of 'satisfied' (ie, the requisition has been satisfied).

The council's stance on clan meth lab LIM notations is as follows:

a) Once a clan meth lab requisition has been issued it will only be deleted from the property record if it was originally entered in error – for example, entered against the wrong property.

b) When a report is received from a suitably qualified professional confirming that the premises have been cleansed, and that there is no longer evidence of contamination and the building is suitable for human habitation, the status of the requisition will be changed from 'current' to 'satisfied'. A copy of that report will be disclosed with the LIM and a copy placed in the property bag.

Depending on the circumstances there are some territorial authorities who will formally serve a property owner with a notice under the Building Act 2004 made pursuant to a warrant[16] issued under this Act to avert immediate danger in conjunction with a cleansing order issued under the Health Act 1956. For more information refer to section 7.6.

Territorial authorities will recommend that properties that are suspected to have been used for the manufacture of methamphetamine should be tested for contamination by a professional scientific analyst as soon as possible. Results of testing will identify how much, if any, decontamination is required. Territorial authorities will advise the property owners that no one should be allowed to enter the building/dwelling, other than for purposes of testing or unless wearing appropriate personal protective equipment, until the property has been cleared by scientific testing.

7.4 Decontamination

The property cannot be re-occupied until decontamination activities have been performed and samples have been collected and analysed to confirm that the remediation guidelines identified in Chapter 4 have been met. It is strongly recommended that qualified professionals with experience in environmental testing of likely contaminants be engaged to confirm that remediation levels have been met. Information and proper documentation gathered by an unbiased, qualified third party can strengthen the validity of sampling results. In addition, it is likely that such a report will satisfy the requirements of a cleansing order issued under section 41 of the Health Act 1956.

[16] This includes a sign, at each point of entry to the dwelling advising people not to enter and stating that the building is unsafe and is required to be vacated under the provisions of the Building Act 2004.

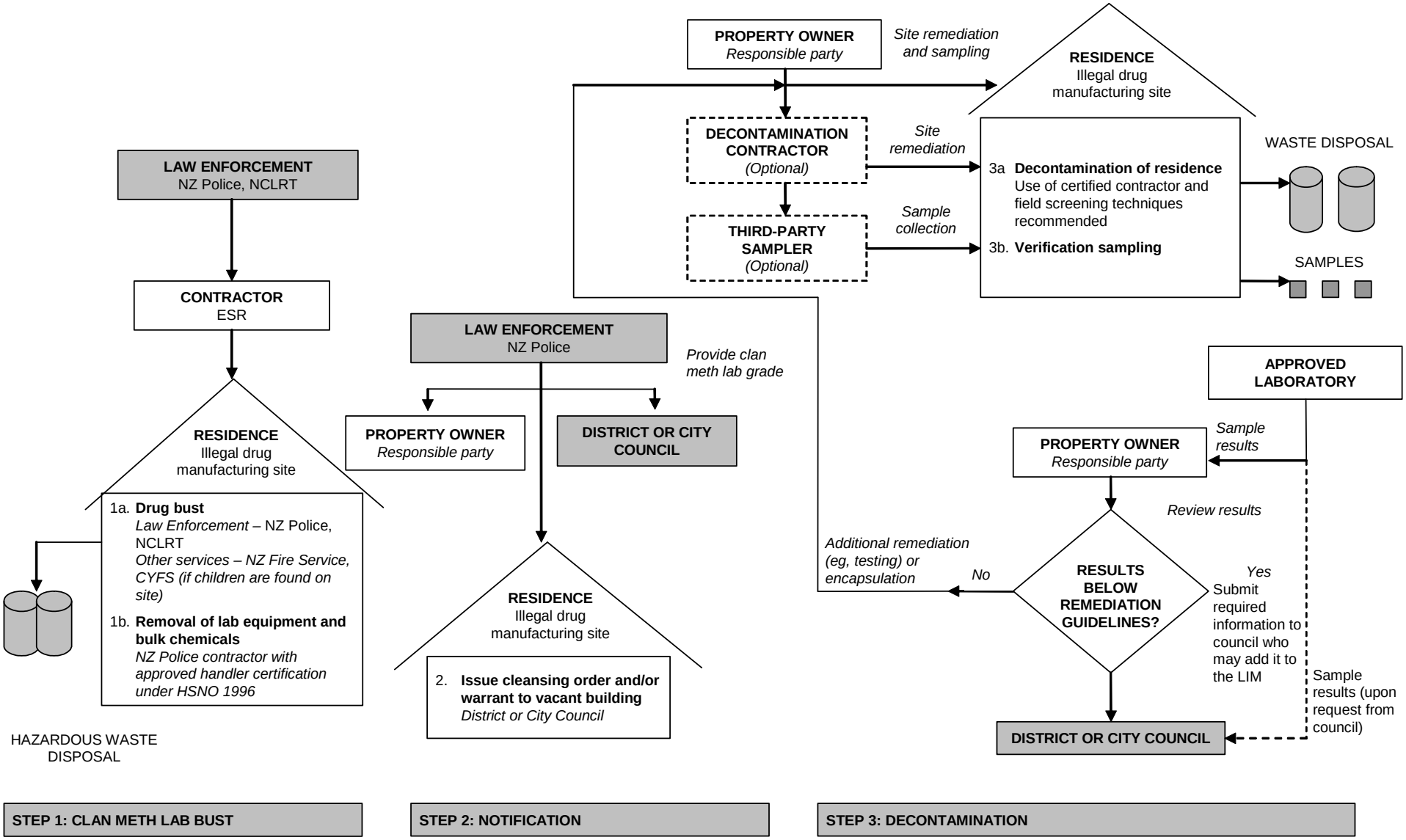
7.4.1 Waste management

Decontamination activities will generate both solid waste for example furnishings, appliances and liquid waste or wastewater.

All waste including chattels must be disposed of to an approved landfill in accordance with applicable legislation and/or provisions contained in district, city, unitary or regional council plans as they relate to waste management. In general, wastewater may be discharged to a sanitary sewer unless it contains decanted or spilled chemicals.

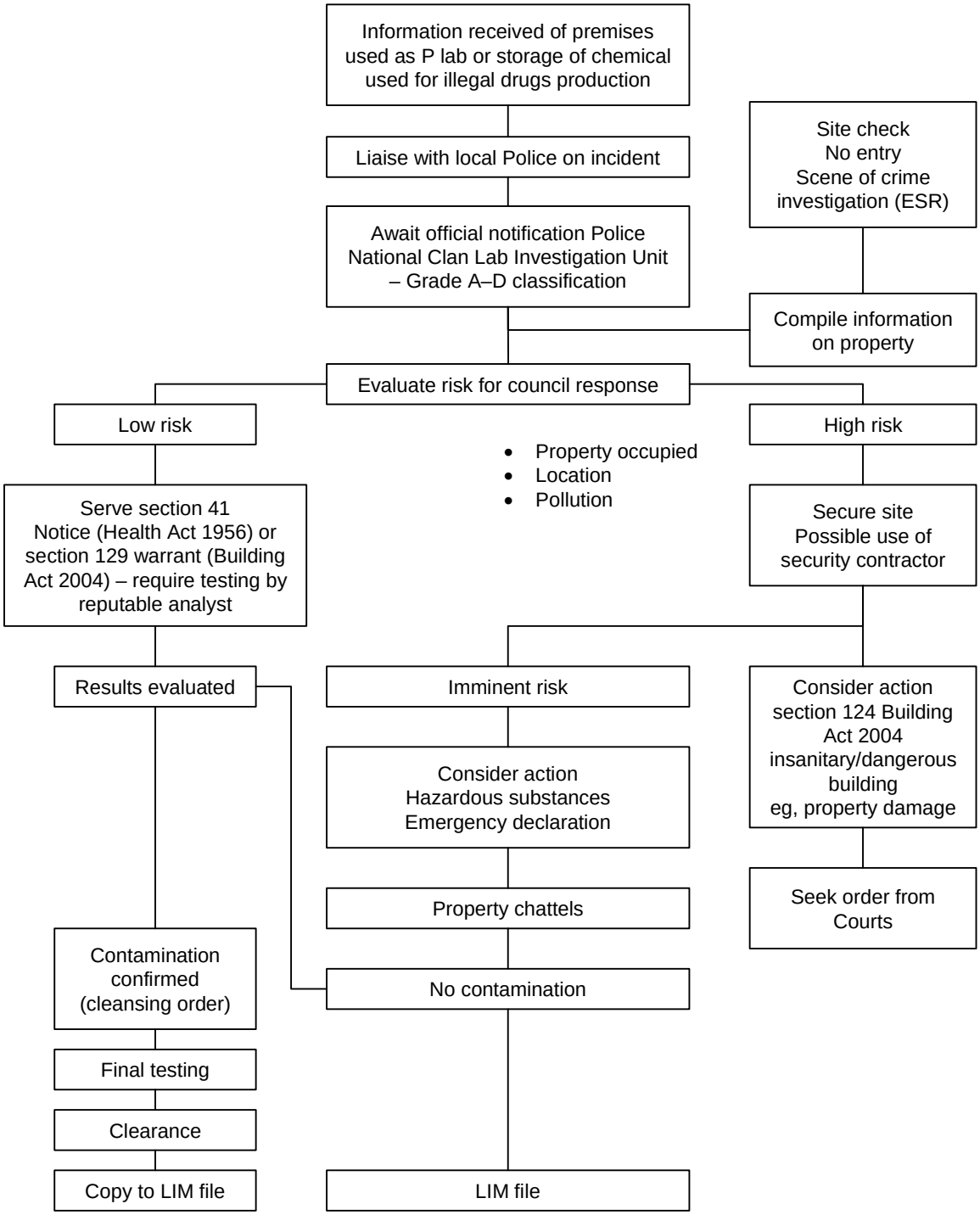
To determine final deposition of waste, testing may be required. Any such testing should be carried out by a person knowledgeable and trained in hazardous waste characteristics, legislation and disposal requirements.

Figure 4: Site remediation process flowchart for illegal drug manufacturing sites



Source: Adapted from Alaska Department of Environmental Conservation (2007).

Figure 5: An example of a council's procedure for dealing with a clan meth lab (Hutt City Council)



7.5 Role of central government agencies

7.5.1 Ministry of Health

One of the major roles of the Ministry of Health is to support 20 District Health Boards by providing national policy advice. The Ministry of Health is also responsible for regulating, funding and monitoring these DHBs to ensure that the health and disability needs of communities in their regions are best met.

The Ministry of Health administers the Health Act 1956 and its role is to improve, promote and protect public health. Section 117 enables the development of regulations for the purpose of 'the inspection, cleansing ... of houses, buildings' (section 117(1)(b)). This provision offers a possible statutory mechanism for the site remediation of clan meth labs at a national level.

The Public Health Bill is intended to replace the Health Act 1956. Its provisions for notifications are similar to those under the Health Act 1956.[17]

The public health functions of the District Health Boards (DHBs) are summarised in subpart 5 of the Public Health Bill. Among these functions are to: employ medical officers of health and health protection officers, to monitor and identify risks to public health in their respective locality and assess and, where appropriate and reasonable in the circumstances, take steps to contain and manage those risks.

Another piece of legislation relevant to clan meth labs is the Misuse of Drugs Act 1975 which is administered by the Director-General of Health. The Ministry of Justice administers the Misuse of Drugs Amendment Act 1978, Part II, which deals with detention, enforcement and sentencing. Amendments to the Misuse of Drugs Act, including the scheduling or rescheduling of drugs, are effected only with parliamentary consent.

7.5.2 Ministry for the Environment

The Ministry for the Environment administers New Zealand's principal environmental legislation namely the Resource Management Act (RMA) 1991. The RMA promotes the sustainable management of natural and physical resources. Section 5, which sets out the purpose of the Act, specifically refers to enabling people and communities to provide for their health and safety.

[17] At the time of writing the Public Health Bill was reported back from Select Committee in June 2008 and was awaiting its second reading when Parliament was dissolved in October 2008. With a change in government it is unclear whether the Bill will continue on its passage through the House, or will be abandoned (at least in its current form).

Under sections 43 and 44 of the RMA, the Minister for the Environment has the power to prepare and recommend national environmental standards (NES) to prescribe 'soil quality in relation to the discharge of contaminants'. The appropriateness of an NES for contaminated land is currently being considered. This guideline will complement any such NES developed for contaminated land in the future. In the meantime the Ministry for the Environment has developed, in consultation with industry and local government, a series of guidelines for managing contaminated land. These guidelines provide a framework for contaminated land management that supports local government responsibilities under the RMA. They also illustrate best practice in reporting, risk screening, application of environmental guideline values, classification of sites, site investigations and analysis of soils.

The Contaminated Sites Remediation Fund (CSRF)[18] is administered by the Ministry for the Environment. Since 2003 the CSRF has been made available for the investigation, remedial planning and remediation of sites that pose a risk to human health and the environment. The CSRF currently totals $1.78 million and comprises two distinct parts:[19] $0.89 million is available to regional councils and unitary authorities on a contestable basis; and the other $0.89 million is administered by the Ministry for the Environment, working in partnership with regional councils and unitary authorities, to address the priority sites.

Regional councils are invited to apply to the CSRF in dealing with contaminated sites they have identified in their regions. Priority for funding will be given to those sites that are posing or likely to pose a high risk to human health and are located in environmentally sensitive areas or areas of national or cultural significance. Also considered are sites where the landowners do not have the financial resources themselves to undertake the investigation or remediation work required but want to work with the regional council on the problem.

A function of regional councils and unitary authorities is to identify and monitor contaminated land. Therefore it is considered appropriate that only regional councils and unitary authorities make or facilitate any applications to the CSRF. However, if district and city councils or landowners wish to address contaminated sites, they will have access to the CSRF through their respective regional councils.

The CSRF is underpinned by the following principles:

- Partnerships involving government, local government and landowners/occupiers are developed to investigate and remediate a contaminated site. As noted above, only regional councils and unitary authorities may apply to the CSRF – district councils, companies and individuals are not eligible to apply directly for funding. A district or city council, an individual site owner or previous polluter may choose to work in partnership with their regional council to address a site of concern.

[18] The fund was originally called the Orphan Sites Remediation Fund but was renamed because the definition of an 'orphan site' rests on a legal liability regime that is not currently in place.

[19] http://www.mfe.govt.nz/issues/hazardous/contaminated/remediation-fund.html

- Where remediation of a site results in significant betterment, and this betterment is realised through the sale of the property, the increase in the value of the site attributable to the remediation is to be shared between the funding parties in the same ratio as their respective funding shares.
- No liability for any site is presumed by the Government through the provision, or application, of the CSRF.

The following principal criteria are used to determine the eligibility of a site for funding:

- **Partnerships:** There is a demonstrated partnership between the regional council/unitary authority and other interested parties.
- **Risk:** The site poses or, following preliminary site inspection, potentially poses significant risk to human health and/or the environment.
- **Status:** The site was undertaking activities likely to result in site contamination either prior to the enactment of the RMA in 1991; or after its enactment in 1991, but, no enforcement can be undertaken by regional councils or territorial authorities to require investigation or remediation of contamination; and activities causing the contamination have since ceased.
- **Capability:** There is a demonstrated capability to undertake the project including the practicality and feasibility of actions.
- **Funding:** Contributions from other parties reflects their ability to contribute to the project.
- **Responsibility:** The actions of the current landowner or occupier did not result in the contamination of the site. If the landowner or occupier is only in part responsible for the contamination, it is expected that their contribution to the contamination of the site will be reflected in their contribution towards any investigation or remediation works.

The CSRF plays a key role in encouraging action on contaminated sites, especially where the responsibility for contamination is difficult to establish. An abandoned former clan meth lab may qualify for investigation and remediation of contaminated outside areas (eg, soil and waterways). However, there are obstacles to achieving remediation (clean-up) by this means, such as the size of the fund and the limited financial resources of local government.

7.5.3 Inland Revenue Department

Taxation (Base Maintenance and Miscellaneous Provisions) Act 2005

The Taxation (Base Maintenance and Miscellaneous Provisions) Act 2005 administered by the Inland Revenue Department provides tax deductions for business expenditure related to contaminated land clean-up and management. The provisions include:

- an immediate tax deduction for restoring contaminated land (other than for land developers)
- a Crown fund, called the Environmental Restoration Account, to allow businesses to set aside money for future site remediation, such that the cost of meeting restoration obligations in the future reduces the overall tax liability of the business.

7.5.4 Environmental Risk Management Authority

The Environmental Risk Management Authority New Zealand (ERMA New Zealand) is responsible for administering the Hazardous Substances and New Organisms (HSNO) Act 1996. The purpose of the HSNO Act is to protect the environment and the health and safety of people and communities by preventing and managing the adverse effects of hazardous substances and new organisms. The HSNO Act allowed for the establishment of ERMA. In exercising all functions, powers and duties under this Act, ERMA must take into account public health.

Hazardous Substances and New Organisms Act 1996

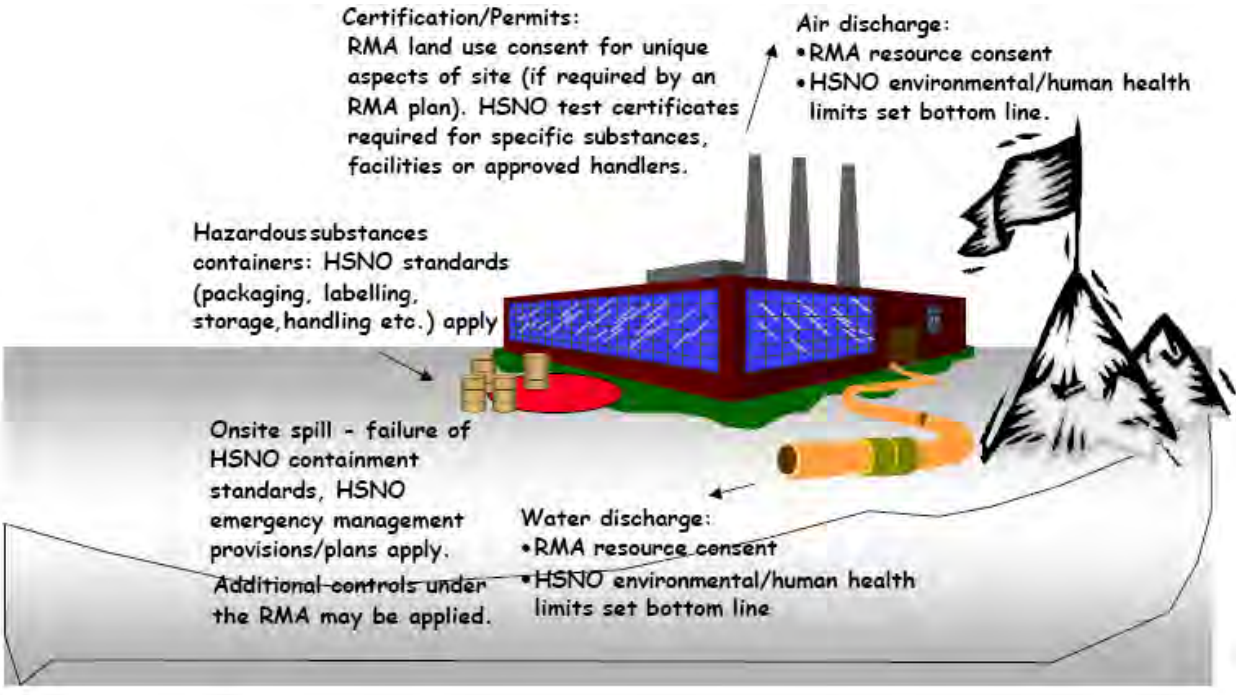
Both the HSNO Act and the RMA are designed to protect human health and the environment from the effects of hazardous substances, and to work in conjunction with each other (Figure 6). By ensuring that hazardous substances are appropriately used, stored, transported and disposed of, the HSNO Act prevents the creation of new contaminated land.

Under this legislation the New Zealand Police and Fire Service officers have the powers of enforcement at emergencies. These powers include powers of entry and seizure where there are hazardous substances present, which may be endangering people or the environment. The New Zealand Police uses these powers to seize and remove chemicals from clan meth labs. However generally the New Zealand Fire Service will use its own legislation (see section 7.5.8).

Any enforcement officer who declares an emergency under the HSNO Act must send a report giving full details to ERMA.

Although the New Zealand Customs Service is not a section 97 enforcement agency, under section 121 of the HSNO Act substances not approved by ERMA are equivalent to prohibited imports under the Customs and Excise Act 1996. Section 54 of this Act provides the New Zealand Customs Service with the power to prohibit the entry into New Zealand of such substances.

Figure 6: Links between the Hazardous Substances and New Organisms Act 1996 and the Resource Management Act 1991



Source: Ministry for the Environment (2003)

7.5.5 Department of Building and Housing

The Department of Building and Housing (the Department) was established in November 2004. Its primary focus is the building and housing sector. The Department combined the Ministry of Housing and the Building Industry Authority, together with the building policy functions from the Ministry of Economic Development and related functions from the Ministry of Social Development and Housing New Zealand Corporation. The Weathertight Homes Resolution Service joined the Department from the Department of Internal Affairs on 1 July 2005, and the functions of the Electrical Workers Registration Board were transferred to the Department in September 2006. On 31 January 2008 the administration of the Plumbers, Gasfitters and Drainlayers Act 2006 was transferred from the Ministry of Health to the Department.

The Department administers two Acts relevant to the remediation of clan meth labs: the Building Act 2004 (including the Building Regulations 1992 under review) and Residential Tenancies Act 1986.

The Department has sole responsibility for:

- ensuring an effective regulatory environment for the housing and building sector
- regulating the building sector and rental housing sector
- delivering effective information, advice and dispute resolution services
- providing purchase and monitoring advice to the government on Housing New Zealand Corporation
- administering the State Housing Appeals Authority.

The Department has lead responsibility for providing:

- policy advice on the building sector and residential tenancy market including emerging trends and issues
- policy advice on housing and building regulation
- advice on the regulation of the residential rental market
- occupational licensing within the housing and building sector.

The Department has joint responsibility or a common interest (with Housing New Zealand Corporation) in:

- defining housing outcomes for the sector
- analysing the housing environment
- influencing the wider government sector to ensure it meets government goals for housing
- working within the social services cluster and economic, growth and innovation frameworks to influence and promote delivery of the government's outcomes for the housing and building sector.

Building Act 2004

The Department of Building and Housing is responsible for administering the Building Act 2004. The Building Act 2004 as it relates to the remediation of clan meth labs is discussed further in section 7.6.1 of these guidelines.

Residential Tenancies Act 1986

In New Zealand rented properties have not been exempt from being used for the illicit manufacture of methamphetamine. The Residential Tenancies Act (RTA) 1986 administered by the Department of Building and Housing has not been designed to deal with such situations and does not provide for a property and any contaminated goods within to be quickly and effectively secured and remediated. This Act is discussed further in section 7.9.

7.5.6 Housing New Zealand Corporation (HNZC)

Housing New Zealand Corporation (HNZC) is a Crown entity established under the Housing Corporation Act 1974, as amended by the Housing Corporation Amendment Act 2001. HNZC is a responsible landlord and works to protect the safety of its staff, tenants and contractors. Since 2004 HNZC has had in place a tenancy management procedure that provides its staff with a clear process where there is a suspicion or confirmation that an HNZC tenancy is being used for the illicit manufacture of methamphetamine. This procedure applies to all tenancies managed by the Corporation.

HNZC will seek to recover any costs[20] associated with the remediation and repair of property from its tenants and may also refuse to house tenants in the future.

7.5.7 New Zealand Police

Together with the New Zealand Customs Service, the New Zealand Police is responsible for enforcing the Misuse of Drugs Act 1975. The New Zealand Police has also been provided with wide powers, including the ability to search premises and people without a warrant if it has reasonable grounds to believe an offence has been committed under the Misuse of Drugs Act 1975.

7.5.8 New Zealand Fire Service

The New Zealand Fire Service is the Crown's principal fire risk management agency. It provides a comprehensive range of services in risk reduction, fire safety and emergency response. The role of the New Zealand Fire Service is limited to decontamination unless the initial response message indicates that rescues are required.

The New Zealand Fire Service is commonly involved in assisting the New Zealand Police at clan meth labs. Although responsible for clearing the hazardous material the New Zealand Police may request assistance from the New Zealand Fire Service.

As far as a hazardous substance emergency is concerned the legal responsibilities of the Fire Service Act 1975, section 28 is as follows:

- *'If, in the event of any hazardous substance emergency occurring, the CFO ... considers that the fire brigade could render assistance, that officer or other person may proceed, ... and ...*
- *Endeavour by all practicable means to cause the stabilising or rendering safe of the hazardous substance emergency, and save lives and property in danger.'*

As noted in section 7.5.4 above, New Zealand Fire and Police officers have the powers of enforcement officers under the HSNO Act 1996 at emergencies. Under section 28 of the Fire Service Act 1975, fire officers have adequate powers of entry at hazardous substance emergencies. The power of entry under the HSNO Act has greater liability in relation to disruption of neighbours. It is recommended that fire officers use the Fire Service Act 1975 (section 28).

This section of the Fire Service Act 1975, however, cannot be used to authorise gathering evidence; for this activity a New Zealand Police or a HSNO warrant is required.

[20] The average cost to test and remediate a state house has been around $4,500 (Nash 2010).

7.5.9 Child Youth and Family

It is recognised that clan meth labs create both physical and chemical risks for children and young people.

The age-related behaviour of children and young people increases the likelihood that they will inhale, absorb or ingest toxic chemicals, drugs or contaminated food. Most people involved in the manufacture of methamphetamine are also drug users. Their behaviour is unpredictable and their reactions to New Zealand Police entry may expose children and young people to further risk such as fire and explosions, spilt chemicals, firearms and other weapons or being taken as a hostage.

Child Youth and Family (CYF), a service of the Ministry of Social Development, works closely with the New Zealand Police at an operational level to ensure the safety and wellbeing of children and young people who are found in clan meth labs, including access to appropriate medical checks.

7.6 Local government agencies

7.6.1 Role of territorial authorities

Once the New Zealand Police has completed its investigation and has gathered the evidence it requires, the territorial authority concerned is notified of the existence of the former clan meth lab. Apart from removing of chemicals and manufacturing apparatus, the New Zealand Police does not undertake any cleansing or remediation.

Territorial authorities have a number of potentially relevant statutory obligations to monitor and initiate inspections and to ensure that proper steps are taken to abate potential nuisances and/or deal with the actual or potential hazards associated with abandoned clan meth labs. These statutory obligations are outlined below.

Health Act 1956

The Health Act 1956 includes provision for territorial authorities to:

- improve, promote and protect the public health (section 23)
- initiate steps to abate nuisances or to remove conditions likely to be injurious to health or to be offensive (section 23)
- enforce regulations under the Act (section 23)
- make bylaws for the protection of public health (section 64)
- issue cleansing orders or obtain closing orders (sections 41 and 42).

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.

In other words, if a territorial authority finds (either by inspection or through information from the New Zealand Police) a clan meth lab in the district that is likely to be injurious to health, then it must do something about it. The first step is to determine whether the building that has been used to manufacture methamphetamine is likely to be injurious to health. Completing this task may involve a council officer and an expert in this area inspecting the premises. Section 128 of the Health Act 1956 provides a power of entry and the conditions set out in that section will need to be met, before such an inspection can take place.

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. A nuisance has to exist before any action can be taken although a situation only has to be 'likely to be injurious to health' to meet the requirement for 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 contamination issues. Failure to comply with the terms set out in sections 41 and 42 is an offence under the Health Act 1956 and is liable to a fine not exceeding $500 and where the offence is a continuing one, a further fine not exceeding $50 for every day upon which the offence is committed (section 136 of the Health Act 1956).

Under the Health Act 1956 there is no provision for a landowner to appeal a cleansing order as opposed to a closing order. It follows that in determining the scope and content of a cleansing order, the council would need to be mindful of the absence of a right to appeal and ensure that any wording/scope of such an order is both valid and reasonable.

A cleansing order which is potentially beyond the ambit of the section, based on an absence of any evidence as to contamination, or is unduly onerous could be susceptible to challenge in judicial review in the High Court or collateral challenge on a prosecution, on the grounds it was invalid or unreasonable.

Section 64 of the Health Act 1956 allows the council, for the purposes of the Act, to make bylaws for a number of matters including (insofar as relevant) for improving, promoting or protecting public health and preventing or abating nuisances, and/or generally, for more effectually carrying out any of the provisions of the Health Act 1956 relating to the powers and duties of local authorities. Section 66 of the Act further provides penalties for the breach of any bylaws made under the Act, including liability for a fine not exceeding $500 and, in the case of a continuing offence, to a further fine not exceeding $50 for every day on which the offence has continued.

Section 64 of the Health Act 1956 is consistent with the general provisions of the Local Government Act 2002 which empower territorial authorities to make bylaws to conserve public health, wellbeing, safety and convenience.

Local Government Official Information and Meetings Act 1987

In accordance with the Local Government Official Information and Meetings Act 1987 (LGOIMA) a territorial authority must notify on the Land Information Memorandum (LIM) that a cleansing order was issued on the property and actioned (section 44A(2)(d) LGOIMA). If the territorial authority has evidence that there is a real and substantial risk that hazardous contaminants are present at the property, then it must notify that information on the LIM (section 44A(2)(a) LGOIMA). If there is no evidence of hazardous contaminants to that high standard, the territorial authority may still elect to notify the information about a clan meth lab on the LIM if it considers the information is relevant (section 44A(3) LGOIMA).

Building Act 2004

Under section 35 of the Building Act 2004, a Project Information Memorandum (PIM) 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 of the building
- known to the territorial authority
- not apparent from the district plan under the Resource Management Act 1991 (section 35 of the Building Act 2004).

The Building Act 2004 also includes provisions 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 substances.

The sections of the Building Act 2004 referring to dangerous and insanitary buildings are found in Subpart 6, Part 2 of the Act. Section 121 defines a dangerous building and section 123 defines an insanitary building.

The definition of ‘dangerous’ in section 121 has been widened from the former 1991 Act. Section 64(2) of the former Act provided categories of building that had high or abnormal fire hazard, but the Building Act 2004 adds the phrase ‘is likely to cause injury or death ... to any persons in it or to persons on other property’. This addition has effectively reduced the threshold test for dangerous buildings.

Section 131 of the Act required each territorial authority to have established a policy on dangerous and insanitary buildings by 31 May 2006.

In identifying dangerous and insanitary buildings it is very likely that in many, but not all, cases a building's dangerous and insanitary status will not be readily apparent. For this reason, councils will take a necessarily passive approach to the identification of dangerous buildings in the district or city relying on complainants to provide information concerning potentially dangerous or insanitary buildings as the only practical way to identify buildings. The most likely sources of information concerning clan meth labs will be:

- building occupants, tenants, users, neighbours or members of the public; or
- as a result of an inspection by the New Zealand Police, Fire Service or other government agency authorised to inspect buildings.

Section 124 of the Building Act 2004[21] sets out powers available to territorial authorities to deal with dangerous and insanitary buildings. A territorial authority may:

- put up a hoarding or a fence to prevent people from approaching the building;
- attach a notice that warns people not to approach the building
- give written notice requiring work to be carried out to reduce or remove the danger or prevent the building from remaining insanitary.

Section 125 deals with the mechanism by which territorial authorities should give notice and section 126 enables them, if necessary, to undertake the required work themselves and recover all costs involved from the owner. Notice served on building owners should specify the work that needs to be carried out, the time in which it is to be completed and whether the owner of the building is required to obtain a building consent in order to carry out the specified work. The process for serving notice on owners should be transparent and in accord with a territorial authority's overall policy on dangerous and insanitary buildings and the provisions of the Act.

Section 129 gives power to territorial authorities to take swift action to remove immediate danger or fix insanitary conditions without first serving notice on owners.

If a building has been assessed as being dangerous and/or insanitary, its status as such will be recorded on the territorial authority's property files. In addition the following information can be placed on the LIM (issued in accordance with the Local Government Official Information and Meetings Act 1987) for each identified building:

- a statement that the building is on the territorial authority's register of dangerous and insanitary buildings
- the date when it was identified to be dangerous or insanitary or when work on the building is required
- a statement that further details are available from the territorial authority to those who can demonstrate a genuine interest in the property. In granting access to information concerning identified buildings the territorial authority would conform to the requirements of any relevant legislation by which it may be bound for example the Privacy Act 1993.

[21] A person who commits an offence under this section of the Act is liable to a fine not exceeding $200,000 (section 124(4)).

Resource Management Act 1991

The Resource Management Act (RMA) 1991 is the core piece of environmental legislation for controlling the effects of contaminated land on the environment and people.

Under section 31 of the RMA, district and city councils (territorial authorities) have the function of controlling of any actual or potential effects of land use and land development, including preventing or mitigating of any adverse effects of use of hazardous substances. This section allows territorial authorities to make provision in their district plans for management of the hazards arising from the use of chemicals. It is emphasised that district plans need to be consistent and compatible with regional plans, but may be more restrictive. The health protection officer should be aware of the appropriate provisions of plans, as advice given in the absence of such knowledge could create difficulties.

Within most territorial authorities the environmental health officers are responsible for environmental issues such as chemical contamination of the environment from clan meth labs.

7.6.2 Role of the regional council

Resource Management Act 1991

Under section 30 of the Resource Management Act 1991 (RMA), regional councils have a responsibility to investigate land for the purpose of identifying and monitoring contaminated land. Contaminated land is defined by the Resource Management Act 1991 (RMA), as amended in 2005, as land of one of the following kinds:

(a) if there is an applicable national environmental standard[22] on contaminants in soil, the land is more contaminated than the standard allows; or

(b) if there is no applicable national environmental standard on contaminants in soil, the land has a hazardous substance[23] in or on it that:
    (i) has significant adverse effects on the environment; or
    (ii) is reasonably likely to have significant adverse effects on the environment.

[22] At the time of writing the Government was proposing a national environmental standard (as regulations under the Resource Management Act 1991) for assessing and managing contaminants in soil to ensure the land is safe for human health. For more information refer to the Ministry for the Environment's website http://www.mfe.govt.nz/laws/standards/contaminants-in-soil/index.html.

[23] Section 2 of the RMA defines 'hazardous substance' to include without being limited to, any substance defined in section 2 of the Hazardous Substances and New Organisms Act 1996 as a hazardous substance.

A number of sites that may have hazardous substances in or on them have been identified using the Hazardous Activities and Industries List (HAIL).[24] However, only some of these have undergone sufficient investigation to determine whether or not they meet the definition of contaminated land used in the RMA.

In 2007 seven regional councils subjected 4424 sites across New Zealand to rapid risk screening (Ministry for the Environment 2007). The Rapid Risk Screening System provides a nationally consistent means of ranking possibly contaminated sites using readily available information, so that they may be prioritised for further investigation.

Five hundred and fifty nine high-risk sites were identified using the Rapid Screening System in 2007. Of these, 56 percent had been remediated or had a remediation or management programme in place (Ministry for the Environment 2007). It is unlikely that this percentage includes abandoned clan meth lab sites as these sites rarely include investigations of outside areas. In addition, the remediation of a site is usually directed by a district or city council not regional councils that administer the HAIL. However in the event that contamination from a former clan meth lab site is identified using HAIL, local authorities have an ongoing responsibility for the management of identified HAIL sites through the RMA planning process. The potential contamination of the site should be addressed during any assessment of the site (eg, as part of a land sale) or as part of a resource consent application (eg, a change in land use) to prevent or mitigate adverse effects on human health or the environment.

The RMA requires each regional council to develop a regional policy statement for the purpose of managing, in a sustainable manner, the natural and physical resources of that region. The RMA also allows for the development of regional plans. Regional councils must ensure that their plans are consistent with national and regional policy statements and other regional plans.

Regional councils may be able to use the general duty (section 17) on any person to avoid, remedy or mitigate any adverse effect on the environment arising from an activity. There are circumstances when enforcement or abatement proceedings may be taken. Section 332 of the RMA allows any enforcement officer, if specifically authorised in writing by any local authority to do so, to enter a property (including a dwelling house provided there is a constable) to inspect and take samples where there is a discharge of contaminants.[25] Enforcement orders or abatement notices can be issued authorising the cessation of such an activity immediately '*where it is likely to be noxious, dangerous, offensive, or objectionable to such as extent that it has or is likely to have an adverse effect on the environment*' (section 314 – scope of enforcement order). For example, in the manufacture of methamphetamines it is likely that there are discharges of toxic gases from the 'cooks'. In addition, there may be discharges of contaminants

[24] The Ministry for the Environment published HAIL in 2003. The manufacture of illicit drugs is included under the HAIL activity 'Pharmaceutical Manufacture'. For more information, refer to the Ministry for the Environment's website http://www.mfe.govt.nz/issues/hazardous/contaminated/hazardous-activities-industries-list.html.

[25] Under s332(2A) of the RMA 1991 the officer may also take a sample of any substance for which there is reasonable cause to be suspected of being a contaminant of any water, air, soil or organic matter. Wilful obstruction of any person executing any powers conferred by the RMA is an offence against s338(3). The maximum penalty is $1,500.

directly onto land for example gardens due to the illegal dumping of chemical wastes, resulting in a potentially hazardous contaminated site.

Enforcement orders and/or abatement notices are also of relevance to abandoned clan meth labs in relation to seeking remediation or clean-up of the environment. This provision is applicable where there is actual or potential contamination of soils and/or water rather than in cases where the actual or likely contamination is confined to a dwelling given the potential availability of other mechanisms such as those under the Health Act 1956 to deal with the latter circumstances.

7.6.3 Summary

In the absence of any specific statutory mechanism available to councils for the remediation/clean-up of abandoned clan meth labs, it may be that the council – in particular a district or city council – could consider the merits of making a bylaw (either under the Health Act 1956 and/or Local Government Act 2002) for the purpose of establishing the appropriate levels of monitoring and investigation, appropriate processes and reporting requirements, and the parameters of the required remediation and/or mitigation works (including the standards that must be met before the council will be satisfied of adequate remediation/mitigation). It is relevant in this regard that section 155(1) of the Local Government Act 2002 requires the council to consider whether a bylaw is the most appropriate way of addressing the perceived problem.

Even with a bylaw in place, the council might still encounter some difficulties in practice with the availability of appropriately qualified scientists and/or engineers to assess health risks and identify remediation/mitigation plans for abandoned clan meth labs. Further, it is likely that the council will also need to rely on such appropriately qualified people to certify an abandoned clan meth lab on completion of the remediation works, before it can be satisfied that the property is capable of rehabitation.

In some circumstances, the failure to carry out its statutory obligations under an Act (such as the Health Act 1956, RMA 1991, and/or Building Act 2004) may give rise to common law liability.[26] It would seem fairly unlikely that the council would be held to be negligent in the performance of its statutory duties under legislation (such as that discussed above) at the time of reoccupation of an abandoned clan meth lab, in the absence of any reason to believe that the existence of contaminants was at a level that may be injurious to health.

If, however, the council is aware of an actual health risk in particular circumstances (through investigations and/or gathering of evidence), and fails to take any action whatsoever, there is the likelihood of increased risk of the council being exposed to potential civil liability in the event of adverse health effects for subsequent occupiers.

[26] This possibility is consistent with the Ontario Court of Appeal decision in *Heighington v The Queen in Right of Ontario*, where the Court found a breach of the Ontario Public Health Act in as much as Provincial officials failed to take reasonable steps to have radioactive material, including contaminated soil, removed so as to prevent danger to the health of future occupants of the land [*Heighington v The Queen in Right of Ontario* (1987) 41 DLR (4th) 208].

7.7 Non-government agencies

7.7.1 New Zealand Chemical Industry Council

The New Zealand Chemical Industry Council represents the collective interest of chemical manufacturers, importers and distributors. In 2007 it developed an approved Code of Practice for the management of illicit drug precursor chemicals with the National Drug Intelligence Bureau representing the collective interest of the New Zealand Police, New Zealand Customs Service and the Ministry of Health. One of the objectives of this Code of Practice is to prevent the diversion of chemicals for the manufacture of illegal drugs such as methamphetamine (New Zealand Chemical Industry Council 2007).

The New Zealand Chemical Industry Council also provides an emergency response service (Appendix F).

7.7.2 Insurance sector

In New Zealand the regularity with which clan meth labs are being discovered in some metropolitan areas has prompted landlords check their insurance policies very carefully. From the insurance sector's perspective the potential financial impact from damage arising from the illicit manufacture of drugs such as methamphetamine is huge. The main concerns for insurers are the effects of:

- major or total losses caused by fire/explosion
- costs to clean residue from the property (whether other physical damage has occurred or not)
- costs arising from alternative accommodation benefit
- loss of rent until property is able to be re-let.

In circumstances where losses from the illicit manufacture of methamphetamine are concerned, cover is generally provided for:

(a) the obvious physical damage to the property (ie, to the dwelling structure) from fire/explosion; and/or

(b) damage (coating of the property with chemical residue) where there are no obvious signs of physical damage exists.

Depending on the level of cover applying to a tenanted dwelling or unit, the majority of insurers cover the costs of removing chemical residue, as they currently view the damage as being accidental rather than malicious. In 2010 the Insurance and Savings Ombudsman investigated a complaint where an insurer had declined a claim on the grounds the damage was both gradual in natural and the result of malicious activity. It was deemed that the production of methamphetamine ('cooking phase') did not automatically make the act malicious with regard to the damage and loss it causes. '*If reliance is placed on an exclusion for intentional/malicious acts, the insurer has to prove that, by 'cooking' methamphetamine, there was malicious intent by the tenant to cause contamination damage to the house. Without substantial evidence, more often than not, proving the malicious intent of the methamphetamine contamination will be difficult and,*

therefore, it could be regarded as accidental' (Insurance and Savings Ombudsman 2010).

However, insurers do not intend to cover the costs of remediation where there is no actual evidence of chemical residue present. A number of councils have demanded remediation of properties based solely on the presence of clan meth lab material and chemicals (without evidence that any cooking has actually occurred at the property). From an insurer's perspective each claim is considered individually, as there are a number of factors involved and criteria to be met before a decision can be made to accept or decline such claims, including:

(a) whether or not the insured:
- took reasonable steps to prevent loss or damage
- carried out regular inspections
- met their insurance policy obligations
- disclosed to the Insurer any known criminal history of the occupant(s)
- knew of any criminal activities taking place prior to loss or damage
- contacted the New Zealand Police as soon as any criminal activity was suspected
- was the occupant (therefore caused the damage themselves)

(b) whether or not:
- the clean-up costs are legitimate
- the policy coverage that is in place actually covers such damage
- a policy exclusion applies.

It is possible the insurance industry could look to utilising site remediation clan lab guidelines for assessing whether remediation costs are legitimate. However it is plausible that the greater the overall effect that clan meth labs losses has on the insurance industry as a whole, the higher the premium pool will be forced to go, with customers contributing via higher premiums. As a result insurers will eventually be forced to either restrict the exposure from former clan meth labs or even totally remove the exposure thereby passing the risk partly or entirely back to the property owner (R Godman, Manager, Vero Insurance New Zealand Limited, personal communication, 2008).

7.7.3 Real estate agencies

The Real Estate Agents Act 2008 establishes a regulatory regime for people working in the real estate industry. As far as real estate purchase agreements are concerned the contractual agreement governing the sale and purchase of a domestic property requires the vendor to inform the purchaser of any outstanding statutory notices served on the property. This would include closing orders and cleansing orders served under the Health Act 1956 to remedy the risks associated with a former clan meth lab site.

In circumstances where a real estate agent knowingly markets a residential property that has been used for the illicit manufacture of methamphetamine as not being decontaminated and makes it available as an open home for viewing to the public such action may result in legal action being brought against the real estate agent through the Crimes Act 1961 (section 145). It is important to bear in mind that any case will be decided on its own particular facts. In the case of section 145 of the Crimes Act 1961 it must be proven that a person actually knew what they did or failed to do so would endanger the safety or lives of others. Alternatively knowingly exposing a person or person(s) to known chemical substances that can cause adverse health effects associated with a non-remediated clan meth lab site could constitute unsatisfactory conduct as defined by the Real Estate Agents Act (Professional Conduct and Client Care) Rules 2009. The Real Estate Agents Disciplinary Tribunal can make orders if it finds that a charge of unsatisfactory conduct is proven including:

- cancelling or suspending a licence
- terminating the employment of an agent
- imposing a fine of up to $15,000 for an individual or $30,000 for a company
- ordering the agent to pay compensation to anyone who has suffered loss through the agent.

7.8 Role of the public health service

The public health services of District Health Boards employ medical officers of health (MoHs) and health protection officers (HPOs) who carry out a range of statutory and non-statutory activities, that '*improve, promote and protect the public health*'. These officers have a statutory accountability to the Director-General of Health and are responsible for the enforcement of the Health Act 1956.

Preliminary investigations should establish who is responsible and whether there is any need to pass on this information to the others. Particular roles for the public health service may include:

- providing specialist advice in epidemiology and toxicology where risk assessment is complex
- preparing statements or advice about the risk to individuals or groups
- providing scientific advice on whether sampling is likely to be useful
- communicating risk to the public and media
- providing advice to other agencies on how to communicate statements about risk to the public and media effectively
- providing advice to lead agencies with statutory authority to effect remedies.

7.8.1 Role of the health protection officer

The skills of the health protection officer are needed for the following activities:

a) Make initial response and undertake preliminary assessment
   - receive, record and interpret queries and concerns
   - identify the cause of concern or complaint, the location and the associated parties
   - provide initial response and support to concerned people.

b) Undertake inspection, hazard evaluation and risk assessment
   - identify individuals(s) or groups at risk
   - seek advice from the medical officer of health and others if necessary (eg, epidemiologists, toxicologists)
   - assess the likely health risk from the information collected
   - assess the risk to public health from likely contamination beyond the premise.

It is recommended that health protection staff **do not** enter the premises prior to the final clean-up/remediation unless they are wearing the appropriate protective equipment as prior to the remediation chemical residues and deposits are likely to be at a higher level and will represent a significant health risk. Even withstanding this caution where appropriate any inspection of a premise made should occur jointly with personnel from the lead regulatory agency.

c) Provide information and engage in risk communication
   - explain how risk should be managed to the lead regulatory agency
   - consult with building owners and occupiers as necessary
   - refer information to the lead regulatory agency to bring about remedial action.

d) Support enforcement

   Here the primary role of the public health service is to support enforcement by the lead regulatory agency by providing information and advice. It is essential that health protection officers form the appropriate linkages with the territorial authority (Environmental Health, Dangerous Goods and Building compliance sections) New Zealand Fire Service, New Zealand Police and Department of Labour. Discussion between all affected agencies should then take place to determine the best course of action.

During a clan meth lab fire, the New Zealand Fire Service is in charge, and although public health has no particular role, they may be called out as part of the local Hazardous Substances Technical Liaison Committee (HSTLC) presence at the scene, as for any other incident or emergency. Once the fire is put out, the site potentially becomes a contaminated site. The territorial authority would then be the agency in charge, dealing with any nuisance issues under the Health Act 1956 or any building issues under the Building Act 2004.

There could be a role for the public health service in assessing whether there may be a risk to public health in terms of contamination fallout beyond the premises. For example, if there is a fire next to a school, and the school is downwind from choking smoke, foul odour and so on, there may be public health issues that need to be addressed.

The public health service may also consider health promotion initiatives aimed at increasing awareness of the dangers of abandoned clan meth labs (Appendix G).

7.9 Role of property owners

Property owners, and their agents and/or managers, have the primary responsibility for correcting chemical hazards on their property. Responsibilities include:

- meeting statutory obligations, such as those under the Health Act 1956 and Building Act 2004
- assessing and managing all chemical hazards arising from the property including hazards that have been caused by past actions such as an abandoned clan meth lab
- administering and financing abatement work, including necessary remediation to the property
- selecting and agreeing to the abatement work in consultation with the territorial authority and/or public health service
- engaging competent and appropriately trained contractors for abatement work who are competent and appropriately trained.

Under the Residential Tenancies Act 1986 (RTA) there is no legal requirement for landlords (or other property owners) to disclose to tenants or users of buildings that the house or building has previously been contaminated although a landlord does have a duty to fully and fairly answer any questions asked by a prospective tenant. On the other hand, the RTA provides the means necessary for a landlord to evict a tenant and seek redress in the event that a tenant breaches duties related to the illegal use of a property, or reasonable expectation to keep it clean. This duty extends to the actions of a person that a tenant allows to use the premises. The RTA also places a duty on a landlord to ensure that a contaminated property has been professionally decontaminated and tested to check that any remaining contamination is at an acceptable level before it is re-tenanted. As noted above, however, this duty does not extend to disclosing to a prospective tenant that the property was used in the manufacture of methamphetamine.

On 11 June 2004 the New Zealand Tenancy Tribunal[27] ruled that renting out contaminated premises is a breach of a landlord's obligation to provide premises in a reasonable state of cleanliness. This obligation is set out in section 45(1) of the RTA 1986.

[27] The Residential Tenancies Act 1986 enables the Tenancy Tribunal to award exemplary damages of up to $3,000 against a landlord's 'failure to meet obligations in respect of cleanliness, maintenance, or building or health and safety' that is a landlord who provides substandard housing.

To ensure they meet those obligations the Tribunal stated that landlords should:

- arrange for the property to be cleansed and decontaminated by a professional cleaning company experienced in the removal and neutralisation of hazardous substances
- have the property tested by appropriately qualified analytical chemists to establish that the level of contaminants is within an acceptable level.

Therefore landlords may also be breaching their obligations to comply with all requirements in respect of the health and safety of buildings, under section 45(1)(c) of the RTA. This is because the New Zealand Police and some territorial authorities have introduced procedures for the New Zealand Police to notify a territorial authority when contaminated properties are identified. A territorial authority would then require owners to decontaminate the property. Failure to do so by the landlord could be a breach of the Act.

In considering this issue, it is important to focus on the primary objective of ensuring that contaminated buildings or houses are remediated before being reused. Imposition of a disclosure requirement once a building or house has been cleaned, may provide a further disincentive for landlords or owners to adequately manage and remediate contaminated properties. This is because remediation is expensive. Why would a landlord commit to this expense knowing that the property will remain difficult to rent because of an ongoing disclosure requirement?

7.10 Role of property occupiers

The responsibilities of owner-occupiers are as outlined above. If occupiers are tenants they are responsible for reporting to the landlord on the development of any potential chemical hazard, co-operating with the landlord in facilitating abatement work and monitoring the condition of abatement work.

Chapter 8: Hazard Identification

8.1 Main points

- The three most common methods of methamphetamine synthesis encountered by law enforcement are the 'Red P,' 'P2P' and 'Birch Reduction' methods.
- The risk of injury from chemical exposure depends on the chemical itself, the concentration, the quantity and the length and route of exposure. Chemicals may enter the body by being breathed, eaten, injected (by an accidental needle or skin prick), or absorbed by the skin.
- Toxic contaminants encountered in methamphetamine laboratories enter the body through the following methods, in order of importance: inhalation, skin absorption and ingestion. Some contaminants may enter the body by more than one of these routes of exposure.
- The central question of hazard identification is: 'What constitutes a hazard?'.

8.2 Use of the term 'chemical'

A 'chemical' is defined as 'any substance used in or resulting from a reaction involving changes to atoms or molecules'.

Legislation such as the Hazardous Substances and New Organisms (HSNO) Act 1996 does not define the term 'chemical' but it does define the term 'substance' as meaning:

> '(a) Any element, defined mixture of elements, compounds, or defined mixture of compounds, either naturally occurring or produced synthetically, or any mixtures thereof:
>
> (b) Any isotope, allotrope, isomer, congener, radical, or ion of an element or compound which has been declared by the Authority, by notice in the New Zealand *Gazette*, to be a different substance from that element or compound:
>
> (c) Any mixtures or combinations of any of the above:
>
> (d) Any manufactured article containing, incorporating, or including any hazardous substance with explosive properties.'

A hazardous substance under the HSNO Act 1996 is any substance with one or more of the following intrinsic properties: explosiveness, flammability, a capacity to oxidise, corrosiveness, toxicity or ecotoxicity. The chemicals that are used to produce methamphetamine fall within the definition of 'hazardous substance'. Many of the chemicals and substances used in methamphetamine manufacture may have these properties, even when they exist in residual levels in a dwelling.

The term 'chemical' is used throughout the document to be consistent with the term used in the Health Act 1956 in connection with 'poisoning arising from chemical contamination of the environment' as a notifiable disease for example lead absorption.

8.3 Methamphetamine manufacturing processes

There are a multitude of approaches to manufacturing methamphetamine (or amphetamine), 22 of which have been reviewed by Allen and Cantrell (1989) and can be found in the scientific literature. Despite the diversity of approaches available, only a few are commonly encountered in clandestine production and these few themselves often vary according to the availability of the necessary chemicals.

The three main methods used to manufacture methamphetamine are the red phosphorus, birch (or Nazi method) and amalgam or P2P methods. Processes based on red phosphorus and those using dissolved metals, known as the Nazi or birch method are commonly used to convert ephedrine and pseudoephedrine to methamphetamine. While variations of these methods can be used, the red phosphorus and birch methods appear to be the main cooking methods used in New Zealand.

The following section provides a brief description of the chemicals or precursors used and wastes generated by each method. Any production method of methamphetamine requires four basic components: precursor material, reagent(s), solvent(s), and catalyst(s). A number of the chemicals listed are commonly used in household products but are not generally stored in the quantities required to manufacture illegal drugs.

8.3.1 Red phosphorus or hydriodic acid method

The Alaska Department of Environmental Conservation (2007) describes the red phosphorus/hydriodic acid method as:

> '... the Red P; HI; or Red, White, and Blue method. Chemicals commonly associated with this method include hydriodic acid (HI), hydrochloric (muriatic) acid, sulphuric acid, sodium hydroxide (lye), sodium chloride (salt), red phosphorus, iodine, isopropyl alcohol, ethyl alcohol (ethanol), methyl alcohol (methanol), hydrogen peroxide, naphtha (Coleman fuel), charcoal lighter fluid (mineral spirits and petroleum distillate), acetone, benzene, toluene, ethyl ether (starting fluid), Freon, hydrogen chloride gas, and chloroform' (Alaska Department of Environmental Conservation 2007 p 2–1).

Other chemicals that may be used include acetic acid, methyl ethyl ketone, and hypophosphorus acid. Wastes generated during manufacturing include potentially flammable extraction process sludges, phosphine gas, HI, hydrogen chloride gas, phosphoric acid, and yellow or white phosphorus (Alaska Department of Environmental Conservation 2007). The manufacture of methamphetamine hydrochloride using this method (also known as the Hypo method) by the reduction of a pseudoephedrine by iodine or hydriodic acid with red phosphorus[28] or hypophosphorous acid is common in New Zealand clan meth labs (Powell 2005; National Drug Intelligence Bureau 2008).

[28] Although weaker than hypophosphorous acid, phosphorous acid can be substituted into a methamphetamine recipe at roughly twice the amount. Phosphorous acid is more readily available in the New Zealand domestic market as it is used extensively in horticulture (particularly fruit growing) to promote plant growth. It is also significantly cheaper.

8.3.2 Birch method

The birch method, also referred to as the *ammonia* or *Nazi* method, relies on a supply of anhydrous ammonia that is most commonly found in commercial freezers and is a commonly used fertiliser in agriculture. Chemicals associated with this method include anhydrous ammonia, lithium metal, sodium metal, isopropyl alcohol, ethyl alcohol (ethanol), methyl alcohol (methanol), hydrogen chloride gas, hydrochloric (muriatic) acid, sulphuric acid, sodium chloride (salt), toluene, naphtha, Freon, ethyl ether, chloroform, and methyl ethyl ketone. Potentially flammable extraction process sludges and hydrogen chloride gas are waste products that are generated during the manufacturing of methamphetamine (Alaska Department of Environmental Conservation 2007).

Anhydrous ammonia boils at –32°C so that should it vent from its cylinder it will be extremely cold and can cause instant frostbite type injuries. This is of little consequence compared to the fact that this vapour is caustic and will begin to dissolve skin, eyes or lungs if accidentally inhaled. Offenders have often stolen the anhydrous ammonia and placed it into LPG gas cylinders or other vessels that are unsuitable for caustic gas containment. After a matter of weeks these vessels will rupture, shrouding any persons in the surrounding area in a cloud of caustic vapour (Steel 2004).

Sodium and lithium metal are both recognised as being extremely explosive. To prevent them from being exposed to the atmosphere they must be stored under oil. This is because they can be ignited by exposure to the air and will violently react with water. Again the potential hazards around quantities of flammable solvents are obvious. In addition, the risk to innocent people injuring themselves accidentally by the incorrect handling of these materials is extreme (Steel 2004).

8.3.3 Amalgam or P2P method

The third method used to produce methamphetamine is known as the *amalgam* or *P2P method*. This method uses phenyl-2-propanone (P2P) and methylamine as precursors. Mercuric chloride, lead acetate, and many other chemicals are used in the synthesis of methamphetamine via the amalgam method (Alaska Department of Environmental Conservation 2007). Cooking time is reduced from 24 to 36 hours using the P2P method to as little as four to six hours, using the new cold or matchbook method.

Lead and mercury contamination can result from this manufacturing method, but it is the least common method because of the limited availability of the precursor since it became regulated, the length of time needed to produce the desired drug, low yield, and low concentration of the finished product. In New Zealand P2P is found quite often in analysis but this is because it is also a by-product of manufacture.

Solvent extraction and precipitation techniques are commonly used in all of these manufacturing methods discussed above. Several potentially dangerous chemicals and chemical compounds are used in the various processes.

8.4 Areas of contamination

The Colorado Department of Health and Environment (2007) recommends dividing areas of potential contamination into primary and secondary areas.

> 'Typical primary areas of contamination include:
>
> - **Processing or 'cooking' areas:** Gross contamination in these areas may be caused by spills, boil-overs, explosions, or by chemical fumes and gases created during the heating and distilling portions of the 'cooking' process. Indoor areas affected may include floors, walls, ceilings, working surfaces, furniture, carpeting, draperies and other textile products, plumbing fixtures and drains, or heating and air-conditioning vents. Outdoor cooking areas could include camping stoves or other outdoor areas where cooking could occur.
> - **Disposal areas:** indoor areas include sinks, toilets, bathtubs, crawl spaces, plumbing traps and floor drains, vents, vent fans and chimney flues. Outdoor areas may include soil, surface water, groundwater, sewer or stormwater systems [and on-site effluent treatment systems].
> - **Storage areas:** Contamination may be caused by leaks, spills or open containers.
>
> Secondary areas of contamination may include:
>
> - Locations where contamination has migrated, such as hallways
> - Common areas in multiple dwelling structures and adjacent apartments or rooms may also be contaminated, including contamination of floors, walls, ceilings, furniture, carpeting and other contents
> - Common ventilation or plumbing systems in hotels and multiple dwellings.'

8.5 Hazards associated with methamphetamine laboratories

The effects of human exposure to the various substances used to manufacture illicit drugs and the effects of these substances on the environment are largely known and fairly well documented in the chemical literature. Some of these chemicals pose little or no risk to either environmental or human health as opposed to others which pose a potentially significant risk to both (Irving and Sutherland 2006). Appendices H and I list chemicals commonly used in various methamphetamine manufacturing processes and their associated health hazards. Chemicals that are known to be used in New Zealand for the illicit manufacture of methamphetamine are highlighted in grey (Appendix H).

The majority of compounds used in the preparation of methamphetamine are household products. Appendix F provides information on local services that can assist in providing information on chemicals that may be found at a clan meth lab site.

Perhaps of more significant concern than the hazards presented by these known substances, are the hazards presented by the various by-products of illicit drug manufacture. The precise nature of these substances and the dangers they pose are neither well known nor well documented (Irving and Sutherland 2006). What is understood is that reactions between compounds commonly yield products that are more toxic than the starting materials themselves (Edwards 2004). Thus, because of the variation in the chemicals used, the quantities used, the location of laboratories and the quality of any given process, the specific hazards that are present at any given clan

meth lab site not only vary enormously but are difficult (if possible) to determine (Irving and Sutherland 2006).

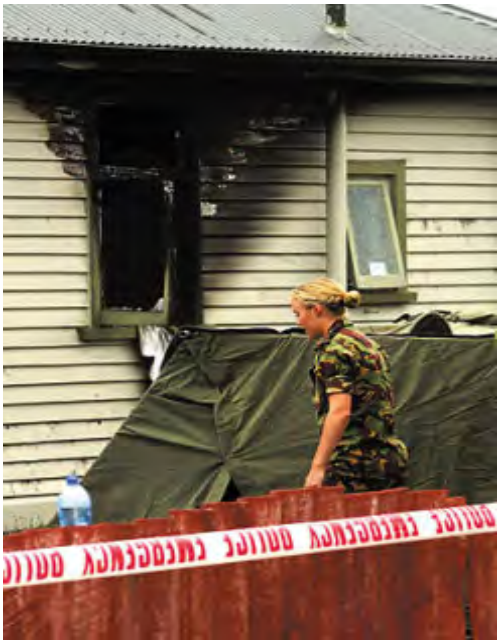
What is apparent is that the illicit manufacture of drugs such as methamphetamine poses a risk to both public health and to the environment. Both can face both immediate dangers as well as longer-term risks (Irving and Sutherland 2006).

8.5.1 Immediate dangers posed by methamphetamine laboratories

In the first instance, clan meth labs pose a number of risks (photo 1) to those who come into contact with them: the drug manufacturers (or 'cooks') and any person who may reside at or visit the site; and 'first responders' attending the site such as New Zealand Police and New Zealand Fire Service officers, forensic chemists, social services and contractors handling hazardous materials including waste. These risks derive from the chemical hazards that are present at the site such as explosive, flammable, poisonous, radioactive and corrosive substances which may be in liquid, solid or gaseous form (Irving and Sutherland 2006).

The underlying problem with the illicit production of methamphetamine is that generally the 'cooks' possess neither the knowledge nor the skill to carry out the synthesis properly. As a result many 'cooks' have been reported to regularly take risks when handling dangerous chemicals and in the chemical processes of manufacture (Horne 1997). In the United States, one in five laboratories are discovered because of an explosion and there is a risk of severe burns to anyone near a laboratory (ESR 2007a). Case reports of patients involved in methamphetamine manufacture detail second degree burns and anhydrous ammonia ocular injury (Lee et al 2003). Methamphetamine manufacturing has also resulted in death by phosphine gas poisoning (Willers-Russo 1999).

Photo 1: An officer inspects the Hei Hei, Christchurch house burnt in a drug-lab explosion



Source: Christchurch *Press*, 28 March 2007

8.5.2 Longer-term hazards associated with residual contamination

After the laboratory equipment and chemicals used to manufacture illicit drugs has been removed, residual contaminants often remain throughout the property. This contamination can be into air, on various building surfaces and furnishings, in the ventilation systems, in the walls, soil and down the drains as a result of spills during the methamphetamine production and deposition of volatilised contaminants. These residual contaminants can persist indefinitely if not adequately remediated raising both public health and environmental issues (Irving and Sutherland 2006).

Overseas studies indicate that the methamphetamine cooking process can release as much as 5,500 µg/m^3 of methamphetamine into the air and deposit as much as 16,000 µg/100cm^2 onto surfaces[29] (Martyny et al 2004a). There are concerns that residual methamphetamine generated during the manufacturing process may indeed pose a risk to human health and render the property unsafe for human occupation until it has been decontaminated.

8.5.3 Clan meth labs as a public health issue

Exposure to the chemicals and by-products of illicit drug manufacture of methamphetamine can cause serious adverse health effects, and in extreme cases, be fatal. Young children are particularly vulnerable, partly because of their lower tolerance to chemical exposure but also because they are more likely to come into contact with contaminated surfaces through crawling and putting objects in their mouths (Irving and Sutherland 2006). The Colorado Alliance for Drug Endangered Children (2007) believes that approximately 30 to 35 percent of the laboratories that are seized in its state are domestic residences that have children living in them. In New Zealand data from 2006 and 2007 indicated almost one in three clan meth labs detected had children living at the residential address. This figure rose to 40 percent (two in five) in 2008 (National Drug Intelligence Bureau 2009). In domestic residences, it is most likely to be future tenants or owners who will unknowingly suffer the effects from exposure to residual contaminants if they are not removed (Irving and Sutherland 2006).

Although there has been a limited amount of scientific research conducted on the health effects of exposure to sites that were once clan meth labs, the work that has been done verifies the anecdotal evidence of the effects of this exposure (Irving and Sutherland 2006).

[29] 'A single cook using the red phosphorus method of manufacture may produce residual surface contamination of methamphetamine ranging from 1.5 µg/100 cm^2 to as high as 860 µg/100 cm^2. A single cook using the anhydrous ammonia method of production may result in surface area contamination ranging from 0.1 µg/100 cm^2 to 160 µg/100 cm^2. These contamination levels are caused by the aerosolisation of methamphetamine during the cook with the highest levels being produced during the salting out phase of the cook. Airborne levels of methamphetamine may range from less than 2.0 µg/m^3 to as high as 5000 µg/m^3 and cause contamination of areas that are significantly removed from the manufacturing process' (Martyny et al 2004b: p 3).

In research conducted in the United States, the National Jewish Medical and Research Centre found that *'the chemical exposures of greatest concern produced during the manufacture of methamphetamine (especially using the red phosphorus method) consist of phosphine, iodine, hydrogen chloride, solvents and drug or its precursors'* (Martyny et al nd). The study concluded that in the samples taken from 16 methamphetamine laboratories, each of these compounds may meet or exceed current occupational exposure guidelines as set by the Occupational Safety and Health Administration and by the American Conference of Governmental Industrial Hygienists. This conclusion was especially true of exposures to phosphine, iodine and hydrochloride (Martyny et al nd). It is important to note however that phosphine has a high vapour pressure (4186 kPa at 20°C, ICSC: 0694) and does not persist for long periods of time in the air that is not completely dry. Therefore phosphine is most unlikely to be encountered by people other than first responders including those undertaking inspections and testing in non-operational clan meth labs (N Powell, personal communication, 2010).

An abandoned laboratory in a domestic residence poses risk to any unwitting future occupants.[30] Adverse health effects have been reported in subsequent occupants of suspected former laboratory sites that have not been adequately remediated (Burgess 1997). Throat irritation, nausea, respiratory difficulties and headaches account for the majority of reported symptoms. In addition, there have been reports of medical staff suffering adverse effects from exposure to patients who were contaminated by clan meth labs which demonstrates the ease of contamination transfer (Irving and Sutherland 2006).

8.5.4 Clan meth labs as an environmental health issue

The disposal of the chemical waste products from methamphetamine manufacture creates further risks, both to humans and to the environment (Australian Bureau of Criminal Intelligence 1999). The Drug Enforcement Agency in the United States has estimated that for every kilogram of pure methamphetamine produced, 5 kg to 7 kg of chemical waste is created (Horne 1997). Cooks have been found to dispose of chemicals directly into the ground, down drains and toilets, in nearby waterways and along the roadside (Australian Bureau of Criminal Intelligence 1999). The sudden arrival of law enforcement officers can cause offenders to attempt to dispose of chemicals in the fastest way possible in an effort to destroy evidence, with no thought of the consequences (Wilkins 2002). Pollutants can be spread off-site by drains and streams into densely populated urban areas or natural ecosystems with no advance warning of spillage and may persist in soil and groundwater for years. Solid waste is sometimes burned to destroy evidence, which creates additional air, ground and water pollution hazards.

[30] Although there have been no documented cases of injury caused to residents of an ex-laboratory site in New Zealand, in June 2004 a West Auckland couple won compensation from their landlord after they found that the house they had rented had been used as a P lab. The Tenancy Tribunal awarded the couple $990, ruling the owners had failed to clean up the property. The owners claimed they had been unaware that the property had been used as a P Lab and that the New Zealand Police had not passed that information on, nor had the council issued a cleansing order.

In the United States environmental remediation costs for clan meth labs range from about US$5,000 to US$150,000. In March 2006, personnel of a US state environmental department who were engaged in a stream restoration project in New Mexico detected acetone and dichloromethane contamination during a routine water sampling event (Soussan 2006). The chemicals, which are commonly used in the illicit manufacture of methamphetamine and were most likely discharged by a clan meth lab, were responsible for the death of hundreds of trout and other native fish. Insects and plant life along the seven-mile stretch of affected stream bed were also killed.

8.5.5 Clan meth labs as an economic Issue

The illicit manufacture of methamphetamine to society appears to have far-reaching costs, including costs to taxpayers for the health care of those injured in laboratory explosions. In the United States a retrospective study of case notes of 507 burns units admissions in 1999–2001 found 34 were involved in either the use of methamphetamine, or its production (Charukamnoetkanok and Wagoner 2004). The authors also noted the cost of treatment was high, with an average length of stay of around 16 days at a mean cost of US$78,580 (approximately NZ$100,000). In New Zealand the exact cost of hospitalisations for methamphetamine-related burns has not been quantified. However, significant burns suffered by two alleged methamphetamine cooks near Auckland (one of whom later died) in early 2007 resulted in the callout costing between $10,000 and $12,000 which included 50 medical staff (a number of whom required subsequent decontamination) (Kiong 2007).

Because clan meth labs produce significant quantities of toxic waste cleaning these contaminated sites requires specialist knowledge and expertise. Consequently the cost of remediating a contaminated site can be expensive. Although no comprehensive cost-related data are available in New Zealand, Housing New Zealand Corporation estimates that the cost of testing and undertaking remediation of a house ranges from NZ$5,000 to $80,000. This range is consistent with US estimates of US$5,000 to US$50,000.

In some instances overseas where proper decontamination for reuse has not been feasible the dwelling has been demolished (Irvine and Chin 1991). In April 2009 Housing New Zealand Corporation won a test case seeking more than $180,000 in damages from a drug ring that manufactured methamphetamine in a Napier state house. The state house was so badly contaminated by the clan meth lab set up inside it that the home had to be completely demolished in 2004. The costs of this remediation and the loss in value for Housing New Zealand and, by extension, the taxpayer amounted to around $185,000. The civil suit Housing New Zealand won has set a precedent which can be used by private landlords as well (New Zealand Government Beehive 2009).

Chapter 9: Dose Response, Exposure Assessment, Risk Characterisation and Risk Communication

9.1 Main points

- Residual methamphetamine – that is by-products of the synthesis of methamphetamine and unused reagents, generated during the manufacturing process may pose a risk to human health and render the property unsafe for human occupation until decontamination has occurred.
- The principal sources of human exposure are through ingestion, inhalation and skin contact.
- The health significance of any estimated exposure requires comparison with a suitable toxicologically based criterion for the chemical(s) in question.

9.2 Health effects

Exposure to methamphetamine residues may cause symptoms similar to those experienced by methamphetamine users. The majority of our knowledge of methamphetamine toxicity in humans is derived from drug use and overdose scenarios. The health effects of low-level, chronic exposures to the illicit manufacture of methamphetamine have not been well studied. However, information from high-dose studies and clinical case reports allows a better understanding of the mechanisms by which methamphetamine may exert its toxicity.

Overall, the potential health effects of methamphetamine depend on several factors including:

- how much methamphetamine a person is exposed to
- how long a person is exposed
- the health condition of the person being exposed.

The primary effect of methamphetamine is as a stimulant to the central nervous system. Exposure to even small amounts of methamphetamine can produce euphoria, increase alertness, paranoia, decreased appetite and increased physical activity. Other effects involving the central nervous system include writhing, jerky body movements, irritability, insomnia, confusion, tremors, anxiety, aggression, hyperthermia and convulsions (National Institute on Drug Abuse 2002).

Death can occur from methamphetamine concentrations in the blood of greater than 0.5 mg/L. Fatal overdoses are more likely to occur among inexperienced or episodic high-dose users than among regular users who have developed a tolerance to the drug. Methamphetamine also increases the risk of a stroke in relatively young people (Expert Advisory Committee on Drugs 2002). In March 2003 it was reported that methamphetamine had been linked to five deaths in New Zealand (Bellamy and McNab 2003).

Methamphetamine exposure causes cardiovascular effects including chest pain and hypertension and sometimes can result in cardiovascular collapse and death. Additionally methamphetamine increases heart rate, blood pressure and risk of stroke, and may cause irreversible damage to blood vessels in the brain (National Institute on Drug Abuse 2002).

The psychological symptoms observed with prolonged methamphetamine abuse can resemble those of schizophrenia and are characterised by paranoia, hallucinations, repetitive behaviour patterns, and delusions of parasites or insects on the skin. Methamphetamine-induced paranoia can result in homicidal or suicidal thoughts, with drug users often exhibiting violent tendencies (National Institute on Drug Abuse 2002).

The target population of concern in establishing a remediation guideline is residents who may re-occupy the structure after seizure. Health impacts on infants and young children raised in areas that were formerly used as clan meth labs, are of particular concern. Children are often more susceptible to hazards due to their physiologic status (rapid growth, incomplete development, and rapid metabolism requiring more air and water per body weight than adults) and behaviours (crawling, hand to mouth activity, gnawing on furniture, window sills and toys). However, there have been no studies of specific risks to infants and children associated with chronic low-level exposure to methamphetamine in a former drug lab site have not been studied.

Health effects caused by exposure to clan meth lab chemicals depend on: (1) the lab process and chemicals used; (2) the amount of chemical and length of exposure; and (3) the age and health of the person exposed. Chemicals may enter the body by being breathed, eaten, or through absorption. Absorption of chemicals by the body may occur through one or more of the following routes of exposure:

- inhalation (respiratory)
- dermal exposure (via direct contact with the skin)
- ingestion
- injection (via skin puncture with a needle or another sharp object).

An acute exposure is one that occurs over a relatively short period of time. Acute exposure to clan meth lab chemicals can cause shortness of breath, cough, chest pain, dizziness, lack of coordination, chemical irritation, or burns to skin, eyes, nose and mouth. Death could result when a person is exposed to a particularly toxic chemical or the person exposed is particularly vulnerable. Acute exposures can occur in non-drug users during or immediately after ‘cooking’.

Less severe exposures can result in symptoms such as headache, nausea, dizziness, and fatigue or lethargy. These symptoms have been known to occur in people exposed to active labs, but also in people – particularly law enforcement personnel and other first responders – who have entered a drug lab before the site has been cleaned or ventilated. These less severe symptoms usually go away after several hours of exposure to fresh air.

Exposures to clan meth lab chemicals or by-products over a long period of time (chronic exposures) may cause both long-term and short-term health effects. Long-term exposures to volatile organic compounds (VOCs) may result in liver and kidney damage, neurological problems, and increased risk of cancer. Benzene is a VOC known to cause cancer. Even at low levels, exposures for long periods by people living in a former clan meth lab site could result in serious health effects.

Acids or bases will cause a burning sensation on the skin and in mucous membranes, and can cause severe eye damage. Exposure to metals and salts can cause a wide range of health effects including respiratory irritation, decreased mental function, anaemia, kidney damage and birth defects. Lead and mercury are particularly hazardous.

The effects of chronic exposure to elemental mercury include central nervous system effects (such as erethism, irritability, insomnia), severe salivation, gingivitis and tremor, kidney effects (including proteinuria) and acrodynia in children.

The effects of lead are related to the level of lead in human blood.[31] Although there are some differences in the bio-availability of different lead compounds, the health effects caused by increased blood lead levels are the same, regardless of the lead compounds causing the exposure. There is now clear epidemiological evidence of a close relationship between prenatal exposure to lead and early mental development indices but it has not been possible to identify a definite threshold for its effects.

Appendix H presents a summary of the key aspects associated with the chemicals identified in the illicit manufacture of methamphetamine. The summary presented in Appendix I is based on available information from published sources and databases and includes information on the health effects, including the potential carcinogenicity of the chemical and the potential for dermal absorption relevant to the assessment of exposure.

The scope of the assessment presented in these guidelines does not extend to a detailed review of toxicological effects and derivation of quantitative toxicological data associated with the chemicals identified. The review presented is not a complete literature review or a summary of all available studies.

9.2.1 Health effects on children

According to the New Zealand Police 59 children in the total were found living at clan meth lab addresses in 2009 compared with 86 in 2008 (National Drug Intelligence Bureau 2010). Martyny et al (2004a) found that during production under controlled circumstances, methamphetamine was widely dispersed as an aerosol and contaminated both vertical and horizontal surfaces including walls, carpets, microwaves, tabletops and clothing. In the United States approximately 35 percent (700 out of 2,028) of children found in clan meth labs in 2001 tested positive for toxic levels of

[31] The Notifiable Disease Order 2007 amended Section B of Schedule 2 of the Health Act 1956 relating to non-occupational lead absorption to change the notifiable level of lead absorption from 15 micrograms per decilitre (0.72 micromoles per litre) to 10 micrograms per decilitre (0.48 micromoles per litre). This commenced on 3 September 2007.

chemicals in their bodies including methamphetamine (National Drug Intelligence Centre 2002). However this percentage was regarded as an underestimate because '*many states do not keep records on children present at laboratory sites or medically evaluate them for the presence of drugs or chemicals*' (National Drug Intelligence Centre 2002).

In New Zealand testing for methamphetamine is often conducted for Child, Youth and Family at the direction of a court. Analysing children's hair to detect methamphetamine has been useful in these situations because it can provide scientific evidence in an area that can usually otherwise only be argued about, often at length.[32] In addition, the length of time a child has been exposed to toxic chemicals that are the ingredients and by-products of methamphetamine production can be linked to their hair length as the chemicals will stay within that piece of hair until it is cut off.[33] The significant level of urine positive children removed from homes of methamphetamine users is another indicator of the high likelihood that children in these homes have experienced both inhalation and dermal exposure (Martyny et al 2008). Grant et al (2010) found that of the 104 children that were evaluated after removal from clan meth labs 46 percent had evidence of methamphetamine in their urine.

The health effects of exposure to methamphetamine on children are relatively unknown. Some studies targeting infants born to women who have used methamphetamine during pregnancy indicate that infants born to methamphetamine users have altered behavioural patterns and lower intelligence test scores than do non-exposed infants. Physical malformations such as cleft lip, cardiac defects, reduced head circumference, biliary atresia, cerebral haemorrhage, systolic murmur and undescended testes have also been linked to pregnant mothers using amphetamines and methamphetamines (Martyny et al 2008).

No published papers were identified regarding the relationship between children exposed to methamphetamine surface contamination or methamphetamine manufacture and any resultant health consequences. Children found at a clan meth lab will have most likely come into contact with meth lab chemicals through inhalation and absorption through the skin. Ingestion is the most dangerous method of contact as it can prove fatal (National Drug Intelligence Centre 2002). In the United States anecdotal reports of increased asthma, pulmonary fibrosis and upper respiratory complaints have been received but no documented health statistics appear to be available at this time (Martyny et al 2004b). A number of the reports that have been received involving exposure to a clan meth lab concerned reactions that could have been to the chemicals used to manufacture the methamphetamine rather than by the methamphetamine itself (Martyny et al 2004b).

Children in clan meth labs are also exposed to significant risk for abuse and neglect. Meth-using guardians may be unable to provide children with adequate food, shelter and care. In addition, they may expose children to other drug-using adults, paranoia-induced behaviours, dangerous animals, firearms and other dangerous items (Bratcher et al 2007).

[32] http://www.esr.cri.nz/SiteCollectionDocuments/ESR/PDF/ForensicScience/forensic-hair-fact-sheet.pdf

[33] Ibid.

9.3 Exposure assessment

The exposure assessment is a critical component in the development of remediation levels for clan meth lab-related chemicals. Unfortunately there are many sources of uncertainty in these estimates particularly as there is currently limited information available regarding the toxicity associated with residual contamination at clan meth labs. It is difficult to estimate a toxic dose for exposure from oral ingestion, let alone for other potential exposure pathways such as inhalation, dermal contact, prenatal or nursing infant exposure.

Exposure estimates are also challenging due to uncertainty regarding the distribution of contamination throughout a property. A literature review shows that there are no established toxicity values for methamphetamine via any exposure route. There is a significant amount of information regarding pharmacological and illicit use of methamphetamine, but there is little information about chronic exposure. There is also a lack of data regarding the potentially interactive effects of different chemicals with methamphetamine, including possible synergistic or antagonistic effects.

However, assessing the exposure is essential for hazard control. The sources of exposure can be determined by exposure characterisation on the basis of questionnaires, interviews, inspections, historical records and/or exposure simulation. Using the exposure simulation method Martyny et al (2004a) reported that iodine compounds, phosphine, hydrogen chloride, and methamphetamine are the major chemicals of concern for the Red Phosphorus (Red P) method. The researchers performed some 'controlled cooks' in a controlled laboratory using the Red P method from which they reported the presence of hydrofluoric acid, hydrochloric acid, hydrobromic acid, phosphoric acid, nitric acid, and sulphuric acid following a Red P cook. Levels of hydrochloric acid exceeded the 'ceiling' short term exposure level (3 mg/m^3, see Table 6) during the cooking phase and levels slightly below the ceiling value during the 'salting out' phase (when liquid free base methamphetamine is converted to solid meth salt). In addition, levels of hydrochloric acid (16.9 mg/m^3) were more than five times the ceiling value, which indicated significant exposure during the active cooking phase (Michigan Department of Community Health 2004).

In regard to phosphine sampling, the Michigan Department of Community Health (2004 p 37) notes that:

> '*during this 'controlled' cook also exceeded short-term exposure standards; however, there was some uncertainty related to this data and future data from controlled cooks should be sought with regard to potential phosphine exposures. The maximum air concentration seen (0.49 mg/m^3) during controlled manufacture was roughly equal to the Acute Exposure Guideline Level 2 (AEGL-2) for a four-hour phosphine exposure (0.50 mg/m^3). The AEGL-2 is the "airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape" (see the Environmental Protection Agency AEGL website – http://www.epa.gov/oppt/aegl/define.htm). It is possible that anyone exposed to phosphine at 0.5 mg/m^3 for four hours could develop serious or irreversible adverse health effects, such as reactive airway dysfunction syndrome (RADS) or spontaneous bone fractures*.'

As noted in section 8.5.3 phosphine has a high vapour pressure (4186kPa at 20°C, ICSC: 0694) so does not persist for long periods of time in air that is not completely dry (N Powell, personal communication, 2010). As Martyny et al's study (2004a) was designed to determine the potential chemical exposures for law enforcement and emergency services personnel (first responders) phosphine is considered unlikely to be encountered by non-first responders including those undertaking inspections and testing in non-operational clan meth labs (N Powell, personal communication, 2010).

During the 'controlled cook' Martyny et al (2004a) also recorded airborne levels of iodine that exceeded short-term exposure limits, including one sample (37 mg/m^3) that exceeded the Immediately Dangerous to Life and Health (IDLH) value of 2 ppm. Acute exposure of this magnitude can be expected to have significant neurological and cardiovascular effects. In addition it could also be assumed that dangerous levels of hydriodic acid could be associated with high concentrations of airborne iodine (Michigan Department of Community Health 2004).

Table 6 from Michigan Department of Community Health (2004 p 38) l'ists acute emergency exposure standards for the major chemical hazards posed by the Red P method, during active cooking: iodine and the related compound hydriodic acid, hydrochloric acid, and phosphine. The Martyny et al (2004a) study showed that the Red P method is capable of generating:

- airborne hydrochloric acid concentrations above levels of acute concern (specifically, higher than the Occupational Safety & Health Administration [OSHA] "permissible exposure level" [PEL] ceiling value)
- airborne phosphine concentrations roughly equivalent to levels of acute concern (specifically, roughly equivalent to the 2nd tier "acute exposure guideline level")
- airborne iodine concentrations slightly above levels of acute concern (specifically, one sample exceeded the "Immediately Dangerous to Life and Health" value)
- airborne hydrogen iodide was not tested for by Martyny et al (2004a); however, it could be found in association with airborne iodine. In addition, hydrogen iodide has corrosive effects similar to exposure to hydrogen chloride (hydrochloric acid) when it comes into contact with moist tissues (such as eyes or mucous membranes).'

Table 6: Some major Red P method contaminants and their associated exposure levels

Compound	IDLH	OSEA PEL	ACGIH TLV	NIOSH REL	AEGL-1	AEGL-2
Iodine	2 ppm	Ceiling – 1 mg/m^3 (0.1 ppm)	Ceiling – 1 mg/m^3 (0.1 ppm)	Ceiling – 1 mg/m^3 (0.1 ppm)	NA	NA
Hydrogen iodide, hydriodic acid					1 ppm proposed (10 min to 8-hr)	11 proposed 8-hr
Phosphine	50 ppm	0.4 mg/m^3 (0.3 ppm)	0.4 mg/m^3 (0.3 ppm)	0.4 mg/m^3 (0.3 ppm)	NR	0.25 8-hr interim; 0.5 for 4-hr exposures
Hydrogen chloride, hydrochloric acid	50 ppm	Ceiling – 7 mg/m^3 (5 ppm)	STEL ceiling – 3 mg/m^3	Ceiling– 7 mg/m^3 (5 ppm)	1.8 ppm interim (10 min to 8-hr)	11 ppm interim 8-hr

Notes:

ACGIH = American Conference of Governmental Industrial Hygienists; AEGL = Acute Exposure Guideline Level; IDLH = Immediately Dangerous to Life and Health; N/A = not applicable; NR = not recommended; NIOSH = National Institute for Occupational Safety & Health; OSHA = Occupational Safety and Health Administration; PEL = permissible exposure level; REL = recommended exposure level; TLV = threshold limit value

Source: Michigan Department of Community Health (2004)

9.3.1 Human exposure pathways

A typical exposure pathway from the illicit drug manufacture of methamphetamine contains five major elements:

1. a source of contamination
2. contaminant transport through an environmental medium
3. a point of exposure
4. a route of human exposure, and
5. an exposed population.

Any exposure pathway is considered a complete pathway if there is evidence that all five of these elements are, have been or will be present at the property. An exposure pathway is considered a potential pathway if there is evidence that at least one of these elements is, has been or will be present at the property.

During the process of producing methamphetamine, there is a complete pathway of exposure. Airborne contaminants from methamphetamine production are documented by Martyny et al (2004a). Points of exposure exist not only within the cooking area but likely throughout the entire building. Past exposures to methamphetamine-related airborne chemicals are considered a complete exposure pathway.

After the removal of bulk chemicals an exposure pathway is no longer complete for the inhalation route as the chemicals of concern are only airborne during and shortly after active methamphetamine production. Prior to remediation, a potentially complete exposure pathway exists only through the dermal route (and subsequent ingestion of small amounts of material picked up by dermal contact through 'hand to mouth' behaviour). Deposition of airborne chemicals and/or contaminant-bearing particulate matter would almost certainly exist in the cooking area. It is the area where the greatest risk generally exists from dermal contact with chemicals related to the production of methamphetamine. This residual dermal risk can be eliminated through thorough and effective remediation by a trained professional.

9.3.2 Chemical exposure pathways

From its initial establishment through to its ultimate re-occupancy, a clan meth lab goes through four phases that vary with the nature of operations, the chemicals present, the exposure pathways and the sensitivity of the potentially exposed populations. The four phases for a discovered clan lab (Table 7) may generally be described as:

1. **operational:** clandestine methamphetamine synthesis takes place
2. **discovery and removal:** the lab is 'busted' (discovered by law enforcement such as the New Zealand Police) and bulk chemicals and equipment are removed
3. **remediation and verification:** samples are collected to verify that residual contaminant levels are below target remediation guidelines
4. **re-occupancy:** a new group of residents occupies the residence which housed the former clan meth lab.

Table 7: Exposure pathways and the potentially exposed populations

Scenario	Potentially exposed populations	Contaminants and exposure pathways
Operational clan meth lab	• Operators • Visitors • Innocent bystanders • Neighbours*	**Primary:** Inhalation of volatile contaminants; intentional dosing (all routes) **Secondary:** Dermal contact with non-volatile residues on surfaces; non-dietary ingestion via hand-to-mouth activities
Discovery and removal	• Law enforcement (NZ Police, NCLRT) • NZ Fire Service • Social services eg, Child, Youth and Family • Industrial hygienists	• Inhalation of volatile contaminants that may or may not be stored in original containers • Inhalation of re-suspended, particle-adsorbed contaminants • Dermal contact with non-volatile residues on surfaces • Exposure minimised by personal protective equipment
Clean-up and verification	Site remediation personnel Industrial hygienist	• Inhalation of volatile contaminants off-gassing from 'soft' media** • Inhalation of re-suspended, particle-adsorbed contaminants • Exposure minimised by personal protective equipment
Re-occupancy	Residents (includes all sensitive sub-populations for example children)	• Dermal contact with methamphetamine residues • Dermal contact with non-volatile chemicals on surfaces that lack remediation guidelines • Inhalation of volatile contaminants off-gassing from 'soft' media (likely to be minimal) • Inhalation of re-suspended contaminants that lack remediation guidelines • Ingestion of discarded contaminants in soil at levels above the remediation guideline

Notes:

* In 2007 a medical officer of health employed by the Waikato District Health Board was asked to prepare a report for the New Zealand Police as part of their investigation into a case where an individual claimed that her illness was caused by living adjacent to a clan meth lab. This lab was discovered at a house in Hamilton in July 2007. A poisons expert stated that the chemicals involved in the production of methamphetamine found at the site would not have caused the clinical symptoms described by the individual. The neurologist who investigated the individual for her symptoms in 2007, diagnosed the individual with migraine. As a result the evidence suggested that the symptoms that were described by the individual were due to migraine; they were not caused by living adjacent to a clan meth lab.

** 'Soft' media include upholstered furniture, drapes and carpet (assuming they have not been removed as part of clean-up operations) and wall board. During this phase, the primary sources of volatile contaminants – storage containers – will have been removed. Secondary sources, such as solvents that were spilled or improperly disposed of, will still be present.

Source: adapted from Salocks (2009)

The risk of human exposure varies considerably depending on the manufacturing process and the quantity and form of chemicals. Also there is greater risk of chemical exposure at a site where a laboratory is actively producing illicit methamphetamine.

After removal of the illicit drug laboratory equipment and chemicals, residual amounts of some substances may persist on building surfaces and furnishings prior to decontamination. There may also be contaminated outside areas (eg, soil, on-site effluent treatment systems (septic tanks), waterways) resulting from the illegal disposal of substances by the former drug operator. When determining the level of risk acceptable for a given dwelling it is necessary to consider potential uses of the dwelling and the extent of expected human contact. Factors to be considered include frequency, type of contact and the sensitivity of exposed populations. To reach the following relative levels of risk associated with relative levels of exposure to methamphetamine and other contaminants, the following actions should be taken:

a) **No residual risk**

- Remove all contents of the dwelling.
- Demolish the dwelling.
- Sample the outside for contamination of soil or water bodies, eg, stream or groundwater.
- Dispose of contents and dwelling in an approved landfill with appropriate acceptance criteria.

b) **Minimal residual risk**

- Remove all building contents, including clothing and appliances.
- Remove carpeting, wallpaper and/or unpainted sheetrock (drywall).
- Remove suspended and attached ceiling tiles and/or ceiling texturising.
- Dispose of all contents and structure's building materials (eg, ceiling tiles, carpeting) in an approved landfill.
- HEPA (High-Efficiency Particulate Air) vacuum all remaining porous surfaces such as raw wood, brick and cement block.
- HEPA vacuum all wood floors and all floors beneath removed carpeting.
- Detergent wash all surfaces twice, rinsing with fresh water.
- Seal remaining contamination by spraying all surfaces with a special encapsulating coating such as those used for asbestos or lead. For further information on the management of lead and asbestos refer to the Ministry of Health guidelines (Ministry of Health 2007a and 2007b).
- Assess the likelihood of any chemicals being dumped around the dwelling, poured down drains or on-site effluent treatment systems, and investigate accordingly.

c) **Acceptable residual risk**

- Remove carpeting, wallpaper and unpainted sheetrock (drywall).
- Remove suspended and attached ceiling tiles.
- Spray paint textured ceilings.
- Remove upholstered furniture, mattresses, paper items, and other porous contents.
- Remove clothing, toys, bedding, baby bottles and cups, and other personal items used by infants and small children.
- Dispose of those items in an approved landfill with appropriate acceptance criteria
- HEPA vacuum all remaining porous surfaces such as raw wood, brick and cement block.
- HEPA vacuum all wood floors and all floors beneath removed carpeting.
- Detergent wash all building surfaces twice, rinsing with fresh water.
- Spray paint all building surfaces with two coats of a high-quality paint, polyurethane or concrete/brick sealer.

9.4 Risk characterisation

Risk characterisation involves integrating the outcomes of the previous steps in the risk assessment: hazard identification, dose response assessment and exposure assessment. Achieving this integration requires making a number of assumptions in cases where empirical information is unavailable. These assumptions result in a number of uncertainties associated with the risk assessment, which need to be acknowledged and discussed.

Risk characterisation combines the information obtained from the hazard identification, dose response assessment and exposure assessment to estimate the risk associated with each exposure scenario considered and to present uncertainties in the analysis (Ministry of Health 1998).

9.5 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 one's own making.

Potentially hazardous residues of the methamphetamine manufacturing process can remain indefinitely in former laboratories and residents can absorb them through contact and to a lesser extent, breathing. People expect to be safe in their homes and former methamphetamine laboratories are hazards that will be perceived by the public in a context wider than that of scientific risk assessment.

Effective risk communication is more likely to be achieved if:

- a careful and sensitive explanation is given to improve the level of understanding of the risk
- the feelings of dread towards the hazards associated with former clan meth labs manufacturing illicit drugs such as methamphetamine are recognised and efforts are made to assist a person to come to terms with those feelings before decisions are made
- there are 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 with young children and by older people
- people tend to simplify complex and uncertain information into ‘rules of thumb’
- people generally attempt to impose patterns on patternless events
- people generally overestimate the frequency of rare events and underestimate the frequency of common events
- individuals taking risks voluntarily tend to be overconfident and believe they are not subject to the same risk as other individuals
- individuals forced to take risks involuntarily 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* (Ministry of Health 1998). 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 also taking account of, and acting on, people’s concerns.

Chapter 10: Risk Management

10.1 Introduction

Priorities for managing risk should be based on risk assessment but should also consider public perception of risk. The range of risk reduction alternatives must be evaluated which includes taking account of the social, economic, and cultural implications of each option.

Risk management may be achieved along two lines:

1. control of actions and events that can translate a chemical exposure hazard into a chemical exposure risk
2. the removal or near-permanent containment of the chemical exposure hazard.

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

10.2 Graded response protocol

Not every chemical exposure incident creates a health risk. The risk of developing health effects depends on the extent of exposure to chemical(s). A graded response is based on the following three elements:

Hazard
↓
Linking event or action causing exposure
↓
Risk, and who is affected and in what way

More specifically, these elements are:

- the nature and scale of the chemical exposure and the corresponding potential to be a risk to human health
- mechanisms that may open pathways of exposure to create risk
- 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 the likely consequences for each them.

Whenever a complaint is received by the public health service, the person taking the call or dealing with the complainant should always record details in the respective investigation form. Data (which may be from more than one complaint) can be evaluated and a decision made on whether an investigation is warranted. The next section includes guidance on factors to be considered in making a decision whether to investigate.

Should an investigation be carried out, data on the event/incident which precipitated the complaint(s) will be obtained and entered into the respective investigation form. At the end of the investigation process it will be necessary to decide whether further action (such as a referral to other authorities, or a requirement for particular precautionary measures to be put in place) is appropriate.

10.2.1 How to use the graded response protocol and investigation forms

The investigation form (Appendix J) records information and decisions corresponding to the graded response protocol. The information recorded should be entered on to the respective form a described in more detail in section 10.3.

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

In practice, while Step 1 will always be completed, Steps 2, 3 and 4 will be completed only if appropriate.

10.3 Step 1: Receipt and processing of the complaint

In each public health service, the initial contact point for complaints about chemical exposure (from a former clan meth lab) should be designated in advance. The initial contact point designation may rotate among several people to ensure that there is always somebody available to receive complaints of this nature.

The designated contact person(s) should have a good telephone manner, be able to reliably record data received over the telephone, and have good judgement and initiative.

The data collected generally relate to the complainant's impressions about the incident. These data are usually subjective and further investigation may be needed to demonstrate their accuracy. Nonetheless, data should be recorded in the form in which they are received. Data collected from the complainant are about what was observed and where, whether anyone was exposed or made ill and any other damage that occurred.

This section details the components of the investigation forms (the complaints form and the exposure/illness form). Although the designated contact person begins to fill in both these forms, some parts of these forms are completed during later steps in the risk management process or may not be filled in at all if the decision is made against investigating further. However, for clarity this section covers all components of the forms, not just those relevant to Step 1.

10.3.1 Collecting complaint data

As complaints to the public health service are usually be made by telephone and the suggested procedures below are based on that assumption. On occasion, however, complaints may be received by other means, such as letter, fax or e-mail, in which case appropriate (but generally minor) modifications may need to be made to the suggested procedures.

When a chemical exposure complainant makes telephone (or direct) contact with the designated contact person within the public health service, the following procedure would generally be appropriate:

1. Thank the caller for calling and advise that:
   - the information collected will be used in assessing whether complaints received present any public health risk so that appropriate action can be taken if necessary
   - only designated staff have access to the information provided
   - the caller's name will not at any time be divulged without the caller's permission to do so.
2. Explain that there is a special procedure for recording data on chemical exposure incident complaints and, therefore, you would like to ask a systematic series of questions, although the person calling will have the opportunity to provide any additional information that they think is relevant, but which has not been requested.
3. Ask the appropriate questions in sequential order and record the information received.
4. Record information on the complaint section of the investigation form. However, for every individual person whom the complainant advises was directly exposed (and possibly ill as a result), record data on the exposure/illness record section of the form.
5. At the end of the specified questions give the caller an opportunity to supply any additional information that they think relevant, thank them for calling and advise that someone from the public health service will get back to them shortly.
6. Supply a photocopy of the paper forms to the appropriate health protection officer.

Complaint data are recorded under four main subheadings (pages): location, details, management, and investigation.

Location

On the location page record fundamental information, including contact details for the complainant, and the geographic location of the site affected.

Details to be recorded include:

- the name of the person in the public health service recording the information
- name, address, and telephone number of the complainant
- date and time of the complaint to the public health service
- type of complainant (eg, member of the public, government agency, doctor, other health practitioner, media, other)
- the address of the area affected by chemical contamination

- type of affected location (eg, private residence, public area, school, workplace, child care centre, etc)
- the name of the owner of that property.

Details

On the details page, record information about the extent and circumstances of the incident, as perceived by the complainant. Recorded data include:

- how the chemical incident was first detected (eg, by sight, smell, physical contact)
- a brief text description of the chemical exposure incident
- date and time of the chemical exposure incident
- what (if anything) the complainant believed the chemical to be.

Management

On the management page, record the names of any individuals exposed (and possibly made ill), and the decision on whether to take any further action. Further action may include a field investigation and/or referral to another agency. This includes:

- whether further action, such as a field investigation, was considered to be warranted
- in cases where a field investigation takes place and is linked (through the event/incident record) to the complaint record the event/incident record number will be displayed on this page (although it cannot be changed from this record)
- in cases where no further action is considered to be warranted, the reason for that decision
- the name of any other agency to which the complaint was referred
- the name(s) of any person(s) believed to have been exposed (for each name recorded, an exposure/illness record will automatically be opened).

Investigation

It will only be necessary to complete the investigation page if a field investigation is considered to be warranted (as recorded on the management page). If such a decision is made, use this page to record information on the investigation of the site where the chemical exposure occurred (not the investigation of the actual event that led to the injury occurring – that is the subject of the event/incident record).

The data to record are:

- the name(s) of the investigating officer(s)
- the date of the investigation
- whether samples (eg, water, air or soil) were taken for analysis
- the results of any analyses
- conclusions of the investigation
- whether further action was required.

10.3.2 Collecting exposure/illness information

Complete a separate exposure/illness record for each person who the complainant alleges has been exposed, whether or not they experienced symptoms or illness as a result. The details recorded should include any biomarker results.

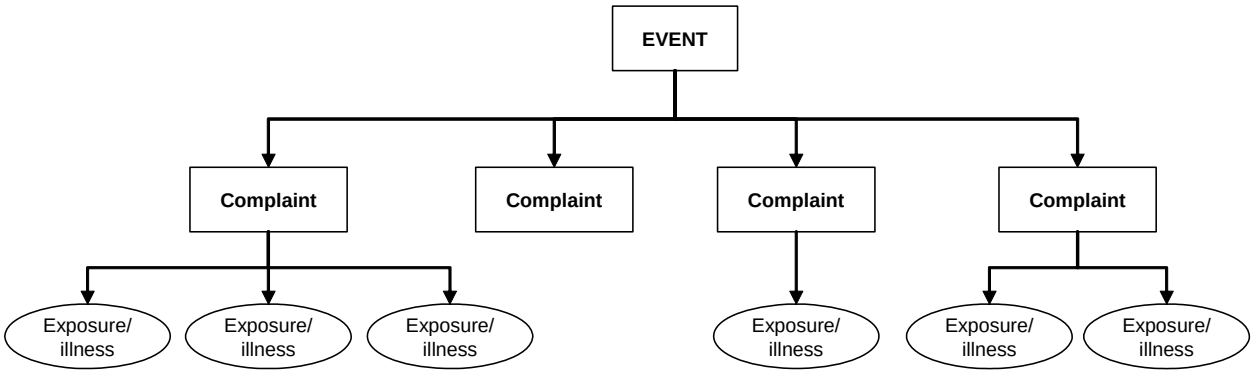
No exposure/illness record can stand on its own. It must come from and be linked to a complaint record. This ensures that additional data on the precipitating incident are available. Aggregation of exposures/illnesses under a complaint record also captures the inter-relatedness of cases of exposure and illness. This is important. For example, five separate illnesses that are linked to five separate complaints associated with the same incident could have a quite different interpretation to five illnesses that are related to a single complaint. By linking individual exposure and illness records to a complaint record it is also possible to identify individuals similarly exposed who did not experience the illness. This kind of information could be important in the interpretation of whether there is a cause and effect relationship.

Linkage of exposure/illness records through complaint records to event/incident records is represented diagrammatically in Figure 7. It shows the relationship of the records within the investigation form that relate to a single hypothetical chemical exposure incident/event involving three complaints and a total of six people exposed.

Initial data for creation of the exposure/illness record will be obtained from the original complainant. However, it may be necessary to interview the exposed/ill person (or a caregiver) to complete the form, particularly if illness is alleged to be associated with the exposure. In some cases it will be necessary to approach the person's medical practitioner to obtain medical details.

Although most exposure/illness records will be initiated from the complainant interview, subsequent investigation may reveal others who claim to have been exposed or made ill. Separate exposure/illness records will need to be created for each of these people. They can be linked to the broader investigation by entering the names of these people onto the management page of the complaint record.

Figure 7: Illustration of the record structure associated with an event



Within the exposure/illness record data are recorded under four main sub-headings (pages): personal, symptoms, risk factors, and diagnosis as described below. See Appendix J for a copy of the exposure/illness record template.

Personal

On this personal page record personal data for the individual affected. This page links this record to the complaint record (and any associated event/incident record) because:

- the name of the person recording the details will appear as a default from the corresponding name on the location page of the complaint record.
- the name of the person exposed or ill is inserted from the complaint record (management page). The address of the complainant from the complaint record will be inserted as a default for the address of the person affected.

Other information to be collected includes:

- the date of birth of the person exposed/ill
- the sex of the person exposed/ill
- the ethnicity (Census categories) of the person exposed/ill
- the current main occupation of the person exposed/ill
- where the exposed/ill person was at the time of the exposure (for example inside one particular part of the house for a prolonged period of time)
- how the exposure was experienced (for example, smell, felt on skin or clothing, visible mist or cloud)
- whether the person experienced symptoms or illness that they associated with the exposure (this item opens the subsequent pages in this record).

Symptoms

Only enter data on the symptoms page if it is specifically indicated on the personal page that symptoms or illness were associated with the exposure. In such cases record any symptoms or illness that the person associated with the exposure using the series of check boxes on the form (refer Appendix J for details). A box should only be checked if symptoms were experienced.

Risk and protective factors

As with the symptoms page, the risk/protective factors page should only be completed if symptoms/illness were experienced. As well as extending the questions about symptoms, this page covers risk factors and protective factors that may have either been responsible for the symptoms/illness experienced or affected susceptibility to the chemical exposure.

Other data recorded on this page are:

- how long ago the symptoms were first noticed
- the most severe symptom
- whether biological samples were taken for analysis
- the results of such analyses

- whether the subject normally suffers from any of the following conditions: asthma, skin allergies, hayfever, migraine, eczema and/or other chronic diseases
- any medicines being taken prior to the exposure
- whether the subject is pregnant
- whether the subject is breastfeeding
- the usual health status of the subject (e.g., excellent, good, fair, poor)
- whether the subject had any illnesses prior to the exposure
- the average number of cigarettes smoked per day (smoking is related to a possible route of exposure).

Diagnosis

The diagnosis page is again only completed if symptoms or illness are not experienced. It mainly records information that will be available if a doctor had been consulted. It also includes the final conclusions of the investigating officer in relation to the possibility of a cause and effect relationship between exposure and illness.

Data recorded include:

- whether a medical practitioner or any other health practitioner was consulted
- doctor's (or other health practitioner's) name and address (this information is required because there may be follow-up with the health practitioner. The person with symptoms needs to be advised that this follow-up may occur and consent gained)
- diagnosis
- whether the illness is systemic or local
- overall severity of the symptoms (mild, moderate, severe, systemic/local)
- whether the symptoms were consistent with an effect of the chemical(s)
- overall conclusions of the investigating officer in regard to the association between illness and the exposure.

10.4 Step 2: Decision as to whether to investigate further

Each public health service should designate in advance levels of authority for decision-making and responsibility for taking action for dealing with chemical incidents such as clan meth labs, with clear lines of accountability. Some officers might specialise in dealing with such incidents, so that experience and responsibility are not spread too thinly.

Once one or more chemical exposure complaints have been received and data recorded, it is necessary to make a decision to be made as to whether to proceed with a field investigation of the incident. This is necessarily a local decision and must take into account local circumstances. These guidelines suggest factors for public health staff to consider in making this decision.

The officer responsible for dealing with a complaint should have available established procedures for ensuring the appropriate response and, as appropriate, should consult or convene the response team. The first task is to decide on the appropriate action.

The three main possible actions are:

1. take no further action
2. refer to another agency (possibly in conjunction with a public health service investigation)
3. begin an investigation (with or without referral to another agency).

Factors that should be considered include:

- whether people were reported as actually exposed, or whether environmental contamination was simply observed
- the number of people exposed
- whether exposed people reported symptoms or illness associated with the chemical exposure
- whether there was possible contamination of food, water supply, or air
- the level of local concern, or potential for such concern to arise
- availability of investigative resources
- the time interval between the incident and the complaint.

How such factors might feature in a decision for each of the three possible actions is set out below.

10.4.1 No further action

Considerations that might influence a decision to take no further action are:

- a lack of human exposure
- only one complaint received (depending on the nature and seriousness of the complaint)
- complaint likely to be frivolous
- no potential for water, soil or air contamination
- low level of public concern
- lack of available investigative resources
- symptoms are not associated with those expected from the alleged contaminant.

When a decision is made that no further investigation is necessary, then the reason should be documented and the decision endorsed by the medical officer of health or the principal/senior health protection officer.

10.4.2 Referral to another agency

Chapter 7 provides information on the roles of other agencies in chemical exposure incidents caused by abandoned clan meth labs. An up-to-date list of appropriate contact people in those agencies should be maintained by the public health service. Similarly, those agencies should be aware of whom in the public health service to contact, should they first become aware of a chemical exposure incident that may originate from a former clan meth lab.

Local agreement should have been reached with other agencies, including regional councils, and territorial authorities, in regard to criteria for referral of complaints to those agencies. In addition, it would be advantageous to establish with those agencies agreed written protocols for procedures to be adopted for joint investigations, including establishment of the lead agency in any such joint action.

If a complaint is to be referred to another agency (whether or not the public health service is intending also to investigate), the consent of the complainant should first be sought.

A summary sheet of the information provided by the complainant (or a copy of the complaint record) should be forwarded to the appropriate agency or agencies. Generally, information passed on to other agencies should not include illness information from the exposure/illness records.

Refer the information in writing to the appropriate agency. Follow up with a phone call to check that it has reached the appropriate person(s). As far as possible, co-ordinate the investigation with the other agencies that will also be carrying out investigations.

10.4.3 Further investigation

Considerations influencing a decision to carry out a further investigation include:

- illness associated with exposure reported
- more than one person exposed
- more than one separate complaint received
- soil, water or air contaminated
- appreciable public concern
- investigative resources available.

10.5 Step 3: The Investigation

A public health investigation of a chemical exposure incident may include some or all of the following.

1. a field visit with staff from other agencies to:
    - inspect the property onto which the chemical identified by the complainant(s) was disposed of
    - interview people identified as exposed (either with or without associated illness)

2. collection of samples (wipes) for laboratory analysis of residues (if appropriate); refer to Chapter 5 for information on the assessment of structures/dwellings after remediation.
3. information requests to medical practitioners (with patient consent) about people who consulted their doctors.

When carrying out investigations, it is important to remain impartial and to show consideration to all parties. Speed of resolution of issues, and fair and appropriate feedback to all parties are important.

10.5.1 Appointment of an investigation team leader

It is important that a leader be appointed for each incident investigation, although this may always be the same person if one person is given responsibility for investigating all such incidents. The responsibilities of the investigation leader would include:

- co-ordinating the investigation team
- seeing the investigation through to completion
- informing and liaising with other investigating agencies
- collecting the appropriate information, including technical and toxicological information on the chemicals implicated from a former clan meth lab
- collecting environmental samples and referring them for analysis (if appropriate)
- ensuring that data from the investigation are recorded
- maintaining a complete physical file of documents from the investigation
- informing the complainant(s) of the outcome of the investigation and action taken (if any) taken, and why
- ensuring follow-up action is taken (if appropriate).

10.5.2 Visiting the former clan meth lab site

Ideally, field investigations should be conducted jointly by representatives of all agencies involved in particular the relevant district or city council and where appropriate the public health service. However, this will often be impracticable, and is not a reason to delay the investigation.

The owner or manager of the property where the former clan meth lab was dismantled should be contacted by phone to arrange a visit, including a face-to-face interview (although there may be circumstances when an unannounced visit is appropriate).

The purpose for the site visit and the interview should be made clear in advance: to obtain information on any chemical residue that might be relevant to assessing the complaint(s). It must be reiterated that the source of the contaminant may not necessarily be the most obvious possibility.

The names of the officer(s) who will be making the site visit(s), and the agencies these individuals represent should be advised in advance.

The name of the complainant should not at any time be divulged, unless the complainant has given their permission to do so.

If, during the investigation, information should indicate that an ongoing operation is causing or is likely to cause danger to humans due to chemical exposure, the designated officer should leave the scene immediately and seek the assistance of the New Zealand Police rather than intercede to stop the operation under sections 29, 60, and 32-35 of the Health Act 1956 or section 104 of the Hazardous Substances and New Organisms (HSNO) Act 1996.

10.5.3 Visiting the location affected by the chemical

The site investigation should ideally take place in the presence of the complainant to complete any gaps in the complaint record. A paper report of that record should be taken and additional data written on it.

If appropriate, environmental samples may be collected under section 103(2) of the HSNO Act to confirm whether remediation of the site has been satisfactory. Collection of samples should follow best practice as outlined, for example for soil, in the *Contaminated Land Management Guidelines No. 5* (Ministry for the Environment 2004). Environmental samples may include:

- water samples, particularly if drinking water is possibly contaminated
- soil samples
- air samples
- other possibly contaminated items.

During the visit it is a good idea to draw an A4 map to approximate scale map or a map using Geographic Information System (GIS), of the location where the contamination took place. This map should include the following details as appropriate:

- where the contamination occurred
- the target area for the application
- any roads, property boundaries and buildings
- an arrow indicating the path of the contamination
- the sampling locations and sample numbers of any environmental samples
- the location of the exposed people at the time the contamination occurred
- an indication of the relevant topography
- any other relevant feature(s).

It will often be appropriate to take photographs, as permitted under section 103(2) of HSNO Act 1996, as well.

10.5.4 Interviewing exposed cases

During the initial complaint report information on each person believed to have been exposed is recorded on an exposure/illness record. Often, particularly when symptoms or illness have occurred, the complainant will not know all the information that is sought.

In such cases it would be appropriate to interview the exposed/ill people themselves as part of the field investigation.

Interviews with people exposed/ill should be arranged by phone, where possible, and conducted as reasonably soon as reasonably possible. If it is intended to take biological samples the following information should be taken into consideration. In most cases, biomonitoring data do not provide information on the timing, sources, or routes of exposure. For chemicals that remain in the body for short periods, biomonitoring data may be difficult to interpret. Timing and duration of exposure become critical to the interpretation (Needham et al 2005). For many chemicals expert advice should be sought before biological sampling, for example, the Institute of Environmental and Science Research (ESR) or from a medical toxicologist at the National Poisons Centre.

When conducting the interview, the investigating officer should refer to an exposure/ illness record and confirm all details supplied by the complainant, as well as filling in the gaps. Interviewees should be assured that all information collected will be kept confidential to those conducting the investigation and involved in any subsequent prosecution.

Anyone under the age of 16 years should be interviewed only in the presence of a parent/guardian.

If a person with symptoms or illness associated with their exposure has consulted with a doctor, request from the patient (or, as appropriate, a caregiver) written permission to contact their doctor to discuss the diagnosis.

Non-invasive urine collection is preferable to blood sample collection. However, if a blood test is justified, advise the person exposed that they should arrange for this test as soon as possible with their medical practitioner.

10.5.5 Collecting event/incident information

Data on the incident collected during the field investigation will be recorded in an event/ incident record on the investigation form. Once an event/incident record has been created, it can be linked to each of the corresponding complaint records.

During the interviews and property inspection, information should be recorded on the event/incident section of the investigation form. Any notes made at the time should be retained on file in case a prosecution is taken.

Within the event/incident record in the investigation form data are recorded under three main subheadings (pages): location, chemicals and management.

Location

On the location page, record basic information to do with the property where the exposure took place, as well as the name(s) of the investigating officer(s). Data recorded are:

- the incident number (automatically assigned when a new record is created)

- the name of the local public health service (automatically assigned)
- name(s) of investigating officer(s)
- the date of the investigation
- the address of the property where illicit drug manufacturing took place
- the territorial authority that contains this property
- the name, address and telephone/fax numbers of the owner (or manager) of the property.

Chemical

On the chemical page, record information on the chemicals involved in the illicit drug manufacturing site. This information may be available from the territorial authority or New Zealand Police.

Management

On the management page, record conclusions of the investigation and any follow-up actions including:

- conclusions from the investigation
- actions initiated
- recommendations
- related complaints. The associated complaint records are linked from a field on this page by selecting from complaint records that are currently unlinked to any event/ incident record.

Glossary of Terms and Abbreviations

Acute exposure An exposure over a relatively short period of time (minutes, hours) that may cause health effects. An acute exposure to high levels of contaminants found in methamphetamine labs may cause acute effects, which can occur during or immediately after a drug bust, before the lab has been properly ventilated. In addition, latent effects may occur following exposure.

ATSDR Agency for Toxic Substances and Disease Registry.

CAS number An acronym meaning Chemical Abstracts Service number. It is the unique number assigned to a specific chemical by the American Chemical Society.

Chronic exposure Chronic exposure occurs over an extended period of time, such as months or years. A chronic health effect is one that usually appears after a lengthy period of time, possibly years. Not much is known about the chronic health effects from clan meth labs. However, there is scientific evidence from animal and human toxicity studies that shows the chemicals used in the manufacture of methamphetamine can cause a range of health effects. These include cancer, damage to the brain, liver and kidneys, birth defects and reproductive problems, such as miscarriages.

Clandestine methamphetamine laboratory A laboratory illegally producing the controlled drug methamphetamine.

Cleansing order An order issued under section 41 of the Health Act 1956 by a territorial authority (city/district council). A cleansing order is issued if a city or district council believes that the cleansing of any premises is necessary to prevent a danger to health or to render premises fit for occupation. The order is served on the owner or occupier of the premises.

Clean-up Proper removal and/or containment of substances hazardous to humans and/or environment at a chemical investigation site. Clean-up refers to two specific parts:

1. **Removal** occurs when a clan meth lab is identified and seized by the New Zealand Police and bulk chemicals, equipment and wastes are removed by an approved hazardous waste contractor under contract with the New Zealand Police.
2. **Remediation** refers to the cleaning and containment of residual contamination that exists after the bulk removal of chemicals and chemical wastes.

Closing order An order issued under section 42 of the Health Act 1956 by a medical officer of health or engineer of a territorial authority or any other officer of a territorial authority (city/district council). A closing order is issued if a city or district council believes a property to be unfit for habitation and work to be done is not completed by the date specified. The property cannot be occupied until a closing order is lifted.

CSRF Contaminated Sites Remediation Fund.

Declaration of Hazardous Substances Emergency	A declaration issued under sections 136 and 137 of the Hazardous Substances and New Organisms Act (HSNO) 1996 by a warranted District Hazardous Substances Officer of a territorial authority. A Declaration of Hazardous Substances Emergency is issued if the council or the New Zealand Police believes the immediate removal of goods and/or substances are paramount to the health and safety of the general public.
DHB	District Health Board.
ESR	The Institute of Environmental Science and Research Ltd (ESR) is a Crown entity owned by the New Zealand Government. The forensic division has expertise in forensic biology (DNA), illicit drugs, toxicology, and all aspects of crime scene investigation, including fire forensics.
Field screening	The use of field (as opposed to laboratory) instrumentation and chemical detection systems to identify the presence of contamination in the field and to monitor the progress of decontamination efforts.
Gross chemical removal	Removal of illegal laboratory equipment, paraphernalia, chemicals, etc by the New Zealand Police for evidence of a criminal offence.
Hazard	A biological, chemical or physical agent or property, or an activity that poses a potentially adverse effect (eg, on plants, animals or humans).
Heavily contaminated areas	Areas where high concentrations of contaminants are likely, such as the rooms where chemicals were used or cooked, or areas where chemicals were spilled.
HEPA vacuuming	High efficiency particulate air vacuuming.
HSNO Act	Hazardous Substances and New Organisms Act 1996.
HVAC	Heating, ventilation and air conditioning.
IARC	International Agency for Research on Cancer.
Metals and salts	Chemical substances containing toxic metals, including lead and mercury.
Methamphetamine	A controlled substance, sometimes illegally manufactured for illicit use by clandestine laboratories.
NCLRT	National Clandestine Laboratory Response Team.
NIOSH	National Institute for Occupational Safety and Health.
Non-porous	A hard, smooth surface that does not have ‘pore’ that would allow for the accumulation of contamination.
OEHHA	Office of Environmental Health Hazard Assessment (California).
Photoionisation detector or PID	A field-screening device used to detect volatile organic compounds (VOCs) in air.
Porous	A surface that has ‘pores,’ not necessarily visible to the naked eye, that are susceptible to the accumulation of contamination and/or liquids.

PPE	Personal protective equipment such as chemical protective suits (Tyvek®, Saranex®), gloves, boots, and respirators.
Precursor	A chemical used to create methamphetamine.
Remediate	To achieve clean-up or to reduce the concentration of contaminants to such a level that there is no significant risk to relevant receptors such as humans.
Residual contamination	Contamination at a site resulting from chemicals being spilt and/or deposited through the air upon walls, floors, ceiling, ventilation, appliances, and other surfaces. The concentration of residual contamination can be high where chemicals were spilled, or low if the chemicals were deposited via air movement.
Risk	A function of the probability of the adverse effect and the magnitude of that effect, that is, the amount of harm, consequential to a specific hazard. A risk may be voluntary that is it is generally known so can be avoided such as deep sea diving or controlled or involuntary.
RMA	Resource Management Act 1991.
Territorial authority	A city council or a district council named in Part 2 of Schedule 2 of the Local Government Act 2002.
USEPA	United States Environmental Protection Agency.
Volatilised	Process by which liquid or solid chemicals are made airborne.
VOCs	Volatile organic compounds. These compounds include solvents used in the manufacture of methamphetamine.
WHO	World Health Organization.
Wipe sample	A sample taken by using a wetted gauze wipe to sample walls, countertops, appliances, and other suitable surfaces.

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Appendix A: Detected Clan Meth Labs in New Zealand and Overseas

A.1 Detected clandestine methamphetamine laboratories in New Zealand

According to data collected by the New Zealand National Drug Intelligence Bureau the number of clandestine laboratories detected in New Zealand continues to rise. Although 'official' clan lab recording started in 1996, Table A1 shows that the number of clan meth labs dismantled in New Zealand has increased from fewer than 9 in 2000, to 135 clan meth labs in 2009. This represented an approximate 30 percent decrease over 2007 where 190 labs were dismantled which was a decrease of 10 percent on the 2006 'record' figure of 211 (National Drug Intelligence Bureau 2010).

Among the 135 clan meth labs detected in 2009, some of these laboratories were located at residential addresses that had children living at the address. In 2008 a total of 29 children were referred to Child Youth and Family (a service of the Ministry of Social Development) primarily in the Auckland region. In 21 of these cases children were actually present at the time of locating the clan meth lab. Ages of the children ranged from less than a year old through to 17 year olds (National Drug Intelligence Bureau 2009). In 2009 the total number of children found living at the address of a clan meth lab was 59 compared with the total number of 86 for 2008 (National Drug Intelligence Bureau 2010).

The Waitematā Police district recorded the highest number of clan meth labs of any Police district from 2000 to 2007. Significant increases in the number of clan meth labs dismantled, between 2004 and 2006, were noted in the Northland, Auckland, Waikato, Central, Tasman and Canterbury districts. Over this same period there was a dip in numbers in the Eastern and Wellington Police districts however Table A1 shows a possible shift south from the Auckland region in 2006 followed by a move further south in 2007 and then more to the centre of the country in 2008 (National Drug Intelligence Bureau 2010).

Table A1: Clan meth labs dismantled by New Zealand Police district, 2000–2009

District	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Northland	0	10	18	20	16	20	15	9	9	11
Waitematā	6	14	44	36	49	54	46	33	20	24
Auckland Central	0	2	17	30	18	31	27	25	13	14
Counties Manukau	2	6	26	26	21	21	30	24	25	24
Waikato	0	2	16	32	16	23	35	25	8	22
Bay of Plenty	0	0	16	19	16	12	25	17	18	13
Eastern	0	0	7	3	12	5	5	5	1	4
Central	1	3	2	9	3	6	4	6	10	4
Wellington	0	1	13	16	19	12	5	9	10	7
Tasman	0	2	1	1	1	5	5	2	5	4
Canterbury	0	0	10	9	9	14	12	31	14	7
Southern	0	1	0	1	1	1	1	4	0	1
Total	**9**	**41**	**170**	**202**	**181**	**204**	**211**	**190**	**133**	**135**

Source: National Drug and Intelligence Bureau (2010)

It is important to note that laboratories are seized during many stages of production. Thus approximately one in three of the laboratories are either functioning or complete but not functioning, when detected. Approximately one in four are almost complete but are missing some essential equipment and/or chemicals. The balance of about 40 percent are incomplete collections of equipment and/or chemicals but are sufficient to support possession of equipment and/or materials and/or precursor charges.

The year 2005 was the first year for which the National Drug Intelligence Bureau has kept records of clan meth lab grades. As Table A2 demonstrates most clan meth labs dismantled are of lower grades. During 2005, grade 'D' clan meth labs were the largest group, representing 40.2 percent of all clan labs dismantled. Grade 'A' labs were the smallest group, at 7.4 percent. The high ratio of grade 'C' and 'D' labs provides an indication of the difficulties in determining the intended manufacturing process. For example, of the 133 clan labs detected in 2008, 83 (62 percent) were clearly methamphetamine related involving PSE extraction (6), methamphetamine reactions (48) or combined pseudoephedrine extraction and methamphetamine reactions (29). The remainder of 50 labs (38 percent) were of an unknown type or type of lab was not stated (National Drug Intelligence Bureau 2009).

Table A2: Clan meth lab grade levels for 2005–2009

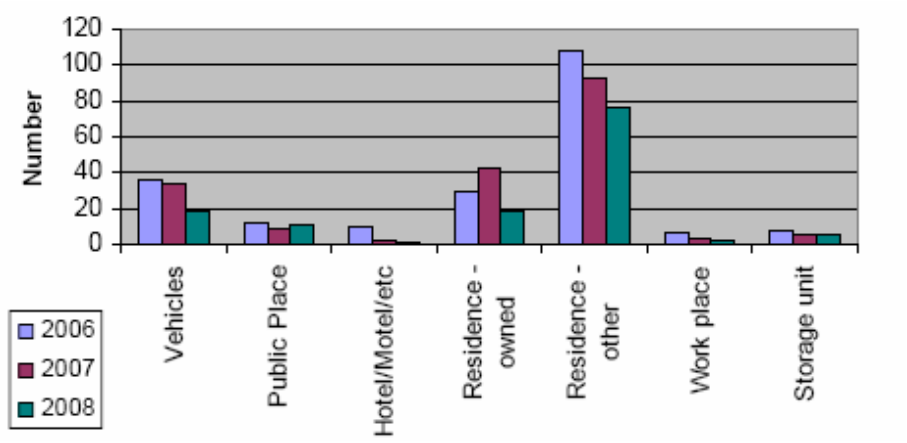
Clan lab grade	Number of clan labs per grade				
	2005	2006	2007	2008	2009
A	15	11	9	6	3
B	46	54	29	15	11
C	56	47	37	38	50
D	82	98	114	72	71
Not stated	5	1	1	2	0
Total	**204**	**211**	**190**	**133**	**135**

Source: National Drug Intelligence Bureau (2010)

The relatively small percentage of grade 'A' clan meth labs dismantled may reflect policing methods rather than the actual number of such clan labs throughout New Zealand. Only 14 percent of all clan meth labs dismantled in 2005 were detected by the New Zealand Police actively targeting clan labs. It is likely that most of these labs were grade 'A' or 'B', because these are more likely to be reported/known to the New Zealand Police, precisely because they are active or at least complete (and possibly previously active). However, a complicating factor is the health and safety risk to New Zealand Police officers entering an active clan meth lab. Labs known to be active present the greatest risk to New Zealand Police officers, who may therefore elect to approach the lab when a 'cook' is not taking place. Such labs are likely to have been graded as 'B' labs because police officers would not have witnessed a 'cook' taking place (Newton 2007).

Clan meth labs have been located in a variety of situations most commonly in residential dwellings (Figure A1). Rented properties continue to yield the greatest number and percentage of clan meth labs detected (76 of 133 or 57 percent in 2008). Because of the nature of some labs in circumstances where chemicals have been located in a car but the equipment is in the house, the house has been considered the 'primary' scene in terms of where the illicit manufacture of methamphetamine is most likely to have occurred (National Drug Intelligence Bureau 2009).

Figure A1: Clan meth lab scene types 2006–2008



Source: National Drug Intelligence Bureau (2009)

In 2009 some of the scene types were reclassified for example ‘residence owned and residence other’ have been amalgamated under one type as ‘urban dwelling’. The total number of clan meth labs located under this category in 2009 was 101. Two new categories were added in 2009: farm/rural (2) and ‘not stated’ (4)). Data for other categories for 2009 include vehicles (13), public place (7), hotel/motel (0), workplace (6) and storage unit (2) (National Drug Intelligence Bureau 2010).

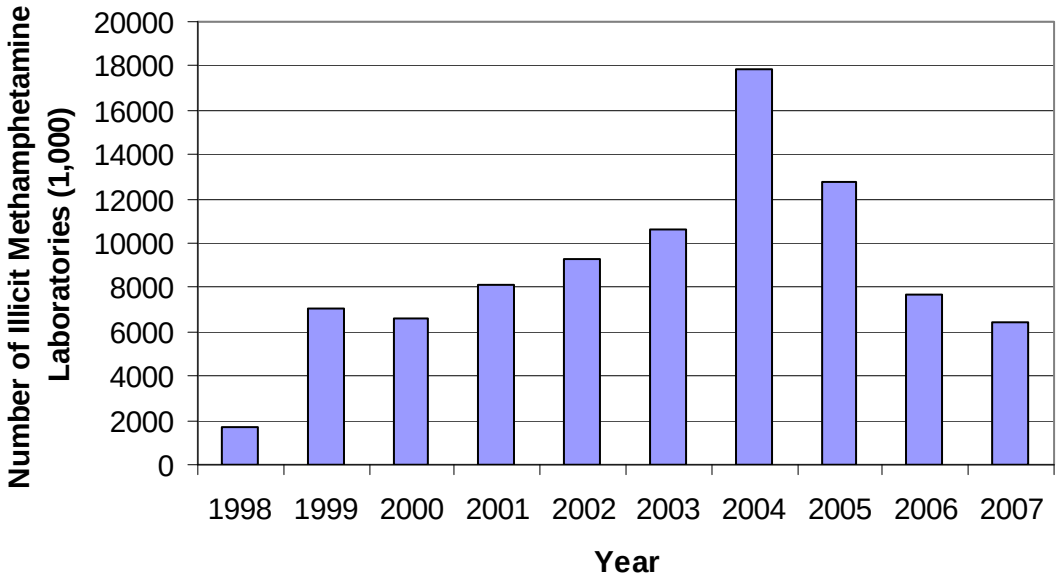
A.2 Detected clandestine methamphetamine laboratories overseas

Figure A2 shows that the number of illicit laboratories reported globally to the United Nations Office on Drugs and Crime producing methamphetamine has increased from 1658 in 1996 to 6439 in 2007 (peaking at 17,853 in 2004). The overwhelming majority of methamphetamine laboratories (82 percent) of the total reported in 2007 were dismantled in the United States and to a lesser extent, Mexico (United Nations Office on Drugs and Crime 2009).

However Figure A3 shows that in the United States the number of reported methamphetamine laboratory seizures has decreased sharply each year since 2004 – the year when states began implementing strong, retail-level sales restrictions of ephedrine and pseudoephedrine products. Moreover, in September 2006 the federal Combat Methamphetamine Epidemic Act 2005 became effective nationwide, setting restrictions on the retail sale of pseudoephedrine and ephedrine products; this Act appears to be contributing to continued decreases in domestic methamphetamine production, according to seizure data through to 2007 (United Nations Office on Drugs and Crime 2009).

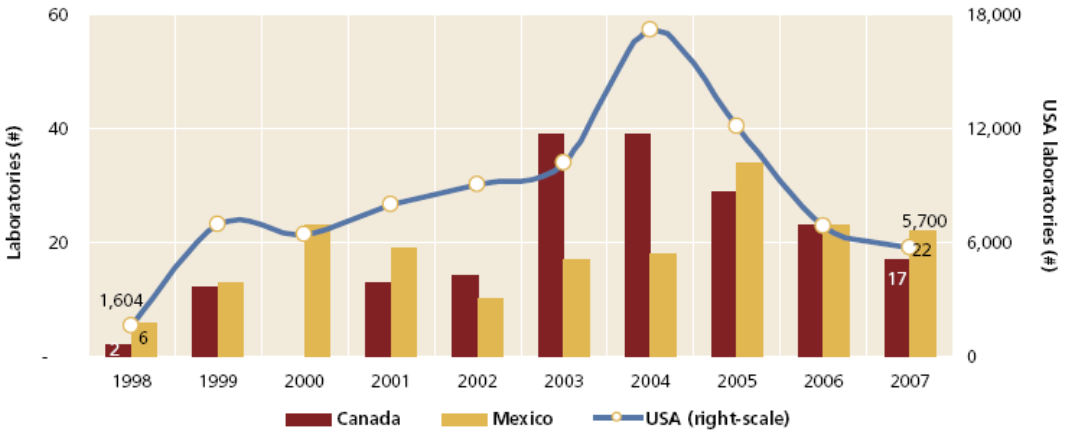
Methamphetamine laboratories were also dismantled in Oceania, in East and Southeast Asia, Europe, the Middle East and South Africa (which appears to be emerging as an important local production centre) (United Nations Office on Drugs and Crime 2009). However, given that this information is what has been reported to the United Nations Office on Drugs, it should be treated with caution. What this information provides is an insight into at least the minimum number of laboratories that are being seized by reporting nations.

Figure A2: Global number of dismantled illicit methamphetamine laboratories 1998–2007



Source: United Nations Office on Drugs and Crime (2009)

Figure A3: Number of reported North American methamphetamine laboratory seizures 1998–2007



Source: United Nations Office on Drugs and Crime (2009)

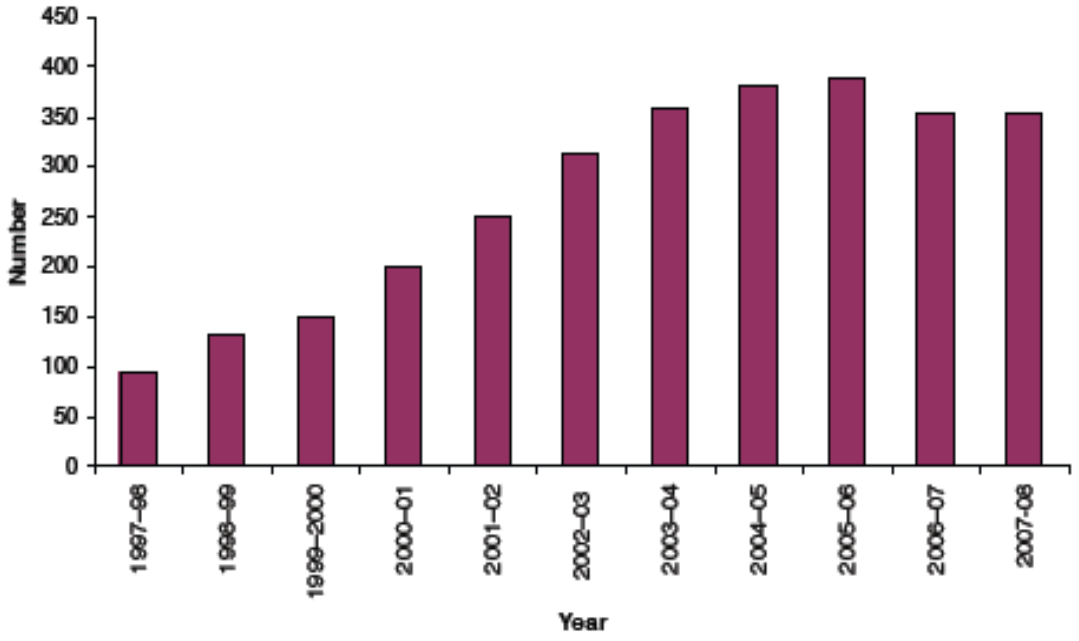
Based on data collected by the Australian Crime Commission Figure A4 shows that 358 clan meth labs were detected in Australia in the 2007/08 fiscal year. This total compares with only 95 detected over the same period in 1997/1998. Of the laboratories detected in 2007/08, over 80 percent were in residential areas. A further 8.3 percent were detected in commercial/industrial areas, 5.3 percent in vehicles and 4.3 percent in rural areas (Australian Crime Commission 2009).

Synthesis of methamphetamine using hypophosphorous acid and iodine is the most common method used in Australia, accounting for 53 percent of detections in 2007/08 (Australian Crime Commission 2009). McKetin et al (2005) notes that:

> 'The so-called Nazi method[34] of manufacture is uncommon in Australia with the exception of Western Australia where it accounts for 62% of detections. Procedures have recently emerged for carrying out variants of the Nazi method that are extremely simple and potentially very accessible to people without any formal training in chemistry.'

Like New Zealand, Australia has a classification system that is used by forensic chemists and investigators when determining the category of a clan meth lab. During 2007/08, category 'C' (stored/unused) clan meth labs accounted for the greatest proportion of detections (Figure A5). Because of the short time-frame required to manufacture methamphetamine the low number of category 'A' (active) laboratories (13 percent) detected was not surprising (Australian Crime Commission 2009).

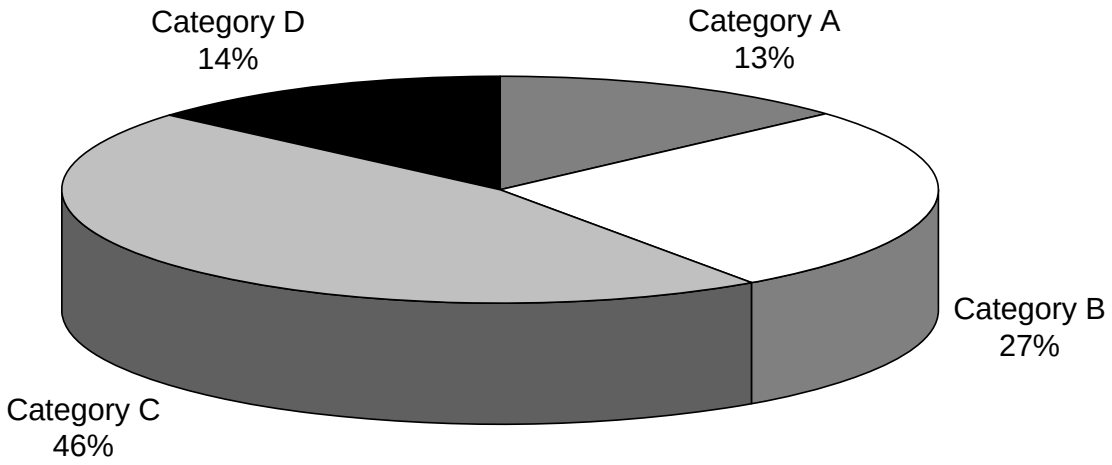
Figure A4: Number of Australian clandestine laboratory dismantled, 1997/98–2007/08



Source: Australian Crime Commission (2009)

[34] A name attributed to its use by German soldiers in the 1940s, or to an early method circulated on stationery bearing a neo-Nazi logo (Caldicott et al 2005).

Figure A5: Number of Australian clandestine methamphetamine laboratories dismantled by classification, 2007/08



Source: Australian Crime Commission (2009)

A.3 Supply control

In recent years the New Zealand Police has been involved in a number of initiatives with pharmacies at a district level pertaining to the sale of products used as precursor substances in the manufacture of methamphetamine such as cold and flu medicines containing pseudoephedrine. Some arrangements have been made whereby pharmacy staff will contact the Police about suspicious customers or refuse to sell multiple packets of pseudoephedrine-bearing products. Many pharmacists now refuse to sell multiple packets of these medicines and others have chosen not to stock pseudoephedrine at all. Some arrangements with the New Zealand Police and cooperation between pharmacies have been particularly successful.

In October 2009 the Government announced proposals to reclassify pseudoephedrine and ephedrine as Class B2 controlled drugs under the Misuse of Drugs Act 1975. This change will mean that products containing these substances will cease to be available over the counter from pharmacies and will only be available with a prescription from a medical practitioner. The purpose of the reclassifications is to restrict the availability of pseudoephedrine and ephedrine and make it difficult for potential manufacturers of methamphetamine to access the key ingredients used to make the drug. On 22 April 2010 a Misuse of Drugs Amendment Bill to give effect to the proposals was introduced to Parliament.

Appendix B: States within the United States with Regulations or Numeric Decontamination Standards for Clandestine Drug Laboratory Clean-up

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Alaska	Yes Alaska Department of Environmental Conservation	Yes	Yes	Meth: 0.1 µg/100cm^2 Lead: ≤ 2 µg/100cm^2 Mercury: ≤ 50 ng/m^3 in air VOC: 1 ppm total hydrocarbons and VOCs in air	Not specified
Arizona	Yes Arizona Bureau of Technical Registry	Yes	Yes	Title 4, Chapter 30, R4-30-305 Red phosphorus – removal of stained material or cleaned pursuant to standards Iodine crystals – removal of stained material or cleaned pursuant to standards Meth: 0.1 µg/100 cm^2 Ephedrine: 0.1 µg/100 cm^2 Pseudoephedrine: 0.1 µg/100 cm^2 VOCs in air < 1 ppm Corrosives – surface pH 6–8 Lead: 4.3 µg/100 cm^2 Mercury: 3.0 µg/m^3 (air)	Yes Title 4, Chapter 30, R4-30-305 Red phosphorus – removal of stained material or cleaned pursuant to standards Iodine crystals – removal of stained material or cleaned pursuant to standards Meth: 0.1 µg/100 cm^2 Ephedrine: 0.1 µg/100 cm^2 Pseudoephedrine – 0.1 µg/100 cm^2 VOCs in air < 1ppm Corrosives – surface pH 6–8 Lead: 4.3 µg/100 cm^2 Mercury: 3.0 µg/m^3 (air)

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Arkansas	Yes Arkansas Legislative Session of 2003 enacted Act 1270, entitled 'An Act Requiring the Arkansas Department of Health to Establish Guidelines for the Clean-up of Clandestine Methamphetamine Labs by April 1, 2004' Arkansas Department of Health	Yes	No	Not specified	Meth: 0.1 µg/100 cm^2 recommended
California	Yes Health and Safety Code, section 25400.16 California Department of Toxic Substances	Yes	No	Meth: ≤ 1.5 µg/100 cm^2 Lead: ≤ 20 µg/100 cm^2 Mercury: ≤ 50 ng/m^3 in air	Not specified although testing is based upon risk assessment
Colorado	Yes Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division	Yes	No – use of a certified industrial hygienist recommended	Meth: 0.5 µg/ 100 cm^2	Testing for meth at 0.5 µg/100 cm^2 recommended. Test for mercury and lead if P2P method used. Recommend indoor testing for VOCs in cases of moderate to heavy contamination. Soil, and surface and ground water testing may be recommended
Connecticut	No	Yes	Recommend certified industrial hygienist for sampling	Meth: 0.1 µg/100 cm^2 Lead: 2 µg/100 cm^2 Mercury: < 1 ug/m^3 VOC: <1 ppm total VOCs in air	Testing for methamphetamine recommended
Hawaii	Yes Hawaii State Department of Health	Yes	No – use of a certified industrial hygienist recommended	Meth: 0.1 µg/100 cm^2 Lead: 2 µg/100 cm^2 Mercury: 50 ng/m^3 in air VOC: 1 ppm total hydrocarbons and VOCs in air	Not specified

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Idaho	Yes The Clandestine Drug Laboratory Clean-up Act (Senate Bill 1122) (2005). The law requires the Idaho Department of Health and Welfare to develop clean-up rules for clandestine drug laboratories.	Yes	Clearance sampling must be done by an industrial hygienist	Meth: 0.1 µg/100 cm^2	Not specified
Indiana	Clean-up rule introduced in 2007 as follows: Title 318 Department of Environmental Management Article 1. Inspection and Clean-up of Property Contaminated with Chemicals Used in the Illegal Manufacture of a Controlled Substance Department of Environmental Management	Yes	Yes	Not specified	Meth: 0.5 µg/100 cm^2
Kansas	No	Yes	Recommends using environmental companies trained in hazardous substance clean-up and removal	Meth: 1.5 µg/100 cm^2	Air testing mandatory if property posted prohibiting occupancy
Kentucky	Yes House Bill 94 (2007) Kentucky Department for Public Health, Division of Public Health Protection & Safety	Yes	Yes	Meth: 0.1 µg/100 cm^2	Not specified

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Michigan	No	Yes	Yes	Not specified	Meth: 0.5 µg/100 cm^2 Lead: 40 µg/ft^2 Mercury: 1 µg/m^3
Minnesota	Roles and responsibilities for property owners, remediation contractors, law enforcement, public health and other agencies are described in Minnesota statute effective, 1 January 2006. Refer to House File 1, Article 7, Meth Provisions: Minnesota Department of Health and Minnesota Pollution Control Agency	Yes Provided by Minnesota Department of Health	No	Meth a) 1 µg/ft^2 or greater: Full remediation of occupancy structures must be completed according to Guidance Meth b) 1 to <10 µg/ft^2: Modified cleaning or disposal of some household contents or some non-occupancy structures may be allowed and will be determined by the local authority Meth c) >10 µg/ft^2: Full remediation of all structures and contents required Clean to: pH 6–8 Clean to: < 1 ppm total VOCs in air (common error for photoionisation detectors (PIDS) can be as much as ± 5 ppm) Mercury: Clean to < 0.3 µg/m^3 (0.036 ppb) in air [IRIS reference concentration for chronic inhalation exposure RfC] Lead: Clean to < 40 µg/ft^2 wipe sample	Testing for methamphetamine recommended

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Montana	Yes The Montana Meth Clean-up Program administers Montana Code Annotated Title 75, chapter 10, part 13, Methamphetamine Contamination-Indoor Property Decontamination Standards (2005)	Yes	Yes	Meth: $\leq$ 0.1 µg/100 cm^2	Not specified
New Mexico	No	Yes	Yes	Meth: 1 µg/ft^2	Not specified
North Carolina	Yes General Statute 130A-284 (Administrative Rules – Methamphetamine Decontamination (10A NCAC 41D.0101-.0105) Department of Health and Human Services	Yes	Yes	Not specified	Meth: 0.1 µg/100 cm^2 Lead: 4.3 µg/100 cm^2 Mercury: 0.3 µg/m^3
Oregon	Yes Illegal Drug Decontamination Rules Oregon Department of Human Services Public Health	Yes	Yes	Meth: 0.5 µg/ft^2 Lead: 10 µg/ft^2 Mercury: 0.05 µg/ft^2 Corrosives: pH 2–12.5 (aqueous waste) ref: upper and lower limits as defined by 40 CFR 261.22	Meth: 0.5 µg/ft^2 Lead: 10 µg/ft^2 Mercury: 0.05 µg/ft^2 Corrosives: pH 2–12.5 (aqueous waste) ref: upper and lower limits as defined by 40 CFR 261.22
South Dakota	No But 2004 South Dakota legislature provides for authorities to require disclosure of knowledge of existence of prior manufacturing of methamphetamines in residential premises	Yes	No	Meth: 0.1 µg/100 cm^2	Not specified

State	State regulations (Yes/No) Lead regulatory agency	Clean-up guidelines	Training required	Clean-up standards for reoccupation	Post-clean-up testing requirements
Tennessee	Yes Executive Order 18 Tennessee Department of Environment and Conservation	Yes	No	Meth: 0.1 µg/100 cm^2 Lead: ≤ 40 µg/ft^2 Mercury: ≤ 50 ng/m^3 in air and VOC: 1 ppm total hydrocarbons and VOCs in air Note: if it is determined that the amalgam (P2P) process was not used then these standards do not apply	Not specified
Utah	Yes Illegal Drug Operations Site Reporting and Decontamination Act 2004. The Act was amended in 2008 to change the definition of contamination to include use, production or the presence of methamphetamine in excess of decontamination standards. Utah Department of Health	Yes	Yes	Meth: < 0.1 µg/100 cm^2 Lead: ≤ 20 µg/ft^2 Mercury (air): <50 ng/m^3	Not specified
Washington	Yes Illegal Clandestine Drug Lab Clean-up Regulation (Chapter 246-205 WAC) Washington State Department of Health	Yes	Yes	WAC 246-205-541 Meth: 0.1 µg/100 cm^2 Lead: ≤ 20 µg/ft^2 Mercury: ≤ 50 ng/m^3 in air VOC: 1 ppm total hydrocarbons and VOCs in air	WAC 246-205-541 Meth: < 0.1 µg/100 cm^2 Lead: ≤ 20 µg/ft^2 Mercury: ≤ 60 ng/m^3 in air and VOC: 1 ppm total hydrocarbons and VOCs in air

Source: Adapted from Alaska Department of Environmental Conservation (2004)

Appendix C: Existing Standards and Guidelines and Their Relevance to the Remediation of Clan Meth Lab Sites

Table C1: Overview of existing standards and guidelines

Name	Purpose	Basis	Comments
Proposed National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil (Ministry for the Environment 2010)	The objective of the NES is to ensure that land affected by contaminants in soil is appropriately identified and assessed at the time of being developed and if necessary remediated, or the contaminants contained, to make the land safe for human use	A discussion document was released for consultation on 6 February 2010	Chemicals for which soil guideline values that are health-based have been derived include: arsenic, cadmium, chromium, copper, benzo(a)pyrene, DDT, dieldrin, boron, Pentachlorophenol (PCP), dioxins and dioxin-like PCBs, lead, mercury (inorganic)
Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Site in New Zealand (Ministry for the Environment 1999)	The guidelines focus on sites that have stored, handled, or distributed petroleum products. They aim to provide details of methods for investigating potentially contaminated sites, and for identifying whether or not remediation or controls of the site are necessary in order to protect human health and the environment	Evaluation of toxicity studies and application of the acceptance criteria	Includes health-based targets for indoor concentrations of chemicals of interest such as benzene, toluene and xylene
Health and Environmental Guidelines for Selected Timber Treatment Chemicals (Ministry for the Environment and Ministry of Health 1997)	These guidelines deal with a wide range of issues related to the assessment and management of contaminated sites. They use a risk assessment methodology to determine acceptable levels of chemical residues	Evaluation of toxicity studies and application of the acceptance criteria	Includes chemicals of interest that may be ground in soil such as benzene and mercury
ATSDR Minimal Risk Levels for Hazardous Substances (USA)[35] **USMRL**	Screening tool to identify contaminated sites (mainly from the chemical and petroleum industry) that require a more thorough examination	Evaluation of toxicity studies and application of safety factors. May be set for acute, intermediate or chronic exposure.	Does not include many chemicals of interest

[35] http://www.atsdr.cdc.gov/toxpro2.html

Name	Purpose	Basis	Comments
US EPA Preliminary Remediation Goals (USA)[36] **PRG**	Guideline for the clean-up of contaminated sites	EPA toxicity data and exposure assumptions. Considered to be protective over a lifetime exposure	Addresses direct exposure pathways, including soil, ambient air, and tap water
Emergency Response Planning Committee guidelines (USA)[37] **EPRG**	Guidelines for responding to potential releases of airborne substances for use in community emergency planning	Based on one-hour exposure	The TWA may be useful but are intended for workplace exposures (could be adapted for public exposure)
The Australian and New Zealand Food Standards Code (2002)[38] **ANZFSC**	Standard 1.4.1 sets the maximum levels of ingestion allowed for contaminants and toxicants in food	Based on lifetime ingestion	May be useful for those chemicals found in soil.
Drinking-water Standards for New Zealand 2005 (revised 2008) Ministry of Health 2008)[39]	Defines good quality drinking water from a health point of view and its aesthetic quality	Evaluation of toxicity data and application of safety factors	Several metals and organic compounds are included in the standards. May be applicable to water contamination
Australian and New Zealand Guidelines for fresh and marine water quality (ANZECC and ARMCANZ 2000)[40]	Sets water quality objectives for natural and semi-natural water resources	Considers biological and ecological effects (including toxicity) to set trigger values	May be applicable to water contamination
California Office of Environmental Health Hazard Assessment – AcRELs and ChRELs for airborne toxicants (USA)[41] **OEHHA**	Health risk assessments of toxic air contaminants	Evaluation of toxicity studies and application of safety factors	The TWA may be useful but are intended for workplace exposures (could be adapted for public exposure). The methodology used to set the levels is useful.

[36] http://www.epa.gov/region09/waste/sfund/prg/xls/master_sl_table_run_12SEP2008.xls

[37] http://response.restoration.noaa.gov/topic_subtopic_entry.php?RECORD_KEY%28entry_subtopic_topic%29=entry_id,subtopic_id,topic_id&entry_id(entry_subtopic_topic)=663&subtopic_id(entry_subtopic_topic)=24&topic_id(entry_subtopic_topic)=1

[38] http://www.foodstandards.gov.au/thecode/foodstandardscode.cfm

[39] http://www.moh.govt.nz/moh.nsf/pagesmh/8534

[40] http://www.mfe.govt.nz/publications/water/anzecc-water-quality-guide-02/anzecc-water-quality-guide-02-pdfs.html

[41] http://www.oehha.org/

Name	Purpose	Basis	Comments
National Institute for Occupational Safety and Health – Pocket Guide to Chemical Hazards (USA)[42] **NIOSH**	Provides exposure limits including IDLHs, RELs, STELs, CRELs. Also provides indications of carcinogenicity, required PPE, and sanitation practices	Evaluation of toxicity studies and application of safety factors	The TWA may be useful but are intended for workplace exposures (could be adapted for public exposure)
New Zealand Department of Labour's Workplace Exposure Standards (OSH 2002)	Establish airborne concentrations which should not cause adverse health effects or undue discomfort to workers	TWA: 8-hr day, 5-day week STEL: 15 min	The TWA may be useful but are intended for workplace exposures (could be adapted for public exposure)

Notes:

* TWA = Time-Weighted Average; STEL = Short-Term Exposure Limits; AcREL = Acute Reference Exposure Levels; ChREL = Chronic Reference Exposure Levels; IDLH = Immediately Dangerous to Life or Health levels; REL = Reference Exposure Limit; CREL = Ceiling Reference Exposure Limit; PPE = personal protective equipment.

Source: Adapted from Office of Chemical Safety (2008)

C.1 Current New Zealand Occupational Health Criteria for Sampled Substances

In New Zealand the Workplace Exposure Standards (OSH 2002), assigns standards for concentrations for approximately 700 substances. The Workplace Exposure Standards (WES) are intended to be used as guidelines for those involved in occupational health practice. Table C2 shows the standards for occupational exposures of substances – namely iodine, phosphine and hydrogen chloride, commonly associated with the red phosphorus method (ie, the method of methamphetamine manufacture most commonly encountered in New Zealand) – that have been effective since 2002.

[42] http://www.cdc.gov/NIOSH/

Table C2: Occupational workplace exposure standards

Compound	New Zealand (OSH, 2002)	OSHA PEL	ACGIH TLV	NIOSH
Benzene	16 mg/m^3 (TWA) (NZ WES)	3 mg/m^3; 15 mg/m^3 (STEL)	3.2 mg/m^3 (TWA)	0.32 mg/m^3; 3.2 mg/m^3 (STEL)
Hydrogen chloride	Ceiling 7.5 mg/m^3 (5 ppm)	Ceiling 7.0 mg/m^3	STEL ceiling 3.0 mg/m^3	Ceiling 7.0 mg/m^3
Iodine	Ceiling 1.0 mg/m^3	Ceiling 1.0 mg/m^3	Ceiling 1.0 mg/m^3	Ceiling 1.0 mg/m^3
Lead (inorganic dusts and fumes)	0.1 mg/m^3	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3
Mercury (inorganic)	0.025 mg/m^3 (TWA) (NZ WES)	0.1 mg/m^3	0.1 mg/m^3 (TWA) (skin)	Ceiling 0.1 mg/m^3 (skin)
Phosphine	0.42 mg/m^3 (TWA); 1.4 mg/m^3 (STEL)	0.4 mg/m^3	0.4 mg/m^3	0.4 mg/m^3
Toluene	188 mg/m^3	750 mg/m^3	240 mg/m^3	560 mg/m^3 (STEL)
Xylene (o-, m-, P-isomers)	217 mg/m^3	435 mg/m^3 (TWA)	435 mg/m^3 (TWA)	435 mg/m^3 (TWA)

Notes:

OSHA PEL – 8-hour time weighted average (TWA) exposure standards established by the Occupational Safety and Health Administration (OSHA)[43] are called Permissible Exposure Limits (PELs).

ACGIH TLV[44] – 8-hour time weighted exposure standards established by the American Conference of Governmental Industrial Hygienists (ACGIH) are called Threshold Limit Values (TLVs). The 8-hour time weighted average (8-hour TWA) concentration is an exposure standard that must not be exceeded during any 8-hour work shift of a 40-hour work week.

NIOSH[45] – National Institute of Safety and Occupational Health Recommended Exposure Level. "Skin" notation (NIOSH): significant uptake may occur as a result of skin contact. Therefore, appropriate personal protective clothing should be worn to prevent dermal exposure.

STEL – Short Term Exposure Limit. This is a 15-minute time-weighted average concentration that should not be exceeded during any part of the workday.

Source: OSH, 2002; Occupational Safety and Health Administration; American Conference of Governmental Industrial Hygienists; National Institute of Safety and Occupational Health

It is important to note however that workplace exposure limits are inappropriate for use in establishing limits for residential exposure given the difference in exposure routes and durations and the fact that workplace exposure has been established for healthy adult populations. The assumption that reducing the levels of methamphetamine on surfaces also reduces the concentrations of other methamphetamine-manufacturing related chemicals to acceptable levels has not been demonstrated empirically. Further research is required in this area.

[43] http://www.osha.gov/

[44] http://www.acgih.org/home.htm

[45] http://www.cdc.gov/NIOSH/

Appendix D: Gisborne District Council Clan Meth Lab Inspection Form

Section 1

Officer:.....

Date: .....

Time:.....

Address:.....

Legal description:.....

Senior police officer at site:.....

HSNO declaration?.....

How long police on site: .....

Section 2

Officer:.....

Name of people who live at this address (owners and/or occupiers): .....

.....

Number of people involved: .....

Contact details (phone):.....

Building type and use:.....

Scene grade and locations: .....

.....

What is the purpose of these areas (bedroom / living room / kitchen / outside garage / sleepout)?.....

.....

Use, storage, type and quantity of chemicals on site:.....

.....

.....

Any sign of waste chemicals being disposed of around the property:

- Holes
- Dead grass / plants

.....

.....

Comments: .....

.....

Section 3

Officer: .....

Risk assessment for environmental health inspection

Seek advice from police supervisor on site re risks. (If BA required, do not enter.)

Protective clothing available: Yes / No

How long before risk reduces (ask Police).

When will ESR (police) scientists leave site.

Officer decision – enter site: Yes / No

Site inspection / assessment

Notes and photos of each area affected and under assessment.

Note level of obvious contamination.

General contents of rooms.

Comment from ESR re level of activity per area assessed.....

.....

.....

.....

Section 4

Officer: .....

Risk assessment for response

Grade	Use of contaminated area	(Please circle)
A	Residential – occupied	Yes / No
B	Commercial – occupied Motel, business	Yes / No
C	Public access likely	Yes / No
D	Temporary location Caravan, vehicle, etc	Yes / No

Contaminated area

What is it?.....

Who is immediately affected?

How many? Adults:.....

Children: .....

Public:.....

Is contamination present?

Yes Heavy / light

No

Could be

Comments: .....

.....

Section 5

Officer:.....

Response

1. Issue HSNO emergency declaration → is the situation causing imminent danger? (Check list of reasons to DECLARE.)
   a. To human health, include occupants, emergency personnel and public.
   b. Significant danger to the environment or chattels requiring immediate action to remove.
   c. Any other situation causing imminent danger.

2. Building Act – Insanitary Building Notice
   a. Consider using if structure is illegal or dangerous.
   b. Use if intending demolition of all or part of building or structure used for P manufacture. Refer document 153784.

3. No action

   Level of contamination is negligible and risk to health is minimal.

   Response decision → complete decision form – refer document 153654.

4. Health Act Cleansing Order → issue to owner/occupier. Has matter been dealt with under 1, 2 or 3 above? Refer documents 153650 and 153652.

Action

Emergency declared → who by: .....
Date: .....

Site security: Yes / No Security firm:.....

Emergency expires / renewed: .....

Verification testing undertaken → who by:.....
Date: .....

Cleansing order issued → who by: .....

Cleaning undertaken → who by:.....

Waste contractor: Yes / No Waste firm: .....

Verification testing post-clean-up → who by: .....
Date:.....

Action taken / dates / times: .....
.....
.....

Section 6

Officer: .....

Records

Update decision form and submit to Chief Environmental Health Officer

Statement on LIM: .....Refer document 153664

Completed property file:	☐	Updated summary P lab file	☐
Confirmation to owner/occupier	☐	cc to Police	☐

Date confirmed: .....

Confirmation to owner/occupier

Complete documentation to advise Chief Executive and ERMA.
Date:.....

All procedures followed and job completed.
Date:.....

Dated:.....

Signed: .....

Source: S Kumar, Chief Environmental Health Officer, Gisborne District Council, personal communication, 2008

Appendix E: Hamilton City Council Letter to Owner and Cleansing Order Templates

[Date]

[Postal address]

Dear Sir/Madam

Council records show that you are the owner of the property at [street address], Hamilton.

Council's Environmental Health Unit has been notified that the above property was [used, or may have been used in the past, for] / [associated with] the illegal manufacture of drugs. [The Police have intervened and removed from the property equipment and substances associated with the operation.]

The [manufacture of drugs] / [storage of equipment and chemicals associated with drug manufacturing] on a property usually results in some degree of contamination of the chattels and structure of building(s) and land. The degree of contamination depends on the scale and intensity of the operation and the length of time it has been occurring. This means that contamination may be at a level that presents a danger to health and habitable buildings on the property may not be fit for human occupation.

Council staff have considered the information and evidence currently available and are of the opinion that the property requires testing to determine the type and extent of any contamination. The results of the testing will be used to determine whether any cleansing of buildings on the property is required. A precautionary approach was used when making this assessment because of the extremely toxic nature of the chemicals involved in drug manufacturing.

Subsequently a Cleansing Order under section 41 of the Health Act 1956 has been prepared requiring you to carry out specified works in order to prevent danger to health and/or to render the premise fit for occupation. Please find the Cleansing Order attached to this letter.

The specified works start with testing in order to determine the type and extent of contamination of both the building and chattels. It may be that this initial testing shows that the property is not contaminated to the extent that cleansing is required, in which case the requirements of the cleansing order will be fulfilled and no further action would be necessary.

Please note the consequences written in the Cleansing Order if it is not complied with in the specified time.

Owner-occupied

[I understand that you currently occupy the property. If you continue to live on the property you may be placing yourself at further risk by continuing to be exposed to contaminants. You should now vacate the property and make arrangements to secure the property against illegal entry.]

Tenanted property

[I understand the property is currently tenanted. We will be advising the tenant of the situation and recommending that they vacate the property to prevent further exposure to contaminants. In the event the property is vacated you should make arrangements to ensure the property remains vacant and to secure the property against illegal entry.]

Tenant vacated property

[I understand the tenant has vacated the property. You should make arrangements as soon as practicable to secure the property against illegal entry, particularly if any possessions of the tenant remain on the property. These possessions may also be contaminated. It is recommended you apply to the Tenancy Tribunal under the Residential Tenancies Act for repossession of the property (section 64) and to secure and properly dispose of abandoned goods (section 62). The latter would serve to prevent the spread of contaminated goods into the community.]

It is up to you as the property owner to prove suitability for continued occupation of the property by providing evidence of effective decontamination along with supporting analytical evidence. The Cleansing Order will remain current until such time as this information is provided. In the meantime any LIM report issued in relation to this property will advise that the property was used for, or in association with, the manufacture of drugs, and is currently the subject of a Cleansing Order issued under section 41 of the Health Act.

Please contact me at this office as soon as practicable to discuss the application of the cleansing order.

Yours sincerely

Environmental Health Officer

Copy to:

Source: P McGregor, Environmental Health Manager, Hamilton City Council, personal communication, 2010

CLEANSING ORDER

Issued under Section 41 of the Health Act 1956

To: [Property owner name and street address]

1. The location to which this cleansing order applies is:

[Street address of subject property]
Hamilton

Legal description: [legal description]

2. Hamilton City Council order that you must take the following action:

(a) Secure all buildings on-site to prevent access by unauthorised persons.

(b) Engage the services of an appropriately qualified and experienced testing laboratory to determine the type and extent of contamination of both the buildings and chattels. This shall occur before any cleansing of the premises takes place.

(c) If contamination is found at a level that presents a danger to human health then engage the services of an appropriately qualified and experienced cleansing company to cleanse the building, chattels and articles of contamination in accordance with instructions prepared from the results of the testing.

(d) Remove from the premises and discard in an appropriate manner all articles that are identified by the testing for disposal.

(e) At the completion of cleansing the premises, engage the services of an appropriately qualified and experienced testing laboratory to determine whether any contamination remains of both the building and chattels at a level that is a danger to human health or that the premises is fit for human occupation.

3. The reasons for this order are:

I have considered the information and evidence currently available and am of the opinion that the property requires testing to determine the type and extent of any contamination. The results of the testing will be used to determine whether any decontamination and/or cleansing of buildings on the property is required. A precautionary approach was used when making this assessment because of the extremely toxic nature of the chemicals involved in drug manufacturing.

4. You must comply with this cleansing order by:

[Date] OR [before the premises is used again for human occupation]

5. If you do not comply with this order in any respect with any of the provisions of this order within the time specified, then Council may under section 41(2) of the Health Act 1956 cause the premise to be cleansed in the manner specified in this order at the cost in all things of the owner.

7. Every person who contravenes or fails to comply in any respect with any of the provisions of this order commits an offence and is liable to a fine not exceeding five hundred dollars ($500) and to a further fine not exceeding fifty dollars ($50) for every day on which the offence continues.

9. Hamilton City Council authorised the Environmental Health Officer who issued this order. Its address is:

Hamilton City Council
Municipal Offices
Garden Place
Hamilton

10. The Environmental Health Officer is acting under the following authorisation:

Section 41 of the Health Act 1956 and a warrant of authority pursuant to section 28 of the Health Act 1956 issued by Hamilton City Council.

11. The name of the Environmental Health Officer serving this order is:

[Name of EHO]

.....
[Signature of Environmental Health Officer]

.....
[Date]

Appendix F: Local Information Services

Electronic databases such as TOXINZ, ATSDR toxicological profiles, Medline, TOXNET, TOXLINE, CANCERLINE, TOMES, Commonwealth Agricultural Bureaux Abstracts (CAB Abstracts), CHEMICAL ABSTRACTS SEARCH (CAS-ONLINE), AGRICOLA, BIOSIS (Biological Abstracts), Chemwatch New Zealand and Science Citation Index (Sci Search) provide useful and detailed technical and toxicological information on chemical compounds. The following are some useful chemical and general toxicology library references.

- Gosselin RE, Smith RP, Hidge HC. 1984. Clinical Toxicology of Commercial Products. 5th Edition. Baltimore: Williams and Wilkins.
- *Environmental Health Criteria* series published by the World Health Organization, Geneva.
- USEPA *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual* (Parts A to F).[46]

National Poisons Centre

The National Poisons Centre (NPC) has a 24-hour service providing information on the health effects of chemicals, drugs, poisonous plants, poisonous insects and marine animals. The urgent telephone number is 0800 POISON (0800 764 766) (24 hours); during working hours the non-urgent number is 03 479 7227. The permanent information specialist staff have expertise in toxicology, medical toxicology, chemistry and pharmacy. The NPC maintains an extensive database, including comprehensive technical and toxicological information on chemical products. In addition, it maintains a comprehensive toxicology library and has access to a range of other databases and information sources, both nationally and internationally.

TOXINZ is an Internet database containing information regarding toxic compounds and the management of poisoned patients. The database contains some 88,000 listed chemical products, pharmaceuticals, plants and hazardous creatures.

The New Zealand Online Antidote Database is a service provided by the Ministry of Health, and maintained by the National Poisons Centre. The public health services have free access to TOXINZ as part of the Ministry's contract with the NPC.

CHEMCALL Emergency Response Service

CHEMCALL® is a 24-hour, 365-day emergency response service provided by the New Zealand Chemical Industry Council. It is funded by industry subscribers and is available at no charge to enforcement agencies, schools, local authorities and the emergency services.

The CHEMCALL® service is part of the international chemical industry's safety, health and environmental (SH&E) protection programme, Responsible Care™. It is also

[46] http://www.semarnat.gob.mx/gestionambiental/Materiales%20y%20Actividades%20Riesgosas/sitioscontaminados/EPA/US-EPA.pdf

accessible within Australia and internationally using dedicated phone numbers. CHEMCALL® is linked to the American CHEMTREC® Hazmat Emergency Centre. For more information refer to the website http://www.nzcic.org.nz/chemcall.htm.

Appendix G: Information to Raise Awareness about Clan Meth Labs

Clandestine drug laboratory indicators

From outside

- Chemical odours, coming from the building, rubbish or detached buildings. The odours can be sweet, bitter, ammonia or solvent smells.
- Exhaust fans running at odd times.
- Frequent visitors at odd hours.
- Windows blackened out or curtains always drawn.
- People coming outside only to smoke.
- Occupants unfriendly, appear secretive about their activities, exhibit paranoid or odd behaviour.
- Expensive security and surveillance gear.
- Access denied to landlords, neighbours and other visitors.
- Rubbish containing a large amount of cold medication containers or packaging. Also bottles, plastic containers and boxes with labels removed.

From inside

- Laboratory glassware, equipment and documents.
- Containers with clear liquids in them with a chalky coloured solid on the bottom or similar.
- Containers with two layered liquids in them; one dark coloured layer and one clear or pale yellow layer.
- Used coffee filters containing either a white pasty or reddish brown substance.
- Baking dishes or similar containing white crystalline substance.
- The presence of hot plates near chemicals.

Actions that should be taken upon discovery

- **Leave the area immediately your safety is paramount.**
- **Never** touch, taste or smell any chemicals or equipment.
- **Do not** attempt to stop the chemical reaction.
- **Do not** turn any electrical devices such as lights or fans on or off. The simple act of turning on an electrical switch may cause an explosion.
- **Do not** shut off the water supply to the house or the chemical reaction.
- **Do not** smoke in or near a clandestine laboratory.

- **Do not** use tools, radios, cellphones, torches or devices that produce sparks or friction.
- **Contact the New Zealand Police**.
- Do not re-enter the premises.

Exposure to chemicals found in clandestine laboratories can result in:

- headaches
- watery or burning eyes
- nausea
- burning skin
- coughing or choking
- pain in diaphragm
- feeling of coldness or weakness
- shortness of breath / dizziness
- decrease in cognitive function, vertigo, and convulsions.

Seek medical advice immediately if you experience any adverse effects linked to hazardous substance exposure

Source: S Kumar, Chief Environmental Health Officer, Gisborne District Council, personal communication, 2008

Appendix H: Chemicals Commonly Used in Methamphetamine Production

This table lists chemicals commonly used in various methamphetamine manufacturing processes. Those chemicals known to be used in New Zealand methamphetamine manufacturing processes are highlighted in grey.

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
2,5-Dimethoxybenzaldehyde	Not available	93-02-7	Not available
Acetic anhydride	Strong oxidising agents, strong reducing agents, bases, alcohols, metal powders, moisture	108-24-7	3.1C Flammable liquids: medium hazard 6.1D (oral) Acutely toxic 6.1D Acutely toxic (inhalation) 8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue
Acetone/ethyl alcohol	Strong oxidising agents, strong acids, perchlorates, aliphatic amines, chromyl chloride, hexachloromelamine, chromic anhydride, chloroform + alkali, potassium tert-butoxide	67-64-1	3.1B Flammable liquids: high hazard 6.1E (oral) Acutely toxic 6.3B Mildly irritating to the skin 6.4A Irritating to the eye
Ammonia		7664-41-7	2.1.1B Flammable gases: medium hazard 6.1C (inhalation) Acutely toxic 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1A (fish) Very ecotoxic in aquatic environment 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Anhydrous ammonia	Mercury (eg, pressure gauges), chlorine, calcium hypochlorite, iodine, bromine and hydrogen fluoride	7664-41-7	2.1.1B Flammable gases: medium hazard 6.1C (inhalation) Acutely toxic 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1A (fish) Very ecotoxic in aquatic environment 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action
Anthranilic acid	Strong oxidising agents	118-92-3	6.4A Irritating to the eye
Butylamine	Oxidising agents	13952-84-6	3.1B Flammable liquids: high hazard 6.1D (oral) Acutely toxic 6.4A Irritating to the eye 8.2B Corrosive to dermal tissue 9.1A (fish) Very ecotoxic in the aquatic environment
Cyclohexanone	Oxidising agents and nitric acid	108-94-1	3.1C Flammable liquids: medium hazard 6.1C (dermal) Acutely toxic 6.1D (oral) Acutely toxic 6.4A Irritating to the eye 9.2B Ecotoxic in the soil environment 9.3C Harmful to terrestrial vertebrates
Ephedrine	Strong acids, acid chlorides, acid anhydrides and strong oxidising agents	321-98-2; 299-42-3; 90-83-5	Not available
Ergometrine	NA	60-79-7; 129-51-1	Not available
Ethyl acetate	Strong acids, strong oxidisers and strong bases	141-78-6	3.1B Flammable liquids: high hazard 6.4A Irritating to the eye 6.9B (inhalation) Harmful to human target organs or systems

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Ethyl ether	Peroxides, combustible materials, halogens, oxidising materials, metal salts, acids, bases	60-29-7	3.1A Flammable liquids: very high hazard 6.1D (oral) Acutely toxic 6.3B Mildly irritating to the skin 6.4A Irritating to the eye 9.3C Harmful to terrestrial vertebrates
Ethylamine	Strong acids (eg, hydrochloric, sulphuric and nitric) and strong oxidisers (eg, chlorine, bromine and fluorine)	75-04-7	2.1.1A Flammable gases : high hazard 6.1C (dermal) Acutely toxic 6.1D (inhalation) Acutely toxic 6.1D (oral) Acutely toxic 6.9A (inhalation) Toxic to human target organs or systems 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3B Ecotoxic to terrestrial vertebrates
Formamide	Iodine, pyridine and sulphur trioxide	75-12-7	6.8A Known or presumed human reproductive or developmental toxicants

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Formic acid	Oxidising agents (eg, permanganates and nitrates), strong acids (eg, hydrochloric, sulphuric and nitric), strong bases (eg, sodium hydroxide) and finely powdered metals	64-18-6	3.1C Flammable liquids: medium hazard 6.1C (inhalation) Acutely toxic 6.1D (oral) Acutely toxic 8.1A Corrosive to metals 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (algal) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3C Harmful to terrestrial vertebrates
Hydriodic acid	Metals, oxidising materials, peroxides, halogens and combustible materials	10034-85-2	6.1B (inhalation) Acutely toxic 6.9A (inhalation) Toxic to human target organs or systems 8.1A Corrosive to metals 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.3C Harmful to terrestrial vertebrates
Hydrochloric acid	Strong bases, amines, oxidising agents, organic materials, metal carbides and sulphuric acid. Reacts with metals to form hydrogen gas, which is highly flammable and explosive	7647-01-0	6.1B (inhalation) Acutely toxic 8.1A Corrosive to metals 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3C Harmful to terrestrial vertebrates

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Hypophosphorous acid		6303-21-5	8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue
Iodine and iodine crystals	Acetylene, ammonia (laboratory gas or solution)	7553-56-2	6.1D (oral) Acutely toxic 6.1D (dermal) Acutely toxic 6.1D (inhalation) Acutely toxic 6.5B (contact) Contact sensitisers 6.9B (oral) Harmful to human target organs or systems 8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1A (fish) Very ecotoxic in the aquatic environment 9.1A (crustacean) Very ecotoxic in the aquatic environment 9.1A (algal) Very ecotoxic in the aquatic environment 9.3C Harmful to terrestrial vertebrates
Isopropyl alcohol		67-63-0	3.1B Flammable liquids: high hazard 6.1E (oral) Acutely toxic 6.3B Mildly irritating to the skin 6.4A Irritating to the eye
Lithium metal	Moisture, acids, oxidisers, oxygen, nitrogen, carbon dioxide, temperatures above melting point (180.5ºC)	7439-93-2	4.3A Solids that emit flammable gas when in contact with water: high hazard 6.8A Known or presumed human reproductive or developmental toxicants 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1C (fish) Harmful in the aquatic environment 9.2C Harmful in the soil environment

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Methyl alcohol (methanol)		67-56-1	3.1B Flammable liquids: high hazard 6.1D (oral) Acutely toxic 6.4A Irritating to the eye 6.8B Suspected human reproductive or developmental toxicants 6.9A (inhalation) Toxic to human target organs or systems 9.3C Harmful to terrestrial vertebrates
Methyl ethyl ketone	Caustics (eg, sodium hydroxide) amines, alkanolamines, aldehydes, ammonia, strong oxidising agents and chlorinating compounds	78-93-3	3.1B Flammable liquids: high hazard 6.1E (oral) Acutely toxic 6.3B Mildly irritating to the skin 6.4A Irritating to the eye 6.9B (inhalation) Harmful to human target organs or systems
Methylamine	Mercury, copper, zinc, aluminium and galvanised surfaces, flammable materials and strong oxidisers (eg, chlorine, chlorine dioxide and bromine)	74-89-5	2.1.1A Flammable gases : high hazard 6.1C (oral) Acutely toxic 6.1C (inhalation) Acutely toxic 6.8B Suspected human reproductive or developmental toxicants 6.9B (inhalation) Harmful to human target organs or systems 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.2D Slightly harmful in the soil environment 9.3B Ecotoxic to terrestrial vertebrates
n-Acetylanthranilic acid	Strong oxidising agents	89-52-1	Not available
n-Ethylephedrine	Not available	Not available	Not available

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Nitroethane	Oxidising agents, amines, acids, alkalis, hydrocarbon mixtures, metal oxides	79-24-3	3.1C Flammable liquids: medium hazard 6.1D (oral) Acutely toxic 6.1D (inhalation) Acutely toxic 6.9B (oral) Harmful to human target organs or systems 9.1C (algal) Harmful in the aquatic environment 9.2C Harmful in the soil environment 9.3C Harmful to terrestrial vertebrates
o-Toluidine	Oxidising agents, strong acids and strong bases	95-53-4	6.1B (oral) Acutely toxic 6.1B (inhalation) Acutely toxic 6.4A Irritating to the eye 6.7B Suspected human carcinogens 9.1A (fish) Very ecotoxic in the aquatic environment 9.1A (crustacean) Very ecotoxic in the aquatic environment 9.1A (algal) Very ecotoxic in the aquatic environment
Phenethylamine	Strong oxidising agents, strong acids	64-04-0	6.1D (oral) Acutely toxic 8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.3C Harmful to terrestrial vertebrates
Phenyl-2-propanone (P2P)	Strong oxidising and reducing agents, strong bases	103-79-7	Not available
Phenylacetic acid	Strong oxidising and reducing agents, strong bases	103-82-2	6.4A Irritating to the eye

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Potassium permanganate	Powdered metals, alcohol, arsenites, bromides, iodides, phosphorous, sulphuric acid, organic compounds, sulphur, activated carbon, hydrides, strong hydrogen peroxide, ferrous or mercurous salts, hypophosphites, hyposulphites, sulphites, peroxides and oxalates	7722-64-7	5.1.1B Oxidising substances that are liquids or solids: medium hazard 6.1D (oral) Acutely toxic 6.8B Suspected human reproductive or developmental toxicants 6.9A (inhalation) Toxic to human target organs or systems 6.9B (oral) Harmful to human target organs or systems 8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1A (fish) Very ecotoxic in the aquatic environment 9.1A (crustacean) Very ecotoxic in the aquatic environment 9.2A Very ecotoxic in the soil environment 9.3C Harmful to terrestrial vertebrates
Pseudoephedrine	Strong oxidising agents	90-82-4	Not available
Red phosphorus	Halogens, halides, sulphur and oxidising materials (may explode on contact)	7723-14-0	4.1.1B Readily combustible solids and solids that may cause fire through friction: low hazard 6.1D (inhalation) Acutely toxic 6.9A (oral) Toxic to human target organs or systems 6.9A (inhalation) Toxic to human target organs or systems 9.1C (fish) Harmful in the aquatic environment 9.1C (crustacean) Harmful in the aquatic environment 9.1C (algal) Harmful in the aquatic environment
Safrole	Oxidising agents	94-59-7	6.1D (oral) Acutely toxic 6.6B Suspected human mutagens 6.7B Suspected human carcinogens 6.9B (oral) Harmful to human target organs or systems 9.3C Harmful to terrestrial vertebrates

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Sodium dichromate	Strong reducing agents, strong acids, organic materials and combustible materials	10588-01-9	5.1.1B Oxidising substances that are liquids or solids: medium hazard 6.1A (inhalation) Acutely toxic 6.1B (oral) Acutely toxic 6.1C (dermal) Acutely toxic 6.5A (respiratory) Respiratory sensitisers 6.5B (contact) Contact sensitisers 6.6A Known or presumed human mutagens 6.7A Known or presumed human carcinogens 6.8A Known or presumed human reproductive or developmental toxicants 6.9A (oral) Toxic to human target organs or systems 8.2C Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1A (crustacean) Very ecotoxic in the aquatic environment 9.1C (fish) Harmful in the aquatic environment 9.2B Ecotoxic in the soil environment 9.3A Very ecotoxic to terrestrial vertebrates
Sodium hydroxide		1310-73-2	6.1D (oral) Acutely toxic 6.1D (dermal) Acutely toxic 8.1A Corrosive to metals 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3C Harmful to terrestrial vertebrates

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Sodium metal	Oxidising and reducing agents, acids, combustible materials, halo carbons, halogens, amines, metals, metal oxides, metal salts, bases	7440-23-5	4.3A Solids that emit flammable gas when in contact with water: high hazard 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action
Sulphuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate	7664-93-9	6.1D (inhalation) Acutely toxic 6.1E (oral) Acutely toxic 6.7A Known or presumed human carcinogens 6.9A (inhalation) Toxic to human target organs or systems 8.1A Corrosive to metals 8.2B Corrosive to dermal tissue 8.3A Corrosive to ocular tissue 9.1C (crustacean) Harmful in the aquatic environment 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action
Thionyl chloride	Reacts violently with water. Strong reducing agents, strong bases and most common metals	7719-09-7	6.1B (inhalation) Acutely toxic 6.1D (oral) Acutely toxic 8.2A Corrosive to dermal tissue 8.3A Corrosive to ocular tissue

Chemical name	Chemical incompatibilities	CAS number	HSNO chemical classification
Toluene	Halogens, combustible materials, acids, oxidising materials, metal salts	108-88-3	3.1B Flammable liquids: high hazard 6.1D (oral) Acutely toxic 6.1D (inhalation) Acutely toxic 6.3A Irritating to the skin 6.4A Irritating to the eye 6.8B Suspected human reproductive or developmental toxicants 6.9B (inhalation) Harmful to human target organs or systems 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (algal) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3C Harmful to terrestrial vertebrates
Xylene	Has a flash point of 28°C and therefore is a flammable liquid	1330-20-7	3.1C Flammable liquids: medium hazard 6.1D (oral) Acutely toxic 6.1D (inhalation) Acutely toxic 6.3A Irritating to the skin 6.4A Irritating to the eye 6.8B Suspected human reproductive or developmental toxicants 6.9B (inhalation) Harmful to human target organs or systems 9.1D (fish) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (crustacean) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.1D (algal) Slightly harmful in the aquatic environment or are otherwise designed for biocidal action 9.3C Harmful to terrestrial vertebrates

Appendix I: Health Effects of Chemicals Used in Methamphetamine Production

This table includes information on the potential carcinogenicity of the chemical listed and for dermal absorption relevant to the assessment of exposure.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Acetone	• Irritation to nose, throat, lung and eye • Increase pulse rate • Nausea, vomiting, headache and unconsciousness	• Damage to kidney, liver and nerves • Research in animals shows increase in both defects and lower reproduction ability, but where these effects occur in humans is unknown • Inflammation of the airways, stomach and small bowel	Acetone has been categorised by the USEPA as a Group D carcinogen (inadequate evidence to classify).	Dermal absorption of acetone has been shown to occur rapidly in humans.	Miscible in water. Not persistent. Readily biodegrades in soil or water.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Ammonia	• Acute oral exposure rapidly results in pain, excessive salivation and burns to the mouth, throat and oesophagus • Acute inhalation may cause upper respiratory tract irritation • Substantial exposures can result in burns as well as airway obstruction, respiratory disease and bronchiolar and alveolar oedema • Ammonia and ammonia solutions are corrosive via direct contact with tissues and splashes to the eye may result in serious injury • Ammonia solutions can also cause burns to the skin, mouth and lungs	• Effects from chronic exposure have not been identified in humans, however data from animals suggest osteoporosis occurs secondary to chronic metabolic acidosis and the key endpoints • Chronic inhalation exposure has been associated with increase cough, phlegm, wheeze and asthma • Limited data is available but it is unlikely that exposure to environmental levels of ammonia would result in reproductive or developmental toxicity. Data from animal research suggests that foetal toxicity or embryo toxicity may occur by secondary maternal toxicity after very high exposures	Limited data available is inconclusive with respect to carcinogenicity of ammonia.	No data are available. As ammonia is a gas it is not expected to be significantly absorbed by the skin.	Lighter than gas, air likely to dissipate into atmosphere.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Benzene	• Causes drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, unconsciousness, vomiting, sleepiness, convulsions, excessive bleeding and death	• Headache, fatigue, loss of appetite and lassitude with incipient blood changes • May cause alterations to immune system and leukaemia	Benzene is a well-established human carcinogen. Epidemiological studies of benzene exposed workers have demonstrated a causal relationship between benzene exposure and the production of myelogenous leukaemia. However a relationship between benzene exposure and the production of lymphoma and multiple myeloma remains to be clarified.	Benzene is absorbed rapidly and extensively after inhalation and ingestion but less extensively through intact skin. However, percutaneous absorption may contribute to total body burden.	Mobile in soils. Lighter than water and slightly soluble. Will biodegrade over time. Maximum Contaminant Level (MCL) of 5 µg/L.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Chloroform	• Causes dizziness, fatigue, headaches • Toxicity to liver and kidneys	• Possible carcinogen • Dizziness, fatigue, drowsiness, memory impairment, increased dreams, anorexia	Chloroform has been classified as a 'probable' human carcinogen (Category B2) by the USEPA and IARC has classified it in Group 2B (possibly carcinogenic to humans) based on carcinogenicity in animals. A review of chloroform by the USEPA (2001) indicated that it was considered likely to be carcinogenic to humans by all routes of exposure under high-dose conditions that lead to cytotoxicity and regenerative hyperplasia. Chloroform is unlikely to be carcinogenic to humans by any routes of exposure at doses that do not cause cytotoxicity and cell regeneration.	The USEPA (2004) guidance on dermal exposure assessment suggests that for volatile chemicals dermal absorption can be effectively considered negligible as the chemical is not expected to remain on the skin long enough to be absorbed.	Chloroform has a high vapour pressure and is likely to evaporate if spilled. In the event of a large spill, it may migrate to shallow groundwater. It is not toxic to aquatic life.
Ephedrine	• Irritation to skin, eye, digestive tract, respiratory tract	• Difficulty sleeping, tension, anxiety • Fast heart beat, poor nutrition and hygiene, fever, cold sweats and dilated pupils (prolonged abuse)	Available studies on animals show no evidence of carcinogenic activity at doses higher than those associated with other effects (such as decreased body weight) (CANTOX 2000).	Not available	Not available

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Ethyl alcohol	• Irritation to eyes, nose and skin • Headaches, drowsiness, weakness, exhaustion, cough, liver damage, narcosis and anaemia	• Defatting with drying, cracking, irritation and dermatitis • Damage to the liver and cause scarring	Ethanol has been linked to cancer in humans. Chronic ethanol ingestion is associated with liver cancer.	Absorption through the skin was confirmed by a report (Dalt et al 1991) of a case of a one month old infant who became intoxicated as a result of absorption of ethyl alcohol from dressings applied to the stump of the umbilical cord and the skin adjacent to it. Additional confirmation of skin absorption has come from a microdialysis study in which a long probe was inserted under the skin for a distance of 3 cm. Ethyl alcohol was then placed in a small area on the skin above the probe while the subcutaneous area was being perfused. Analysis of the perfusate indicated the presence in an amount that was related to the extent of skin exposure (Anderson et al 1991).	Miscible with water. Large spills may reach water table. Very biodegradable.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Ethyl ether	• Dizziness, drowsiness, headaches, narcosis, nausea, vomiting • Irritation to eye, upper respiratory and skin	• May cause nervous system impairment and liver and blood changes	This substance has not undergone a complete evaluation and determination under USEPA's Integrated Risk Information System program for evidence of human carcinogenic potential.	May be absorbed into the skin.	When released into the soil, this material is expected to quickly evaporate or biodegrade to a moderate extent. There is also the potential for it to leach into groundwater. When released to water, this material is expected to quickly evaporate or have a half-life between 1 and 10 days. When released into air, it can be expected to be readily degraded by reaction with photochemically produced hydroxyl radicals.
Hydriodic acid	• Irritation of skin, eyes and throat • Shortness of breath, burns and blisters of skin • Severe burns when contact occurs	• Digestive disorders • Erosion of teeth, swelling and/or ulceration of mouth lining • Irritation of airways to lung, with cough and inflammation of lung tissue often occurs • Skin inflammation	Hydriodic acid is not listed as a carcinogen by US National Toxicological Program, International Agency for Research on Cancer, or US Occupational Safety and Health Administration.	Chronic dermal exposures could result in dermatitis or skin ulcerations (Michigan Department of Community Health 2004).	Small spills may evaporate (water and HI gas). Miscible with water and slightly heavier. What does not react with soil may reach shallow groundwater through a leaching process.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Hydrogen chloride	• Corrosive to skin, eyes, nose, mucous membrane and gastrointestinal tract • Suffocation, rapid breathing, narrowing of bronchioles • Blue colouring of the skin accumulation of fluid in lung and death	• Chronic inflammation of bronchi, ulceration in nasal passages • Chronic dermatitis and photosensitisation	No information is available on the carcinogenic effects of hydrochloric acid in humans.	Generally dermal absorption of hydrogen chloride is not expected. No reliable studies have been reported in the literature pertaining to the toxicity to reproduction and development in animals after dermal exposure to hydrogen chloride. This lack of data is possibly because protons and chloride ions are normal constituents in the body fluid of animal species and low concentrations of hydrogen chloride gas/mist or solution do not seem to adversely affect animals.	Small spills may evaporate (water and HCl gas). Miscible with water and slightly heavier. What does not react with soil may reach shallow groundwater through leaching process.
Hydrogen peroxide	• Burning of eyes and skin if there is contact • Irritation to respiratory and pulmonary system • Vomiting, gastric distension, loss of consciousness	• No human exposure data are available	Concern regarding hydrogen peroxide carcinogenicity arises from its ability to act as a strong oxidising agent. Generally in animal studies hydrogen peroxide exposure neither initiates nor promotes tumours (DeSesso et al 2000). IARC has concluded that there is 'limited' evidence of carcinogenicity of hydrogen peroxide in experimental animals (IARC 1999).	Hydrogen peroxide is routinely used as a topical skin antiseptic because of its antibacterial properties. Hydrogen peroxide solutions of 3% and 0.3% have been shown to be toxic to human fibroblasts and dilutions of 0.03% still having moderate toxicity (Roberts and Walters 1998).	Hydrogen peroxide released to air will react very rapidly with other compounds found in air; breaks down rapidly in water. If released to soil, it will be broken down by reacting with other compounds.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Iodine (crystals)	• Severe irritation to eye, skin, respiratory tract • Vapour causes coughing, wheezing, shortness of breath and pulmonary oedema	• Lung, kidney and thyroid gland damage	With respect to carcinogenicity iodine has not been classified by USEPA or IARC as studies of population in which iodine intakes were sufficient did not find significant associations between iodine intake and thyroid cancer.	According to data presented from ATSDR (2004) dermal absorption of iodine may range from 0.1% to 14%. Although WHO (2009) suggests a value of <1% may be relevant, a value of 14% has been conservatively assumed.	Slightly soluble in water (300 mg/L) with very low vapour pressure.
Isopropyl alcohol	• Mild irritation to eye, nose and throat • Can cause dizziness, headaches and dry cracking skin	• Carcinogen • Reduced memory and concentration • Lack of co-ordination, lethargy and reduced weight gain • Can cause narcosis, lack of co-ordination and liver degeneration	Isopropyl alcohol manufacture (strong-acid process) has been classified by the International Agency for Research on Cancer as Group 1, carcinogenic to humans.	Isopropyl alcohol can be absorbed through intact skin in animals, and case reports have suggested dermal absorption as the cause of human isopropyl alcohol toxicity (Leeper et al 2000). This prompted studies to consider whether a significant amount of isopropyl alcohol is absorbed through the skin of healthcare workers who use alcohol hand rubs frequently at work. Turner et al (2004) recorded measurable blood isopropyl alcohol levels (range 0.5–1.8 mg/l) in nine subjects.	When released into the soil, this material is expected to quickly evaporate or biodegrade to a moderate extent. There is also the potential for it to leach into groundwater. When released to water, this material is also expected to quickly evaporate or have a half-life between 1 and 10 days. When released into air, it can be expected to be readily degraded by reaction with photochemically produced hydroxyl radicals.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Mercury (inorganic)	• High concentrations of ingestion of inorganic mercury have been associated with gastrointestinal damage, cardiovascular damage, acute renal failure and shock	• Kidney damage in particular autoimmune glomerulonephritis • There is some evidence that inorganic mercury may cause neurological effects particularly associated with studies of mercuric chloride. Reproductive and developmental effects in rats prescribed with mercuric chloride have been observed	Inorganic mercury compounds have not been considered classifiable as to human carcinogenicity by IARC. However, mercuric chloride has been classified as a possible human carcinogen (Class C) by the USEPA based on increased incidence of squamous cell papillomas of the forestomach and marginally increased incidence of thyroid follicular cell adenomas and carcinomas from a long term oral research study in rats.	No data are available on the dermal absorption of mercury although it is noted the USEPA (1995) value is 1% for absorption. Mercury reacts with skin proteins, so as a result penetration does not increase commensurably with increasing exposure concentration but rather approaches a plateau value (Ministry for the Environment 2010).	'*Inorganic mercury has been reported to produce harmful effects at 5 microg/l in a culture medium. Organomercury compounds can exert the same effect at concentrations 10 times lower than this. The organic forms of mercury are generally more toxic to aquatic organisms and birds than the inorganic forms. Aquatic plants are affected by mercury in water at concentrations of 1 mg/l for inorganic mercury and at much lower concentrations of organic mercury*' (Boening 2000 p 1335).
Methamphetamine	• Irritation to skin, eyes, mucous membrane and the upper respiratory tract • Dizziness, headache, dry mouth, insomnia, chest	• Insomnia, irritability, poor concentration, hyperactivity, personality changes, weight loss, hallucinations, anxiety • Heart disorders and kidney poisoning	No human data is available. Available research on animals has shown no evidence of carcinogenic activity for *d*- or *l*-amphetamines (Golub et al 2005).	OEHHA (2009) has assessed dermal absorption of methamphetamine as 57%.	Limited data are available on the fate and transport of methamphetamine. Methamphetamine was included as one of the chemicals evaluated with respect to fate and transport in soil by Pal and Kirkbridge (2009). In addition, Janusz et al (2003) found that methamphetamine persisted unchanged in soil which suggests that it could migrate into shallow groundwater.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Methyl alcohol (methanol)	• Irritation to eye • Headaches, drowsiness, vomiting and visual disturbance	• Headache, fatigue, nausea, blurring of vision and double vision • Damage to optic nerves which may become severe with permanent visual impairment even blindness	There are no data in the literature to indicate that methanol is carcinogenic in humans.	Based on urinary methanol levels, the rate of absorption of the chemical appears to be proportional to the concentration of vapour inhaled. The rate of dermal absorption increased for 35 minutes then decreased over the next 25 minutes (no other details given) (USEPA 1994b).	Methanol is miscible in and lighter than water. When released to the ground in sufficient quantities to get into the subsurface it will leach into percolating water and may reach the groundwater. Methanol is biodegradable.
Methyl ethyl ketone	• Irritation to the eyes, nose, throat and skin	• Defatting with drying, cracking, irritation and dermatitis	No information on the carcinogenicity of methyl ethyl ketone in humans was located.	Dermatitis has been reported in humans following dermal exposure to methyl ethyl ketone. Tests involving acute exposure of animals, such as the LD_{50} test in rabbits, has shown methyl ethyl ketone to have high acute toxicity from dermal exposure (USEPA 1990).	Methyl Ethyl Ketone is fairly soluble in water (239,000 mg/L) and has a log Kow of 0.29. If released to the ground it will partially evaporate, and if the release has a sufficient quantity to enter the subsurface will leach to shallow groundwater. It does not biodegrade readily.
Naphtha	• Irritation to eyes, nose and skin • May cause drowsiness and light-headedness	• May cause kidney damage • Nervous system impairment and liver and blood changes	Considered to be carcinogenic to humans as it contains material that can cause cancer. Risk of cancer depends on duration and level of exposure.	Naphthas may be absorbed through the skin. Tests involving acute exposure of animals such as the LD_{50} test in rabbits, has shown 3 mg/kg toxicity from dermal exposure.	Naphthas are hydrophobic and lighter than water. In sufficient volume, they will move through the subsurface until they encounter a low permeability soil or the groundwater. Naphthas are biodegradable, but the process is lengthy.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Phosphine gas	• Nausea, vomiting, pulmonary oedema, shortness of breath, convulsions and death	• Inflammation of nasal cavity and throat • Degenerative changes to the bones • Liver and kidney damage • Reduced red blood cell level	Phosphine is clastogenic and has not been associated with carcinogenic effects (Health Protection Agency 2007).	The skin is not a common route of absorption of phosphine. As it is essentially a gas a default dermal absorption value of 0.05% (for highly volatile compounds) from the USEPA (1995) has been suggested.	Heavier than air. May accumulate in low spots. High reactivity will minimise environmental effects.
Phosphorous (red)	• Coughing, bronchitis, nausea, vomiting, abdominal pain • Severe irritation and burns to the eye	• Stomach pains, vomiting and diarrhoea • Bronchitis • Mandible necrosis • Long term ingestion of red phosphorus contaminated with white phosphorus may result in jaw bone degeneration	No data is available although the USEPA has classified white phosphorus, Group D – not classifiable as to human carcinogenicity.	Not available.	Harmful to aquatic organisms. Insoluble in water. Will remain on ground surface if released.
Phosphoric acid	• Irritation to eyes, skin and upper respiratory tract • Burns to eyes and skin	• Corrosive to tissue • No human exposure data available	This substance has not undergone a complete evaluation and determination under USEPA's Integrated Risk Information System programme for evidence of human carcinogenic potential.	There is information regarding absorption by no humans or animals available.	When released in sufficient quantities, it may reach shallow groundwater. Neutralisation leaves phosphate.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Pseudoephedrine	• Irritation to skin, eye, digestive tract, respiratory tract	• Difficulty sleeping, tension, anxiety • Fast heart beat, poor nutrition and hygiene, fever, cold sweats and dilated pupils (prolonged abuse)	Available studies on animals show no evidence of carcinogenic activity at doses higher than those associated with other effects (such as decreased body weight) (CANTOX 2000).	Not available.	Completely soluble in water with a Log Kow (octanol-water partition coefficient) of 1.74. As crystal may be transported by wind. Dissolved in water or subjected to water (rain) will leach through soil. Moderately biodegradable.
Sodium hydroxide	• Irritation of nose, throat and respiratory airways • Corrosive injury to mouth, throat oesophagus and stomach • Severe burns to skin and eye if contact • Can cause death	• Erosion of teeth, inflammatory and ulcerative changes in the mouth • Bronchial irritation with cough and frequent attacks of bronchial pneumonia	IARC and USEPA have not classified sodium hydroxide for carcinogenicity in humans.	No valid studies were identified regarding effects on developmental toxicity in animals after dermal exposure to sodium hydroxide.	Dissolves in water with release of heat, creating a high pH solution.
Sulphuric acid	• Irritation to nose and throat • Corrosive and burns of mouth, throat and stomach • Severe tissue burns • May cause death	• Lung damage and possibly cancer	No carcinogenic effects have been observed in the rat, mouse, hampster and guinea pig (carcinogenicity studies of sulphuric acid mist). However, the studies are unreliable due to significant protocol deficiencies (NICNAS 2003)	No data are available on repeat dose toxicity for sulphuric acid by oral or dermal routes (NICNAS 2003).	Miscible with water with evolution of heat. In sufficient quantity may leach to shallow groundwater. Release to a surface water may be toxic to aquatic organisms if sufficient energy is not available for quick dilution.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Toluene	• Nausea, tiredness, confusion, loss of appetite, hearing or vision	• Damage to kidneys • Nervous system impairment and liver and blood changes • Children of pregnant women exposed to toluene by inhalation have been reported to have development effects such as central nervous system dysfunction, attention deficits and minor craniofacial and limb anomalies.	Two epidemiological studies did not detect a statistically significant increased risk of cancer due to inhalation exposure to toluene. However, these studies were limited due to the size of the study population and lack of historical monitoring data. The US EPA has placed toluene in Group D: Not classifiable as a carcinogen (USEPA, 1994a). The IARC has placed toluene in Group 3: Not classifiable as a carcinogen (IARC 1989).	Absorption through the skin is estimated at about 1% of that absorbed by the lungs when exposed to toluene vapour. Dermal absorption is expected to be higher upon exposure to the liquid; however, exposure is limited by the rapid evaporation of toluene (USEPA 1994a).	Toluene has a solubility in water of about 534 mg/L. When released to the soil near-surface toluene will evaporate, with deeper releases leaching to shallow groundwater. Toluene will slowly biodegrade in both the soil and groundwater. It is lighter than water, so it will stop migrating down at the water table.

Chemical	Acute health effects	Chronic health effects	Carcinogenicity	Dermal absorption	Fate and transport
Xylene	• Small amounts of liquid aspirated into the lungs from ingestion or from vomiting may cause chemical pneumonitis which can be fatal • Moderately irritating to eyes. May cause redness, burning sensation and blurred vision • Irritating to skin. Causes redness, burning sensation, blisters and swelling • Inhalation may cause headaches, dizziness, nausea, loss of co-ordination, light headedness and central nervous system depression. May lead to unconsciousness and death.	• May include conjunctivitis • Dryness of the nose, throat, and skin • Dermatitis • Kidney and liver damage	Information from animal studies is inadequate to determine whether or not xylene causes cancer in humans. Both the IARC and the USEPA have found that there is insufficient information to determine whether or not xylene is carcinogenic. As a result xylene has been placed in Group 3: Not classifiable as a carcinogen.	Dermal absorption of xylenes has been studied after exposure to the vapour or the liquid.	Xylene when leaked into soil, surface water or groundwater, can remain for months or more before it breaks down into other chemicals. However, because it easily evaporates, most of the xylene (if not trapped deep underground) evaporates into the air. In the air, xylene is broken down by sunlight into other less harmful chemicals.

Source: Adapted from Abdullah (2007); United States Environmental Protection Agency (2009)

Appendix J: Investigation Form for Possible Exposure/Illness to Chemicals from a Former Clan Meth Lab

Exposure/illness personal (Part 1 of 4)

Exposure/illness number:		
Local public health service:		
Complaint number:		
Investigating officers:	First name	Surname

Case details

First name:				
Surname:				
Address:				
Phone number:			**Date of birth:**	
Ethnicity: (tick one)	European		**Sex:**	
	New Zealand Maori			
	Pacific groups			
	Other			
Main occupation:				

Exposure definition

Where (when exposed):						
Activity engaged in:						
What was experienced? (tick one)	Visible mist or cloud					
	Felt on skin or eyes					
	Smell					
	Other					
Were symptoms of illness experienced from the exposure?			Yes		No	

Exposure/illness symptoms (Part 2 of 4)

General		Psychological function		Respiratory		Central nervous system	
Feeling unwell		Anxiety		Cough		Headache	
Tired		Insomnia		Wheeze		Dizziness	
Fever		Confusion		Out of breath		Blackout or fits	
		Depression		‘Burning’ lungs		Double vision	
		Tearfulness		Blocked nose		Unsteady walking	
		Other		Other		Other	

Cardiovascular		Eyes		Skin		Musculoskeletal	
Palpitations		Burning eyes		Sweating		Muscle weakness	
Rapid pulse		Watering eyes		Flushing		Aching muscles	
Slow pulse		Blurred vision		Rash		Twitching muscles	
Other		Other		Describe rash		Other	

Gastrointestinal		Peripheral nervous system	
Salivation		Numb/tingling extremities	
Swollen lips		Other	
Nausea			
Vomiting			
Diarrhoea			
Stomach pains (cramps)			
Other			

Other body systems affected	
Renal	
Hepatic	
Reproductive	
Immune	
Endocrine	
Other	

Risk/protective factors: exposure/illness medical history (Part 3 of 4)

Outcome (complete if symptoms experienced from the exposure)

Date symptoms were first noticed:				
Time symptoms were first noticed:				
Length of exposure, eg, months, years				
Most severe symptom:				
Samples collected for analysis:	Blood		Clothing	
	Urine		Other physical surface	
Results of analyses:				

Medicines taken prior to exposure

Medicine	

Individual risk/protective factors

Do you suffer from ...	Skin allergies		Migraine		Hayfever	
	Eczema		Asthma			
If you suffer from any chronic diseases, list these:						
Are you currently pregnant?	Yes		No			
Are you currently breastfeeding?	Yes		No			
Usual health status (tick one)	Excellent		Good			
	Fair		Poor			
If you are a smoker (average number of cigarettes smoked per day)						

Exposure/illness diagnosis (Part 4 of 4)

GP/health professional consulted

First name:						
Surname:						
Address:						
Have the details been confirmed with the GP?		Yes		No		
GP's diagnosis:						

Management and conclusions

Are these symptoms:	Acute		Systemic		Chronic				
	Local		Intermittent						
Overall severity:									
Have these symptoms resolved?			Yes		No				
If so, date symptoms resolved:									
And time symptoms resolved:									
Symptoms/illness consistent with the known effects of the chemical exposure?		Yes		No		Unsure			
Conclusions of the investigating officer:									