

METHAMPHETAMINE CONTAMINATION IN RESIDENTIAL ENVIRONMENTS: LIMITS FOR CONTAMINATION

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ACRONYMS AND ABBREVIATIONS

bw	Body weight
CalEPA	California Environmental Protection Agency
HBGV	Health-based guidance value
HUD	Ministry of Housing and Urban Development
LOAEL	Lowest observed adverse effect level
NOAEL	No observed adverse effect level
PMCSA	Prime Minister's Chief Science Advisor
PPE	Personal protective equipment
RfD	Reference dose
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

Residential environments may become contaminated by the illicit drug, methamphetamine, due to the use of the premises for the synthesis of methamphetamine (clandestine laboratories) or due to the use of methamphetamine by occupants of the premises. Residues of methamphetamine, precursor chemicals and processing chemicals may persist and constitute a health hazard to subsequent residents of the premises.

The Ministry of Housing and Urban Development (HUD) have legal obligations in relation to the built residential environment. HUD is developing regulations under section 138C of the Residential Tenancies Act 1986 and has requested further advice from ESR in relation to a target level for remediation of premises which test above 15 µg/100 cm².

HUD's request for advice from ESR was captured in two questions. The following text addresses these questions in the context of the analysis and review provided in the current report.

Building on the advice provided to HUD in December 2020 which concluded that “a maximum mean surface contamination of 15 µg/100cm² will be associated with a very low probability of harm” and that “a mean surface contamination concentration of 15 µg/100cm² should be viewed as a guideline level”:

- 1. Does ESR recommend that 15 µg/100 cm² is also appropriate as a target level for remediation to achieve for premises which test above this level? Please explain the reasons for your conclusion.**

ESR's 2020 report identified 15 µg/100 cm² as a level of methamphetamine surface contamination equating to a revised RfD of 3 µg/kg body weight per day (Cressey and Fowles, 2020). By definition, exposure to a chemical at a rate below the RfD or any other health-based guidance value is without appreciable risk of adverse health effects for exposure over a lifetime, on the basis of currently-available information. On this basis alone, 15 µg/100 cm² is an appropriate target level for remediation to achieve for premises that test above this level.

In addition to arguments based on risk of adverse effects, no precedents were identified in relation to methamphetamine contamination or any other contamination scenario for different limits to trigger remediation and for remediation to achieve. It should be noted that in most jurisdictions, testing of methamphetamine contamination levels was not the deciding criterion for initiation of remediation of methamphetamine-affected properties. However, these jurisdictions were mainly concerned with the remediation of properties used for the manufacture of methamphetamine.

While there is insufficient information on adverse health effects following third-hand¹ exposure to methamphetamine residues, further remediation of a property remediated to a methamphetamine surface concentration of less than 15 µg/100 cm² is highly unlikely to result in additional health benefits for residents, while resulting in additional costs for the property owner and additional inconvenience for the residents.

As with all health-based limits, the currently proposed limit of 15 µg/100 cm² is based on the best currently-available information. Re-evaluation would be appropriate if additional robust and relevant epidemiological data were to become available.

- 2. If ESR recommends that 15 µg/100cm² is not an appropriate target level for remediation to achieve under question (1), what level do you think is the highest acceptable target level? Please explain the reasons for your conclusion.**

ESR recommends that 15 µg/100 cm² is an appropriate target level for remediation to achieve for premises that test above this level.

1. INTRODUCTION

Residential environments may become contaminated by the illicit drug, methamphetamine, due to the use of the premises for the synthesis of methamphetamine (clandestine laboratories) or due to the use of methamphetamine by occupants of the premises. Residues of methamphetamine, precursor chemicals and processing chemicals may persist and constitute a health hazard to subsequent residents of the premises. This is termed third-hand exposure; unintended exposure to residues remaining from the manufacture or use of methamphetamine.

People may be exposed to a range of chemical hazards in the residential environment, including residues from tobacco smoking, metabolites of moulds, residues from building and decorating materials (asbestos and lead) and household chemicals. It is not currently possible to say what the public health risks of exposure to methamphetamine are, relative to exposure to other chemicals.

1.1 BACKGROUND

In 2017, Standards New Zealand published *NZS 8510:2017 Testing and decontamination of methamphetamine-contaminated properties*. Section 2.1.2 of the Standard specifies that:

“Individual high-use areas of a property that have been tested according to methods in this standard and shown to have methamphetamine present at levels exceeding $1.5 \mu\text{g}/\text{cm}^2$ shall be regarded as contaminated. These areas shall be decontaminated by cleaning or removing contaminated materials, or both, and tested to verify that decontamination has been effective.”

Under this interpretation, the limit ($1.5 \mu\text{g}/\text{cm}^2$) is viewed as a ‘trigger’ for remediation, with any concentration above the limit requiring remediation.

The limit value for methamphetamine contamination of $1.5 \mu\text{g}/\text{cm}^2$ was informed by a risk assessment commissioned by the Ministry of Health (Fowles *et al.*, 2016). The risk assessment proposed a slightly higher limit ($2.0 \mu\text{g}/\text{cm}^2$) and stated that the limit represented “a proposed standard for methamphetamine (MA) residues in remediated houses”, that is, a level of contamination for remediation to achieve, rather than a level of contamination above which remediation should be initiated.

In 2018, the Office of the Prime Minister’s Chief Science Advisor (PMCSA) published a report, *Methamphetamine contamination in residential properties: Exposure, risk levels, and interpretation of standards* (Bardsley and Low, 2018). The report concluded that:

“...methamphetamine levels that exceed the NZS 8510:2017 clean-up standard of $1.5 \mu\text{g}/100 \text{ cm}^2$ should not be regarded as signalling a health risk. Indeed, exposure to methamphetamine levels below $15 \mu\text{g}/100 \text{ cm}^2$ would be highly unlikely to give rise to any adverse effects.”

Based on this report, some have interpreted the higher figure ($15 \mu\text{g}/100 \text{ cm}^2$) as a trigger for remediation of methamphetamine-contaminated residential environments.

In 2020-2021, ESR was contracted by the Ministry of Housing and Urban Development (HUD) requested advice from ESR in relation to potential adverse human health effects from third-hand¹ exposure to methamphetamine (Cressey and Fowles, 2020). This study concluded *inter alia* that:

“a maximum mean surface contamination concentration below 15 µg/100 cm² will be associated with a very low probability of harm, although such residues should still be viewed as undesirable”.

1.2 MAXIMUM LIMITS – GENERAL PRINCIPLES

Maximum limits are used in a number of domains to specify the maximum concentration of a component that may be present in or on a specified medium. Maximum limits may be defined at a level that is protective of public health or at a level that is consistent with good practice, such as good agricultural practice (GAP), good manufacturing practice (GMP) or good hygienic practice (GHP). Usually, maximum limits are required to be consistent with both health protection and good practice.

Exceedance of maximum limits may result in a range of risk management responses but these can be broadly grouped into two groups of responses:

- Removal of the item or circumstance from the relevant situation, for example, recall and destruction of non-complying foods or consumer products.
- Requirement for improvement to a complying state, for example, remediation or rework.

With reference to methamphetamine-contaminated residential properties, removal of the property from the residential stock is not desirable and remediation is the usual risk management response.

Remediation standards in the form of maximum limits aim to either:

- Return the environment to a state that is as close as feasible to its pre-contamination state (baseline), or
- Return the environment to a state that is without appreciable risk to public health and/or the environment.

1.3 INTERNATIONAL SITUATION

A number of state and national authorities have set limits for concentrations of methamphetamine in residential environments following remediation (USEPA, 2021; Wright, 2009). Limits are in the range 0.05-1.5 µg/100 cm². Some of these limits are health-based, some are feasibility-based, and some are based on the limit of detection of the analytical method used to determine methamphetamine. A feasibility-based limit is a level of surface contamination that can be achieved through best-practice remediation.

The United States Environmental Protection Agency (USEPA) *Voluntary Guidelines for Methamphetamine and Fentanyl Laboratory Cleanup* recognises that, “While EPA originally developed these voluntary guidelines to apply to structures in which meth was manufactured or “cooked,” the voluntary guidelines contained in this document may be useful for cleaning up all sites contaminated by meth including “smoking sites” and other “use sites” (USEPA, 2021). However, the Guidelines do not identify criteria for deciding whether remediation is required or not.

In contrast, many of the US state regulations are specifically for the remediation of residential properties used as manufacturing facilities and pre-remediation sampling and testing is not generally required, except to exclude residences or parts of residences from the need for remediation. Regulations often include detailed description of the remediation process and the certification process of remediation practitioners is common.

1.4 THE CURRENT PROJECT

The Ministry of Housing and Urban Development (HUD) have legal obligations in relation to the built residential environment, including under section 138C of the Residential Tenancies Act 1986:

138C Regulations in respect of contaminants and contaminated premises

- (1) The Governor-General may, by Order in Council made on the recommendation of the Minister, make regulations prescribing substances, or classes of substances, as contaminants for the purposes of this Act.
- (2) Before making a recommendation for the purposes of subsection (1), the Minister must be satisfied that the substance may be harmful to the health of persons.
- (3) The Governor-General may, by Order in Council, make regulations for all or any of the following purposes:
 - (a) prescribing maximum acceptable levels, or a means of calculating maximum acceptable levels, of contaminants for premises for the purposes of the definition of contaminated:
 - (b) prescribing maximum inhabitable levels of contaminants for premises for the purpose of section 59B.

HUD is developing regulations under section 138C of the Residential Tenancies Act 1986. The regulations seek to:

- minimise the health risk from exposure to third-hand methamphetamine in rental housing
- provide certainty to tenants and landlords about their rights and responsibilities around methamphetamine contamination
- provide clear rules and processes for testing, sampling, and decontamination
- support professional conduct and standards in the testing industry
- prescribe an approach that will manage the costs of testing and decontamination for landlords and tenants.

The current project is intended to provide evidence to support these activities and specifically:

- Consider if 15 µg/100 cm² is also appropriate as a target level for remediation to achieve for premises
- If 15 µg/100 cm² is not considered an appropriate target level for remediation to achieve under question, what level could be supported as the highest acceptable target level

The current report considered three approaches to considering whether a lower surface contamination concentration than 15 µg/100 cm² should be defined, to be achieved by the remediation process:

- Precedent. Are there exemplars of differential trigger and target concentrations for methamphetamine or other contaminants that could provide a precedent?
- Risk. Is there a lower level of surface contamination that could be viewed as equivalent to a more acceptable level of risk?
- Risk-benefit. Is there a level of surface contamination that provides a demonstrable and acceptable balance between the risks associated with the presence of methamphetamine residues and the costs (social and financial) of more stringent levels of remediation?

2. PRECEDENT-BASED APPROACH

No examples were found of remediation requirements where the initiation of remediation and the final remediation standard were defined as separate concentrations. Remediation is generally required to be carried out to achieve a baseline level of contamination or a level of contamination without significant risks to human health and the environment (CRC CARE, 2017; SAEPA, 2019; USEPA, 1991). While numerical limits for contaminants may be used to assess whether the level of remediation is sufficient, the decision to remediate is generally based on an in-depth assessment of the particular circumstances of the site.

While these conclusions are drawn from non-methamphetamine domains, they are consistent with current regulatory approaches to residential remediation of methamphetamine contamination. Table 1 summarises information from a range of jurisdictions (mainly US states) on the triggers for methamphetamine remediation and the standard that methamphetamine remediation is required to achieve.

The information in Table 1 suggests that criteria other than the methamphetamine contamination level in a residential environment are used to decide whether remediation is required or not. In some jurisdictions, testing for methamphetamine can be used to exclude areas of a dwelling from the need for remediation but not to decide if a dwelling of unknown methamphetamine status requires remediation.²

The methamphetamine levels listed in Table 1 are a mixture of feasibility-based and health-based limits, with the feasibility-based limits being more common. The intent of the feasibility-based limits is to reduce methamphetamine concentrations to the lowest level achievable or measurable.

² <https://www.health.state.mn.us/communities/environment/meth/#laws> Accessed 27 July 2022

Table 1. Remediation triggers and remediation standards for various jurisdictions

Jurisdiction	Triggers for remediation	Remediation standard ($\mu\text{g}/100 \text{ cm}^2$ methamphetamine)	Basis for remediation standard	Reference
Australia	Investigation levels for clandestine drug laboratories	0.5 (residential) 10 (commercial)	Health-based	(Wright, 2009)
Alaska	Law enforcement agency posts property as unfit for habitation due to manufacture. Methamphetamine contamination resulting from <i>drug use only</i> is not monitored	0.1	Reasonably achievable	a
Arkansas	Following law enforcement activities, the property will then be placed on a list of contaminated properties and will remain on this list until a certified clandestine laboratory contractor hired by the property owner remediates the property to the appropriate standards	0.05	Expert working group recommendations	b
California	Health officer determination that the property is contaminated, following notification from law enforcement	1.5	Health-based	c
Colorado	Notification from a peace officer that chemicals, equipment, or supplies indicative of a methamphetamine-affected property are or have been located at the property, or screening level sampling is conducted at a property that has not been deemed a methamphetamine-affected property	0.5 (4 for limited exposure areas, 1.5 for painted over surfaces)	Not stated	d
Connecticut	Not stated	0.1	Detection limit of analytical methods	e
Hawaii	Law enforcement notify Department of Health, which determined whether or not the property is safe for occupancy	0.1	Not stated	f

Idaho	Property is identified by law enforcement as a clandestine drug laboratory, the property will be posted, and the law enforcement agency will notify the property owner and the Department of Health. Property will be placed on Clandestine Drug Laboratory Site Property List	0.1	Not stated	g
Indiana	Notification of the illegal drug lab is provided to the county health department by law enforcement	0.5	Not stated	h
Michigan	Law enforcement notify Department of Community Health, which makes a Clandestine Drug Laboratory determination	0.5	Not stated	i
Minnesota	Law enforcement notifies health authority of property found to be a clandestine drug laboratory. Health authority prohibits property from being occupied until remediated	1.5 Limit of 0.1 can be applied to exclude a structure or portion of structure from remediation in a declared meth lab	Health-based	j
Montana	Law enforcement report contamination to environmental and health agencies if it becomes aware that an inhabitable property has been contaminated by its use as a clandestine methamphetamine drug lab. Property added to public list. Property is removed following confirmation of satisfactory remediation	1.5	Health-based	k
Nebraska	Law enforcement notifies health department, which monitors remediation of the property	0.1	Not stated	l
Washington	Law enforcement notify health. Written warning posted on premises, inspection carried out. If contaminated, order issued prohibiting use of the property	1.5	Not stated	m

West Virginia	Residential property owner notified by a law enforcement agency or becomes aware of a clandestine drug laboratory on property. Must ensure the residential property remains unoccupied and secured until analytical test results indicate a level of contamination at or below 1.0 µg /100 cm ² , a certificate of remediation completion is issued for the property by the department, or the property is properly demolished	1.0	Not stated	n
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^a <https://dec.alaska.gov/spar/csp/meth-lab/>

^b <https://www.adeg.state.ar.us/emergency/cscpc/>

^c <https://dtsc.ca.gov/drug-lab-removals-erp/>

^d <https://cdphe.colorado.gov/methlabcleanup>

^e https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/eoha/pdf/METHLABCLEANUPPROTOCOLpdf.pdf

^f <https://health.hawaii.gov/heer/files/2019/11/methfactsheet062107.pdf>

^g <https://healthandwelfare.idaho.gov/health-wellness/environmental-health/clandestine-labs>

^h <https://www.in.gov/meth/cleanup-information/>

ⁱ https://www.michigan.gov/-/media/Project/Websites/mdhhs/Folder2/Folder85/Folder1/Folder185/MI_Guidelines.pdf?rev=c775539b0c064d99aac599abec86a036

^j <https://www.health.state.mn.us/communities/environment/meth/#laws>

^k <https://deq.mt.gov/cleanupandrec/programs/meth>

^l <https://www.methlabcleanup.com/NE%20FinalRegs.pdf>

^m <https://doh.wa.gov/about-us/programs-and-services/environmental-public-health/environmental-health-and-safety/about-drug-lab-cleanup-program>

ⁿ <https://oehs.wvdhhr.org/media/oludqpnny/64csr92-effective-5-1-22.pdf>

3. RISK-BASED APPROACH

The ESR 2016 methamphetamine report used a published and peer-reviewed reference dose (RfD)³ developed by the California Environmental Protection Agency (CalEPA) for methamphetamine of 0.3 µg/kg bw/day (Fowles *et al.*, 2016; Salocks, 2009). Alternative RfDs, derived by the state of Colorado, based on neurological development in rodents, were in the range 5-70 µg/kg/day (Fowles *et al.*, 2016; Hammon and Griffin, 2007). The highly disparate bases of the two RfDs were discussed in the ESR report, and further considered in light of the standard default 300-fold cumulative uncertainty factors used in their derivations (Bardsley and Low, 2018; Kuhn *et al.*, 2019).

ESR's 2020 report confirmed that studies in humans are a more appropriate basis for deriving reference doses, due to the well documented vast differences in metabolism kinetics between humans and rodents (Cressey and Fowles, 2020). The drug is much more rapidly cleared by rodents and humans are consequently more susceptible to effects of low, daily, additive chronic doses. Doses administered to rodents in experimental studies often approach equivalent lethal doses in humans, on a body weight basis. It should be noted that the key studies are now quite old, however, due to ethical constraints new studies of this type are unlikely.

The ESR report also included an analysis of the uncertainty factors applied in the derivation of the RfD. The conclusions are summarised in Table 2.

³ The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfD is generally expressed in units of milligrams per kilogram of bodyweight per day (mg/kg bw per day)

Table 2. Proposed RfD for methamphetamine

RfD parameters	CalEPA	Proposed RfD - ESR
Study	Primary: Humans (adult pregnant women) ^a Supporting: Children 4-15 years old ^b	Primary: Humans (adult pregnant women) ^a Supporting: Children 4-15 years old ^b
Effects Dose	0.08 mg/kg bw per day (5 mg/day) (LOAEL) 0.1 mg/kg bw per day (NOAEL)	0.08 mg/kg bw per day (5 mg/day) (LOAEL) 0.1 mg/kg bw per day (NOAEL)
Effect	Reduced weight gain Sleep deprivation in 8/110 children	Reduced weight gain Sleep deprivation in 8/110 children
Uncertainty/Safety Factor	300 10x - Variation in susceptibility among the members of the human population 10x - Uncertainty in extrapolating from a LOAEL to a NOAEL 3x - Uncertainty associated with extrapolation when the database is incomplete	30 (rounding up from 27) 3x - Variation in susceptibility among the members of the human population 3x - Uncertainty in extrapolating from a LOAEL to a NOAEL 3x - Uncertainty associated with extrapolation when the database is incomplete
RfD (µg/kg bw per day)	0.3	3.0
Equivalent surface contamination concentration (µg/100 cm²)	1.5	15

^a (Chapman, 1961)

^b (Young and Turner, 1965)

While the RfD derived by ESR is less conservative than the RfD derived by CalEPA, the decisions made to reduce the uncertainty factors, resulting in an increase in the RfD, were based on currently-accepted risk assessment principles and should be considered to be still health protective.

While a lower RfD could obviously be viewed as 'more protective', the principles of risk assessment conclude that any level of exposure below a suitably derived RfD would be expected to be without appreciable health risk, on the basis of currently-available information. On this basis, there is no rationale for defining an additional exposure limit lower than the RfD.

No studies have been published since the 2020 report that would further inform the development of a RfD for methamphetamine.

4. RISK-BENEFIT APPROACH

With respect to residential housing, HUD's website states that:

“Te Tūāpapa Kura Kāinga - Ministry of Housing and Urban Development works with central and local government agencies, the housing sector and communities across New Zealand to improve housing affordability and supply, ensure tenants live in warm, dry, healthy and safe rental housing, and improve housing quality and choices for Māori and their whanau.”⁴

In the current housing situation in New Zealand there is considerable pressure on the affordability and supply of residential housing. In this context, the decision to displace the residents of housing in order to remediate the premises or to extend the period of displacement to achieve a lower level of methamphetamine contamination should ideally be balanced against the risks to human health of the methamphetamine residues and the costs of remediation.

A quantitative analysis of the risks and benefits of differing levels of methamphetamine remediation would require information on:

- the direct costs of remediating residential properties to different final levels of methamphetamine contamination,
- the direct costs of displacing residents for the duration of the remediation,
- the indirect costs, in terms of loss of quality of life, of displacing residents for the duration of the remediation, and
- the direct and indirect costs of the adverse health effects associated with residential exposure to methamphetamine residues.

Of these, the first two cost elements could potentially be defined and have been discussed in recent publications (Sanchez Lozano *et al.*, 2020; Sanchez Lozano *et al.*, 2022). At this point in time, the adverse health effects associated with third-hand exposure to methamphetamine are poorly characterised and the associated costs could not be estimated.

While it is not possible to carry out a quantitative risk-benefit analysis, to identify an optimum level of remediation, the currently-available information suggests that there will be no appreciable risks to human health at surface methamphetamine concentrations below 15 µg/cm² and, hence, no associated health care costs. This suggests that if initial remediation has achieved a surface contamination level below 15 µg/cm², the costs of further remediation and resident displacement are unlikely to be associated with any benefit.

⁴ <https://www.hud.govt.nz/residential-housing/> Accessed 25 July 2022

5. CONCLUSIONS

HUD's request for advice from ESR was captured in a series of questions. The following text addresses these questions in the context of the analysis and review provided in the current report. It should be noted that the RfD and associated surface contamination limit derived by ESR relate to methamphetamine (Cressey and Fowles, 2020). While methamphetamine will be the primary residue of concern in situations where the contamination is due to methamphetamine use, other chemicals may be present when contamination is due to methamphetamine manufacture and site-specific risk assessment may be required.

Does ESR recommend that 15 µg/100 cm² is also appropriate as a target level for remediation to achieve for premises which test above this level? Please explain the reasons for your conclusion.

ESR's 2020 report identified 15 µg/100 cm² as a level of methamphetamine surface contamination equating to a revised RfD of 3 µg/kg body weight per day (Cressey and Fowles, 2020). By definition, exposure to a chemical at a rate below the RfD or any other health-based guidance value is without appreciable risk of adverse health effects for exposure over a lifetime, on the basis of currently-available information. On this basis alone, 15 µg/100 cm² is an appropriate target level for remediation to achieve for premises that test above this level.

In addition to arguments based on risk of adverse effects, no precedents were identified in relation to methamphetamine contamination or any other contamination scenario for different limits to trigger remediation and for remediation to achieve. It should be noted that in most jurisdictions, testing of methamphetamine contamination levels was not the deciding criterion for initiation of remediation of methamphetamine-affected properties. However, these jurisdictions were mainly concerned with the remediation of properties used for the manufacture of methamphetamine.

While there is insufficient information on adverse health effects following third-hand exposure to methamphetamine residues, further remediation of a property remediated to a methamphetamine surface concentration of less than 15 µg/100 cm² is highly unlikely to result in additional health benefits for residents, while resulting in additional costs for the property owner and additional inconvenience for the residents.

As with all health-based limits, the currently proposed limit of 15 µg/100 cm² is based on the best currently-available information. Re-evaluation would be appropriate if additional robust and relevant epidemiological data were to become available.

If ESR recommends that 15 µg/100cm² is not an appropriate target level for remediation to achieve under question (1), what level do you think is the highest acceptable target level? Please explain the reasons for your conclusion.

ESR recommends that 15 µg/100 cm² is an appropriate target level for remediation to achieve for premises that test above this level.

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