

Voluntary Guidelines for Methamphetamine and Fentanyl Laboratory Cleanup



Contents

Acronyms	3
1.0 Introduction	4
1.1 Background	4
1.2 Purpose and Scope	5
1.3 Methodology	7
1.4 Potential for Future Research	7
1.5 How to Use this Document	8
2.0 Remediation Standards	9
3.0 Remediation Sequence and Techniques	11
3.1 Overview of Remediation Sequence	11
3.2 Hiring a Contractor	12
3.3 Ventilation	12
3.4 Worker Safety and Health	12
3.5 Preliminary Assessment	13
3.6 Pre-Remediation Sampling	14
3.7 Cleanup Plan	15
3.8 Removal of Contaminated Materials	15
3.9 Waste Characterization and Disposal Procedures	16
3.10 High Efficiency Particulate Air (HEPA) Vacuuming	16
3.11 Initial Wash	17
3.12 Heating, Ventilation and Air Conditioning (HVAC)	17
3.13 Detergent-Water Solution Washing	18
3.14 Post-Remediation Sampling	19
3.15 Encapsulation	19
3.16 Plumbing	20
3.17 Sewer/Septic	20
3.18 Outdoor Remediation	21
3.19 Final Report	21
4.0 Item- and Material-Specific Best Practices	22
4.1 Walls	22
4.2 Ceilings	22
4.3 Floors	22
4.4 Kitchen Countertops	23
4.5 Concrete, Cement and Brick	23
4.6 Appliances	23

4.7	Wood	23
4.8	Windows	24
4.9	Electrical Fixtures, Outlets and Switch Plate Covers	24
4.10	Dishes, Flatware and Other Hard Non-Porous Household Goods	24
4.11	Toys and Other Children’s Items	24
4.12	Carpets	24
4.13	Clothing and Other Fabrics.....	24
4.14	Leather or Fabric Upholstered Furniture.....	25
4.15	Mattresses	25
4.16	Paper Items/Books	25
4.17	Mobile Residences	25
5.0	Potential Sampling Constituents, Theory and Methods.....	26
5.1	Sampling Constituents.....	26
5.2	Sampling Theory	27
5.3	Wipe Sampling Methods	28
5.4	Microvacuum Sampling Methods.....	29
5.5	Quality Assurance/Quality Control (QA/QC).....	29
6.0	Clandestine Fentanyl Laboratory Cleanup.....	30
6.1	Background	30
6.2	Prevalence.....	30
6.3	Protection/Precautions/Planning.....	31
6.4	Remediation Standards	32
6.5	Remediation Techniques	33
6.6	Item- and Material-Specific Best Practices.....	34
6.7	Potential Sampling Constituents, Theory and Methods.....	34
	Endnotes	35
	Key Contributors.....	37
	Appendix A: Primary Methods of Meth Production and Associated Hazards	38
	Appendix B: Costs Associated with Meth Lab Cleanup	39
	Appendix C: Properties of Chemicals Associated with Meth	40
	Appendix D: Meth Resources.....	49
	Appendix E: Meth Lab Remediation Diagrams	53
	Appendix F: Fentanyl Resources.....	55
	Appendix G: Common Fentanyl Analogs	57
	Appendix H: Fentanyl Lab Remediation Diagrams.....	58
	Appendix I: Photo Credits.....	60

Acronyms

AACT	American Academy of Clinical Toxicology
ACMT	American College of Medical Toxicology
APR	Air Purifying Respirator
ASTM	American Society for Testing and Materials
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
DEA	U.S. Drug Enforcement Administration
DEC	Drug Endangered Children
DOJ	U.S. Department of Justice
DQOs	Data Quality Objectives
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HHW	Household Hazardous Waste
HVAC	Heating, Ventilation and Air Conditioning
IH	Industrial Hygienist
IHE	Illicit Hazardous Environments
LGR	U.S. EPA Local Governments Reimbursement Program
NACO	National Association of Counties
NAMSDL	National Alliance of Model State Drug Laws
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
OJP	U.S. Department of Justice Office of Justice Programs
ONDCP	White House Office of National Drug Control Policy
OSHA	Occupational Safety and Health Administration
P2P	Phenyl-2-Propanone
PID	Photoionization Detector
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SCBA	Self-Contained Breathing Apparatus
TCOs	Transnational Criminal Organizations
TSP	Trisodium Phosphate
TSP-PF	Phosphate-Free Trisodium Phosphate
USCG	U.S. Coast Guard
VOCs	Volatile Organic Compounds

1.0 Introduction

1.1 Background

The production and use of methamphetamine (meth) across the United States continues to pose considerable challenges to our nation. Meth is easy to make, is highly addictive and its production and use can have serious impacts on both human health and the environment. Despite a decline in domestic meth production in recent years, vigilance is warranted not only because of the destructive nature of meth itself, but also due to the significant environmental hazards meth laboratories (labs) generate. See *Appendix A: Primary Methods of Meth Production and Associated Hazards* and *Appendix B: Costs Associated with Meth Lab Cleanup* for more information.

Our nation first demonstrated its commitment to better understand the hazards associated with meth labs in March 1990, when the Joint Federal Task Force (Task Force) published the *Guidelines for the Cleanup of Clandestine Drug Laboratories* (commonly referred to as the *Red Book*). The Task Force was created as a result of Section 2405 of the Anti-Drug Abuse Act of 1988 (Public Law 100-690) and included representatives from the U.S. Drug Enforcement Administration (DEA), the U.S. Environmental Protection Agency (EPA) and the U.S. Coast Guard (USCG). The Task Force's charge was to issue guidelines to assist state and local officials conducting clandestine laboratory cleanups. The *Red Book* was first updated in 2005 and again in 2019. DEA's *Guidelines for Law Enforcement—Cleanup of Illicit Hazardous Environments (2019)*, addresses the various types of illicit hazardous environments (IHEs) found at illicit drug operations to include clandestine meth laboratories and clandestine fentanyl laboratories. Whereas DEA's document focuses on law enforcement's response to IHEs and their responsibility for the *removal* of hazardous chemicals and chemical waste (gross contamination), this document addresses *remediation* (the cleanup of residual contamination after gross removal has occurred), which is necessary to allow unrestricted future use of former clandestine drug laboratories.

In 2006, the White House Office of National Drug Control Policy (ONDCP) published the *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse (Synthetics Strategy)* as a companion to the *National Drug Control Strategy*. The *Synthetics Strategy* acknowledges that, "compared to first responder issues, a more complicated and less understood area of science is the optimal set and sequencing of response actions at former meth lab sites



that may possess residual chemical contamination."¹ Thus, the *Synthetics Strategy* tasked EPA with identifying best practices related to the remediation of former meth labs.

Congress passed the Methamphetamine Remediation Act (Public Law 110-143) in December 2007 directing EPA to establish voluntary guidelines for

EPA's Local Governments Reimbursement Program

In the event of a release (or threatened release) of hazardous substances, EPA may reimburse local governments for expenses related to the release and associated emergency response measures. The Local Governments Reimbursement (LGR) Program provides a "safety net" of up to \$25,000 per incident to local governments that do not have funds available to pay for response actions.

Under the LGR Program, costs associated with the gross removal of meth labs and their related wastes may be eligible for reimbursement. These costs may include overtime wages related to hours spent securing the site or performing decontamination, costs for equipment purchased specifically for the response and contractor cleanup costs incurred by the local government for gross removal. However, costs related to long-term remediation actions as described in these voluntary guidelines (e.g., hiring a remediation contractor, conducting pre- and/or post-remediation sampling, developing a remediation cleanup plan and outdoor remediation) are generally not eligible for reimbursement under the LGR Program.

For more information, please visit the LGR website:
<https://www.epa.gov/emergency-response/local-governments-reimbursement-program>

the remediation of former meth labs based on the best currently available scientific knowledge. This document, in addition to new research, serves to meet both the *Synthetic Strategy's* and the Methamphetamine Remediation Research Act's goals of improving "our national understanding of identifying the point at which former methamphetamine laboratories become clean enough to inhabit again."²

1.2 Purpose and Scope

EPA prepared this document to provide voluntary cleanup guidelines to homeowners, cleanup contractors, industrial hygienists, policy makers and others involved in meth lab remediation. It does not set requirements, but rather suggests a way of approaching meth lab remediation. Those using this document should also consult their appropriate state and local requirements or guidelines. This document is not meant to supersede state and local requirements or guidelines (however, this document may be useful to state and local authorities as they develop and/or review and revise their own requirements or guidelines). EPA did not design this document for real estate transaction purposes. For disclosure laws, those using this document should consult their state and local authorities. Recognizing the emerging threat of fentanyl and the significant hazards fentanyl poses to the public, EPA updated this document in 2021 to include a new chapter on fentanyl remediation. This chapter can be found in *Section 6.0*. The purpose and scope described above related to meth lab remediation may be applied to fentanyl lab remediation as well.



Meth Labs

These voluntary guidelines specifically address the remediation of former meth labs and the unique dangers and hazards associated with them and may be applied to all meth labs regardless of the manufacturing method utilized. For the reasons listed below, no two meth labs are alike:

- Meth labs range from crude, makeshift operations to highly sophisticated and technologically advanced facilities.
- Meth labs can be set up almost anywhere and are often found in private residences, motel and hotel rooms, apartments, trailers, automobiles, campgrounds and commercial establishments. Labs are also found in rural outbuildings, barns and other structures that may appear uninhabitable.
- There are many ways to make meth, and the precursor chemicals, by-products and hazards associated with each production method differ.

Partial Meth Labs

The manufacture of meth is a multi-stage process. In some cases, the various steps are performed in more than one lab or structure. For example, unrefined drug precursors may be chemically altered in one location and used in the final steps of the meth manufacture process later at a different location. Labs in which only a partial step of the meth manufacturing process was performed are called "partial labs." The remediation process described in this document accounts for the possibility that precursor chemicals, in addition to meth, may be present in the structure. While each lab should be evaluated on a case-by-case basis, the remediation techniques contained in this document are applicable to partial labs.

Meth Conversion Labs

Mexican Transnational Criminal Organizations (TCOs) are the primary suppliers of meth in the United States. Manufactured on an industrial scale in Mexico, the meth is smuggled across the Southwest Border of the United States and is available in greater quantities and a lower cost than product made in domestic laboratories. Before it is smuggled into the country, the meth is often dissolved into liquids including vehicle fluids, fuel, water and alcoholic beverages to avoid detection. Once across the border, the meth needs to be extracted from the solution in which it was dissolved and recrystallized so conversion labs are becoming more commonplace. This process requires a variety of hazardous chemicals.³ While each lab should be evaluated on a case-by-case basis, the remediation techniques contained in this document are generally applicable to conversion labs.

Cooking vs. Smoking Meth

Studies have shown that the smoking of meth alone can produce levels of airborne meth that may result in a general contamination of the structure in which it is smoked (although contamination levels will depend

upon how much meth was smoked and the smoker's technique).⁴ 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." This may be especially relevant as the number of meth labs in the United States where manufacture occurs has significantly declined in recent years – from a high of 23,703 in 2004 to the lowest reported in 19 years of 891 in 2019.⁵ Despite the drop in the number of labs seized in the United States, the abuse of meth in this country remains high as does the likelihood of encountering contaminated meth sites.

Fentanyl Labs

Properties may be contaminated by hazardous chemicals used or produced in the manufacture or packaging of fentanyl where those chemicals remain and where the contamination has not been remediated. Procedures for the assessment and remediation of properties or materials contaminated with fentanyl may be most applicable in situations where contamination of fentanyl is known (or determined) to have occurred. In this document, "clandestine fentanyl laboratory" means any location involved in the illegal manufacturing or storage of fentanyl. This may include manufacturing, compounding, converting, producing, deriving, processing or preparing, either directly or indirectly by chemical extraction, pill pressing, distribution, cutting, diluting, synthesis or other activity that has the potential to contaminate the property with fentanyl or any of its precursors.

As with meth labs, law enforcement will conduct the initial cleanup of the fentanyl-contaminated property limited to the removal of bulk hazardous materials, equipment and associated glassware that pose an immediate threat to public health and the environment. Where fentanyl production has occurred, significant levels of contamination may be found throughout properties if the contamination is not remediated.

As of August 2021, there are currently no state or federal standards in the United States for determining when the site of a closed fentanyl drug laboratory has been successfully remediated.

While many of the remediation considerations and techniques for fentanyl are similar to those for the remediation of meth, the particle size, toxicity and production of fentanyl means a few different procedures should be followed. These differences are noted in *Section 6.0*.

Removal vs. Remediation

Making a former meth or fentanyl lab safe for reoccupation requires two basic efforts: 1) the removal of gross contamination (i.e., containers of chemicals, equipment and apparatus that could be used to make illegal drugs); and 2) the remediation of interior structures and surrounding soil, surface waters and groundwater. This document provides voluntary guidelines related to remediation. As the *Synthetics Strategy* explains, "remediation involves utilizing recognized procedures and technology-based standards to restore former meth labs to a state in which the property can be inhabited again—or, instead, identifying properties that are not yet ready for reoccupation and must undergo further treatment."⁶ Remediation always occurs after gross chemical removal, when the site is secured and is no longer subject to criminal investigation.

Household Hazardous Waste

While the Resource Conservation and Recovery Act (RCRA) allows disposal of household hazardous waste (HHW) in municipal landfills, meth and fentanyl lab waste chemicals would neither be generated as waste in normal residential households, nor generated in the quantities that might be used in the normal activities and maintenance of a residence. For these reasons, EPA does not consider meth and fentanyl lab waste chemicals and materials contaminated by those chemicals to be RCRA exempt household hazardous wastes.

Children's Health

Protecting children's health from environmental risks is fundamental to EPA's mission. Children may be more vulnerable to environmental exposures than adults because their bodily systems are still developing; they eat more, drink more and breathe more in proportion to their body size; and their behavior can expose them more to chemicals and organisms.⁷ According to the Department of Justice (DOJ) Office of Justice Programs (OJP), children who live in or visit meth labs or are present during drug production face acute health and safety risks. The age-related behaviors of young children (such as frequent hand-to-mouth contact and physical contact with their environment) increase the likelihood that they will inhale, absorb or ingest toxic chemicals, drugs or contaminated food. Their physiological characteristics (such as higher metabolic and respiratory rates and a developing central nervous system) leave them particularly vulnerable to the effects of toxic chemical exposures. Exposure to drugs and alcohol before birth places infants at increased risk for neurological abnormalities and respiratory problems, which may be compounded by ongoing

environmental exposures. Children may also have a special vulnerability to certain harmful materials that may be present during meth lab remediation activities, including lead, asbestos and mercury. For these reasons, special care should be taken when cleaning up a former meth lab if a child lives or will live in the residence. The same considerations related to children's health for meth lab remediation should be employed for the remediation of fentanyl.

Drug Endangered Children

Many states have enacted Drug Endangered Children (DEC) laws to protect children from the consequences of drug production, trafficking and abuse. For more information, please see the National Alliance for Drug Endangered Children website: www.nationaldec.org.

Environmental Justice

EPA does not regulate the cleanup of meth or fentanyl labs; the priorities for such cleanups are set by state and local laws. As such, concerns related to environmental justice (an EPA priority) should be left to the discretion of the state and local jurisdiction.

1.3 Methodology

A research team reviewed federal and state requirements and guidelines and other relevant studies, noting potential best practices as well as discrepancies in recommended practices.

After this research was completed, a group convened at EPA headquarters in Washington, D.C. in December 2007 to review the findings, provide feedback and share individual opinions. The group of 13 individuals (internal and external to EPA) included environmental, public health, industrial hygiene and toxicology professionals. During the meeting, these subject matter experts confirmed existing best practices, discussed the discrepancies in recommended practices and shared other best practices based on their own experiences. EPA used both the findings from the research effort and the opinions expressed in the meeting to develop these voluntary guidelines.

Following the meeting, this document was distributed for wider review. EPA received comments from the Association of State and Territorial Solid Waste Management Officials (ASTSWMO), the Agency for Toxic Substances and Disease Registry (ATSDR), the National Association of Counties (NACO), the National Institute of Standards and Technology (NIST), ONDCP and several other stakeholders. Updates were made based on these comments, as appropriate.

Then, in August 2008, the National Alliance of Model State Drug Laws (NAMSDL) convened a forum of its Cleanup and Remediation Working Group in Santa Fe, New Mexico to discuss the issues surrounding the cleanup and remediation of properties contaminated by meth labs. As part of the forum, working group members provided feedback on these voluntary guidelines and addressed outstanding questions. The voluntary guidelines were updated as a result of this input and other feedback from experts around the country.

In November 2012, EPA began a process to update these voluntary guidelines. As such, EPA solicited feedback from the original group of subject matter experts and other partners. The experts and partners assessed whether the information in this document was still accurate and relevant, identified other information that might be added and discussed how these voluntary guidelines are being used. Based on the input from the experts, the document was revised again and distributed for wider review during early 2013. Comments were received from several states and other stakeholders and additional updates were made to finalize these voluntary guidelines in March 2013.

In January 2020, EPA began the process of updating the guidelines again to better reflect the current state and to include a new section about fentanyl. Internal and external stakeholders reviewed the document and provided feedback and targeted comments. Based on the input from these partners, the document was revised and distributed for wider review. Additional updates were made to finalize these voluntary guidelines in August 2021. The name of the document was also changed to reflect the addition of the new fentanyl chapter.

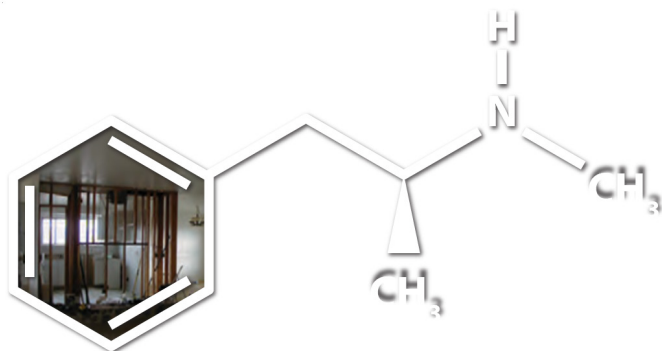
A list of key contributors to this document can be found on page 37.

1.4 Potential for Future Research

Because state and local approaches to cleaning up meth labs vary, there are sometimes differences in recommended practices or techniques. This variance in opinion indicates a need for further research. In many cases, the remediation techniques and approaches included in this document have not been vetted through rigorous scientific review. Instead, the recommendations are based on the lessons learned and practical experience of experts in the field. These voluntary guidelines may be augmented by EPA's research and development, with support from DEA, NIST and other agencies, as it is made available.

The above also applies to fentanyl remediation. As of August 2021, there are no state or federal standards for

determining when a closed fentanyl drug laboratory has been successfully remediated in the United States. Due to this and as on the ground situations change, new fentanyl analogs are encountered or remediation techniques are improved; these voluntary guidelines may need to be augmented by other sources and information.



1.5 How to Use this Document

This document begins with background information on quantitative meth remediation standards from across the United States. Next, this document presents users with a possible sequence of remediation activities, from securing the site to delivering the final report. Once the process for remediation is understood, users will find best practices on how to clean specific items and/or materials found within a former meth lab (e.g., walls, floors, appliances, electronics, fabrics, toys). This document also offers detailed information on sampling techniques and methods. A new chapter about fentanyl cleanup is included as well due to increasing clandestine fentanyl lab encounters in the United States. Special considerations are warranted because of the toxicity of fentanyl, its physical properties and the ability to alter the fentanyl structure resulting in hazardous/toxic fentanyl analogs. Finally, the appendices provide additional information and resources.

2.0 Remediation Standards

Due to the variety of chemicals that could potentially be used to manufacture meth, it can be time consuming and prohibitively expensive to sample for all of them. In addition, many of the chemicals used in the manufacturing process are already present in most homes. See *Appendix C: Properties of Chemicals Associated with Meth* for more information. [Note: In cases where the manufacturing method is known to employ chemicals that present unique hazards (such as a Phenyl-2-Propanone (P2P) lab), testing for individual components of the manufacturing process may be warranted.]

With this in mind, meth is often used as an indicator for the effectiveness of cleanup activities. This is based on the following assumptions:

- Bulk chemicals will be removed during the gross removal;
- Furniture, appliances or building materials with obvious stains (i.e., contamination) will be discarded;
- Many of the other potential contaminants are volatile organic compounds (VOCs) and tend to volatilize before and/or during cleanup; and
- The activities needed to clean up a structure to meet the applicable state standard for meth should be sufficient to reduce concentrations of other potentially hazardous chemicals as well.

EPA does not intend this document to set, establish or promote quantitative cleanup standards. Many state and local authorities have established quantitative cleanup standards for meth and chemicals associated with its production. As of August 2021, 21 states require or recommend that meth labs be cleaned to meet certain quantitative meth remediation standards. Current state standards range from 0.05 $\mu\text{g}/100\text{ cm}^2$ to 1.5 $\mu\text{g}/100\text{ cm}^2$. The most common standard is 0.1 $\mu\text{g}/100\text{ cm}^2$. Additionally, 11 states have process-based cleanup guidance materials, but no associated numerical remediation levels. See *Appendix D: Meth Resources* for more information. Those using this document should bear in mind that state and local requirements and guidelines change frequently.

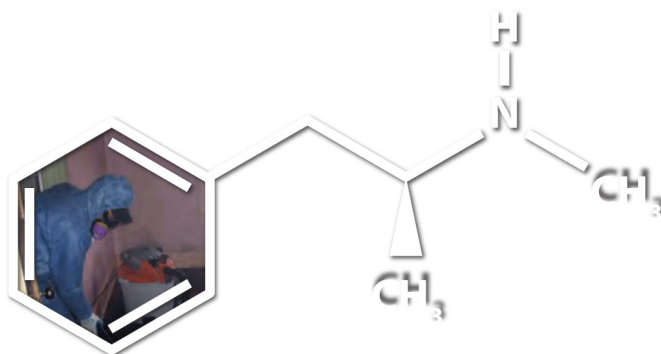
Most state remediation standards are based on analytical detection limits and feasibility—they are not health-based standards. It is important to note, however, that



these standards are believed to be set at sufficiently conservative levels to still be health-protective.⁸ In other words, remediation standards are believed to account for the scientific uncertainty involved in meth lab remediation in the interest of protecting human health and the environment.

In December 2007, California's Department of Toxic Substances Control (DTSC) announced that it had calculated a health-based remediation standard for meth of 1.5 $\mu\text{g}/100\text{ cm}^2$.⁹ In February 2009, DTSC finalized the scientific documents that form the basis for this health-based cleanup standard. In October 2009, the new health-based standard of 1.5 $\mu\text{g}/100\text{ cm}^2$ was signed into state law as a safe level of methamphetamine on an indoor surface. Washington adopted the 1.5 $\mu\text{g}/100\text{ cm}^2$ remediation standard. Additionally, Kansas, Montana, Virginia and Wisconsin guidance use the value of 1.5 $\mu\text{g}/100\text{ cm}^2$.

In addition to including remediation standards for meth, some states include quantitative standards for VOCs, corrosives, lead, mercury and iodine. Cleanup standards for meth and VOCs apply to all meth manufacturing sites, regardless of the cooking method(s) used. Cleanup standards for lead and mercury are especially relevant in instances where the P2P method of manufacturing meth was employed.



As of August 2021, nine states require or recommend VOC levels of less than 1 ppm. Six states set corrosive standards or recommend targets for surface pH of 6 to 8. [Note: *The challenges associated with pH sampling are described in Section 5.1.*] Ten states include lead standards or targets in their remediation guidelines; standards and targets range from 40 µg/ft² (or its equivalent of 4.3 µg/100 cm²) to a more protective standard of 10 µg/ft² (or its equivalent of 1 µg/100 cm²). Eleven states include mercury standards

or targets in their remediation guidelines; standards and targets range from a more conservative 0.05µg/m³ (equivalent to 50 ng/m³) to 3.0 µg/m³ (equivalent to 3,000 ng/m³) of mercury in air. Two states set an iodine standard or target of 22 µg/100 cm² for iodine-stained surfaces that are cleaned rather than removed. See *Appendix D: Meth Resources* for more information. These standards and associated sampling techniques are addressed in greater detail in *Section 5.0*.

Chemicals Used in Meth Production									
Chemical	Commonly Sold/ Found As	Usage	Health Hazards	Poison	Flammable	Toxic Vapors	Explosive	Corrosive	Skin Absorption
Acetone	Paint Thinner, Nail Polish Remover	Solvent	Reproductive disorders; skin and tissue irritation	●	●	●			●
Ammonium Nitrate	Instant Ice Packs, Fertilizer		Eye and lung irritant; skin irritant, permeator; ingestion of large amounts cause stomach irritation	●	●		●		●
Anhydrous Ammonia	Farm Nurse Tanks	Reagent	Freezes and burns skin; destroys mucous membranes; causes asphyxia	●		●		●	●
Camping Fuel	Coleman Fuel	Solvent	Skin irritation	●	●		●		
Ether	Starter Fluid	Solvent	Respiratory failure	●	●		●		
Hydriodic Acid	Sold commercially as lab grade	Reagent	Burns; thyroid damage; lung damage	●		●		●	●
Hydrogen Chloride Gas	Sold commercially as lab grade	Reagent	Respiratory failure; liver damage	●		●	●	●	●
Hydrogen Peroxide	First Aid Antiseptic (3%)	Reagent	Skin and eye irritant and corrosive; lung sensitizer	●					●
Iodine	7% Iodine Tincture	Reagent	Extremely hazardous in case of skin or eye contact	●	●			●	●
Isopropyl Alcohol	Rubbing Alcohol	Solvent	Eye, lung and stomach irritant; somewhat hazardous in case of skin contact (irritant, sensitizer, permeator)	●	●		●		●
Lithium Metal	Lithium Batteries	Reagent	Burns; lung damage	●			●	●	●
Methanol	HEET	Solvent	Blindness	●	●	●			●
Mineral Spirits	Paint Thinner	Solvent	Eye and lung irritation	●	●	●	●		
Muriatic Acid	Pool Cleaner/ Concrete Etcher	Reagent	Burns; toxic vapors	●		●		●	
Pseudoephedrine	Decongestant (e.g., Sudafed)	Precursor	Unknown						
Red Phosphorous	Striker Plates on Matches and Road Flares	Reagent	Irritant; produces phosphine gas	●		●			
Sodium Hydroxide	Drain Cleaner (e.g., Drano)	Reagent	Burns	●				●	●
Sodium Metal	Sold commercially as lab grade	Reagent	Eye and tissue burns; temporary hair loss	●	●	●			●
Sulfuric Acid	Drain Cleaner (e.g., Liquid Fire)	Reagent	Very hazardous in case of skin or eye contact; may produce severe irritation of respiratory tract	●			●	●	●
Toluene	Paint Thinner	Solvent	Hazardous in case of skin or eye contact	●	●	●		●	●

3.0 Remediation Sequence and Techniques

Section 3.0 suggests a remediation sequence and techniques.

3.1 Overview of Remediation Sequence

Below is an overview of the possible sequence in which remediation activities may occur. See *Appendix E: Meth Lab Remediation Diagrams* for more information. Each of the processes below is described in greater detail later in this section. The sequence in this list begins after gross removal has occurred and any law enforcement investigation has concluded. All procedures should adhere to the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard, 29 CFR 1910.120 and other applicable state and local requirements and guidelines. Gross removal includes the removal and disposal of bulk chemicals, equipment and apparatus (hazardous wastes) that could be used to manufacture meth and typically occurs immediately following the seizure of a clandestine lab by law enforcement. *[Note: Chemical containers, equipment or apparatus from the lab may be left behind during the gross removal step. If these items are encountered, stop work and contact local law enforcement personnel (or other appropriate agencies). If law enforcement does not need these items and they can be handled safely, dispose of them appropriately as outlined in the Red Book.]*

1. Secure the property to prevent unauthorized entry. The structure should not be reoccupied until after remediation is complete.
2. Hire a contractor to conduct remediation, sampling and air monitoring.
3. Ventilate or “air out” the structure with fresh, outdoor air [e.g., open doors and windows; use fans, blowers and/or a negative air unit with a high efficiency particulate air (HEPA) filtration system] to ensure worker safety and health. Continue ventilation during the remediation process, taking steps to protect nearby or adjacent structures from contamination.
4. Perform a preliminary assessment:
 - a. Conduct an off-site evaluation using relevant documentation.
 - b. Conduct an on-site evaluation.
 - c. Assess the need for pre-remediation and post-remediation sampling.
5. Conduct pre-remediation sampling, if applicable.
6. Develop a cleanup plan using information from the preliminary assessment. This should include a decontamination plan and a waste disposal plan.
7. Remove contaminated materials. Any materials or objects that will be disposed of should be discarded before cleanup begins.
8. Clean the rooms and areas in the structure from the back to the front, sealing those areas to avoid potential recontamination and continuing through the structure.
9. Vacuum walls, floors and other hard surfaces using a vacuum with a HEPA filter.
10. Complete an initial washing of the walls and floors to remove most of the contamination.
11. Clean and seal the heating, ventilation and air conditioning (HVAC) system at all openings. Do not run this system again until all other cleanup is complete to prevent potential recontamination.
12. Flush plumbing traps.
13. Use a detergent-water solution to wash ceilings, walls, floors, non-porous furniture and other items that will be kept.
14. Conduct post-remediation sampling, if applicable. (Ensure structure/items are completely dry before sampling.)



15. Consider encapsulating washed ceilings, walls and floors once they meet remediation requirements or guidelines.
16. If wastewater from detergent-water washing is disposed of down drains within the structure, flush the system again after remediation.
17. Ventilate the structure once more after indoor cleanup is complete.
18. Perform outdoor remediation activities.
19. Secure the property once more to prevent unauthorized entry.
20. Prepare the final report.

3.2 Hiring a Contractor

Hire a contractor who has hazardous waste expertise and is certified (if certification is required by the state) to conduct cleanup operations at known or suspected meth labs. Several states have developed meth lab remediation certification programs for contractors, which help to ensure remediation processes are adequately conducted. Contractors who have not been certified in a similar program should, at a minimum, complete the 40-hour HAZWOPER training (OSHA 29 CFR 1910.120).

It may also be appropriate to involve a certified industrial hygienist (CIH) in cleanup operations. Some states require that a CIH or experienced industrial hygienist (IH) conduct the preliminary assessment and post-remediation sampling. A CIH is trained in the assessment and control of chemical hazards and can play a significant role in ensuring that working conditions are safe during the remediation process. It is recognized that a CIH may not be available to accompany contractors to every cleanup site and that the use of a CIH can be expensive if they are involved in the entire remediation process. Therefore, contractors may consult a CIH to establish a general meth lab cleanup strategy. Other potential resources that may be consulted include state and local health agencies and environmental health specialists.

3.3 Ventilation

For the safety of on-site personnel, ventilate or “air out” meth labs with fresh, outdoor air (by opening doors and windows, and using fans, blowers and/or a negative air unit with a HEPA filtration system) before, during and after the remediation process. HVAC systems should be shut down and remain off until remediation of the former meth lab is complete.

Pre-Remediation Ventilation

Ventilate the lab prior to the entry of cleanup personnel. In some cases, law enforcement personnel will have already ventilated the lab before conducting criminal

investigation activity or the gross removal of chemicals. If the lab was sealed after these activities, ventilate the lab again before remediation occurs. Ventilation should be performed per the contractor’s recommendation or for a minimum of 24 hours.¹⁰

While several state guidelines recommend “baking,” or heating the structure with the doors and windows closed to promote the volatilization of chemicals, its effectiveness has not been documented. Baking is sometimes used for the remediation of mercury, so in cases of a P2P lab, this step might be employed. However, it is believed that baking may mobilize and redistribute chemicals, thereby spreading contamination. For this reason, baking is not recommended until further research is conducted.

Continued Ventilation

It is important to continue ventilation throughout the remediation process (except when it would interfere with air monitoring). To protect workers and to limit cross-contamination, leave windows open and use fans, blowers and/or a negative air unit with a HEPA filtration system during cleanup. If using fans, blowers and/or a negative air unit, personnel should take precautions to avoid contaminant migration to areas that were not previously contaminated. A negative air unit equipped with a HEPA filtration system limits or prevents the transfer of airborne contamination from dirty to previously cleaned areas. Also, take precautions to avoid contamination of nearby or adjacent structures during all ventilation activities.

Post-Remediation Ventilation

Ventilate the property after cleanup is completed. After completion of all cleanup activities, contractors, owners and future occupants should be on alert for any new staining and/or odors (the presence of which would indicate that additional cleaning is necessary).

3.4 Worker Safety and Health

All procedures should adhere to OSHA HAZWOPER Standard, 29 CFR 1910.120 and other applicable state and local worker safety and health requirements. Do not begin remediation work until gross chemical removal is complete, law enforcement personnel have cleared the structure of defense measures placed by the lab operators (such as anti-personnel devices or “booby traps”) and the structure has been ventilated. Use the “buddy system” when making initial entry for remediation work, in case unforeseen dangers are encountered. In addition, conduct air quality monitoring to ensure the atmosphere is safe for entry.

Personnel who enter a former meth lab should have safety and health training (40-hour HAZWOPER training), and should use the appropriate level of personal protective equipment (PPE) based on the site-specific conditions.

Types and Levels of Personal Protective Equipment (PPE)*

Level A (*greatest level of skin, respiratory and eye protection*) — **positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH); totally-encapsulating chemical-protective suit; gloves, outer, chemical-resistant; gloves, inner, chemical-resistant; boots, chemical-resistant, steel toe and shank; and disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).**

Level B (*highest level of respiratory protection but lesser level of skin protection*) — **positive pressure, full-facepiece SCBA, or positive pressure supplied air respirator with escape SCBA (NIOSH approved); hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls); gloves, outer, chemical-resistant; gloves, inner, chemical-resistant; boots, outer, chemical-resistant steel toe and shank.**

Level C (*concentration(s) and type(s) of airborne substance(s) is known and criteria for using air purifying respirators are met*) — **full-face or half-mask, air purifying respirators (APR) (NIOSH approved); hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls); gloves, outer, chemical-resistant; gloves, inner, chemical-resistant.**

Level D (*work uniform affording minimal protection: used for nuisance contamination only*) — **coveralls; boots/shoes, chemical-resistant steel toe and shank.**

*OSHA Standard 1910.120, Appendix B

PPE for meth labs may include protective eye glasses, disposable gloves, foot coverings, steel toe boots and long-sleeved coveralls or a disposable protective suit. Decontaminate or discard, as appropriate, all clothing and PPE worn during remediation.

Because meth can be injected intravenously, loose hypodermic needles may be present in a former meth lab and may pose a danger to those involved in remediation activities. Therefore, wear heavy work gloves and thick-soled leather shoes when collecting and removing trash, bedding, clothing, drapes, furniture, carpet, flooring or materials from any location that could conceal needles.¹¹ Dispose of all needles in a labeled sharps container following state and local requirements or guidelines.

Use respiratory protection when removing carpet and other flooring or working in highly contaminated areas. Respirators also should be used if the inhalation of sampling materials and cleanup solvents poses a threat

to human health. Never eat, drink, smoke or store food or beverages in a former meth lab prior to or during remediation.

3.5 Preliminary Assessment

Once the materials and equipment used in the manufacture of meth have been removed by law enforcement, a preliminary assessment should be conducted. The goal of the preliminary assessment is to provide information that will inform the development of the sampling and cleanup plan (if needed). The preliminary assessment should be documented in a written summary and include a record review and a site survey.

Record Review

To perform the record review, coordinate with state and local health departments and review copies of law enforcement or hazardous waste removal contractor reports (if available) for information on the duration of lab operation, manufacturing method, chemicals found, cooking locations, storage locations, disposal areas and observed contamination. This information, when coupled with the professional judgment of a cleanup professional (e.g., cleanup contractor, CIH/IH), can provide a foundation for the cleanup plan. Information gathered from those directly involved with the meth lab should be evaluated carefully because they may not be reliable sources.

Based on law enforcement or hazardous waste removal contractor reports, or on the professional judgment of the assessor, the record review can help to:

1. Establish the cooking method(s) employed during the manufacturing process.
2. Determine the quantities of chemicals found at the site and types of chemicals expected to have been on-site, based on the cooking methods.
3. Identify areas of expected contamination.

Site Survey

After compiling all available information, conduct the site survey to confirm the information gathered during the record review, document actual conditions of the site and provide information for developing the cleanup plan. Whenever possible, document conditions of the site with photographs.

While conducting the site survey, take precautions to ensure worker safety and health. Contamination can be removed prior to the preliminary assessment if it poses an imminent threat to human or environmental health. The structure(s) should be ventilated before entry, and assessors should wear the appropriate PPE.

Assessors should notify law enforcement personnel (or other appropriate agencies) if additional materials likely to have been used in the manufacture of meth are discovered.

To complete the site survey:

1. Compile a description and diagram of the site that includes: address, description and location of all structures; the layout of the property; and a description of adjacent properties and structures. For structures, the diagram should document the size and location of all rooms (e.g., basement, attic, closets), how the rooms connect and their expected use (e.g., bedroom, closet). In addition, the location of doors, windows, the ventilation system and appliances should be noted on the diagram. This description should include interior surfaces (e.g., walls, ceilings, floors, countertops) and any furnishings that remain on-site after gross removal.
2. Document areas of heaviest contamination. These areas could be identified by visible evidence of contamination (such as staining) or based on the professional judgment of the assessor. If visible signs of contamination do not exist, this does not mean there is no contamination. Residual meth should be routinely expected throughout the structure.
3. Determine or confirm the cooking method(s) employed during the manufacturing process.
4. Determine the presence of other potential hazards to cleanup personnel or future occupants including lead, asbestos and mercury which may include specific health concerns in their own right.
5. Examine the ventilation system for signs of contamination (e.g., rust). If contamination is suspected, sample the cold air return.
6. Examine the plumbing system (e.g., sinks, toilets, showers, tubs, drains) for damage. In addition, the assessor should identify the type of wastewater disposal system present (e.g., sewer connection, septic system).
7. Investigate any adjacent or nearby structures for avenues of potential contamination (e.g., common spaces, hallways, shared ventilation system). Cross contamination can often occur in townhouses, motels/hotels, apartments or duplexes.
8. Determine if outside disposal occurred (e.g., burning, dumping, burying, drainage to septic system) and caused soil, surface waters or groundwater contamination. Common signs of outside disposal include burned or dead vegetation and stained soil.

3.6 Pre-Remediation Sampling

The decision whether to conduct pre-remediation sampling (and for which constituents) is best made on a property-specific basis. Owners and contractors should consult state and local requirements or guidelines when making the determination whether to conduct pre-remediation sampling.

Pre-remediation sampling can reduce costs by streamlining the cleanup process and identifying materials that are too contaminated to clean and should simply be removed. Pre-remediation sampling also can be useful in excluding certain portions of a property from a cleanup, such as areas to which the operators of the lab did not have access.

If pre-remediation sampling is conducted it should be conducted using the same protocols used for post-remediation sampling (see *Section 5.0*).

Pre-remediation sampling also may be performed for the following reasons:

- To ensure the safety and health of those working on a site before or during remediation.
- To establish whether contamination exceeds state and local requirements or guidelines.
- To inform the cleanup plan and process by identifying the extent of contamination in areas of the former lab.
- To determine which materials can be cleaned and which should be removed. This assessment can help lower overall cleanup costs.
- To help quantify cost estimates for cleanup.
- To sample for lead and mercury, two elements commonly associated with the P2P method of production, if this method was employed.
- To corroborate or augment information that law enforcement officers gathered from those directly involved with the meth lab.
- To meet pre-remediation sampling requirements of a bank, insurance agency, mortgage holder, other private entity or state and local authorities.
- To allow for the comparison of pre- and post-remediation samples to show the reduction of contaminants achieved through remediation. *[Note: The same sample collection method should be used for both pre- and post-remediation sampling if parties intend to compare results.]*
- To establish a record of baseline conditions prior to remediation.

In other cases, pre-remediation sampling is not required and may increase costs. Some states assume that all areas of a former meth lab are contaminated and require that the entire structure be cleaned. For some structures, it is more cost-effective to remediate the entire structure than to take pre-remediation samples in an attempt to avoid having to remediate certain areas.

3.7 Cleanup Plan

The information from the preliminary assessment and pre-remediation sampling (if conducted) should be used to develop the cleanup plan. This plan will guide the remedial actions at the site and should:

- Describe security provisions in place for the site.
- Contain a summary of all information gathered in the preliminary assessment.
- Provide information on the contractor, project manager and site supervisor performing the cleanup (if applicable). This should include verification and documentation of the contractor's certification and/or qualifications.
- Contain a list of emergency contacts and telephone numbers.
- Determine whether utilities should be disconnected from the structure until cleanup and remediation activities are complete and make appropriate provisions for power needs, if necessary.
- Determine what level of PPE workers should wear while in the contaminated portion of the site. This section should describe any safety and health procedures (including personnel decontamination procedures) that will be followed throughout cleanup. All procedures should adhere to OSHA and other applicable state and local worker safety and health requirements or guidelines. The location and route to the nearest hospital or emergency service facility also should be noted.
- Contain a shoring plan, if structural integrity was determined to be a concern during the preliminary assessment.
- Describe the cleanup methods to be used, including:
 - a list of the items to be removed from the structure;
 - a list of all surfaces or items to be cleaned on-site;
 - procedures for cleaning;
 - areas to be encapsulated;
 - locations and procedures for on-site decontamination; and
 - containment plans for the cleanup to prevent off-site contamination.

- Describe the plan for waste disposal that complies with federal, state and local requirements or guidelines regarding materials removed from the structure. This plan applies to hazardous waste and solid waste, as well as wastewater. The plan should include the name of the disposal facility and documentation that the facility is equipped to handle the types of wastes generated (such as hazardous materials).
- List any permits that will be required for the cleanup.
- Describe pre-remediation (if applicable) and post-remediation (if applicable) sampling methods, including where and how many samples will be collected and the remediation standards that will be used.
- List the personnel collecting the samples, the name of the analytical laboratory and the analytical methods for the samples.
- List Quality Assurance/Quality Control (QA/QC) practices that will be followed.
- Contain a schedule of anticipated actions.
- Outline the post-remediation walk-through and final report to document the effectiveness of the cleanup.

Once developed, the cleanup plan should be accepted by the property owner and the decontamination contractor, and any necessary government approvals should be sought and received.

3.8 Removal of Contaminated Materials

After gross removal has occurred and the structure has been ventilated for a minimum of 24 hours, properly discard all materials that will be removed from the lab per the cleanup plan. *[Note: If you find chemical containers, equipment or apparatus from the lab left behind during the gross removal step, stop work and contact local law enforcement (or other appropriate agencies). If law enforcement does not need these items and they can be handled safely, dispose of them appropriately.]*

Discard any visibly stained, odor-emitting or damaged materials and decide whether to clean or discard other items on a case-by-case basis using information from the preliminary assessment and a cost-benefit analysis. Although there is no single determinant that can be used to decide which items should be discarded and which items can be cleaned and kept, consider the following during the decision-making process:

Potential for Contact — Consider whether inhabitants of the structure are likely to come into contact with the item regularly (such as bedding). Discard contaminated items

with a high potential for human contact more readily than items with a low potential for human contact. Take extra consideration when deciding whether to discard items that children are likely to come into contact with (e.g., toys, bottles) as children may be especially vulnerable to environmental toxins.

Intrinsic or Emotional Value — Weigh the intrinsic or emotional value of the item with how much it would cost to effectively clean the item. If sampling will be conducted, the cost of cleanup includes the cost of sampling to ensure the item is cleaned. In many cases it is more cost-effective to dispose of an item and replace it than it is to clean it. In some circumstances, however, items of great emotional value (e.g., wedding albums) may be salvaged.

Porosity — Consider the porosity of the item or material. In general, porous items and materials are easily penetrated or permeated by hazardous gases, liquids or residues. Non-porous surfaces are more resistant to this type of contamination. As a result, contamination is often found in porous items and *on the surface* of non-porous items. Thus, it is generally more difficult to eliminate contamination from porous items and materials. Because definitions of “porous,” “semi-porous” and “non-porous” differ, the recommendations in *Section 4.0* are organized according to item or material.

Considering the potential for human contact, the intrinsic and emotional value and the porosity of an item or material may help guide decisions as to whether the item or material should be discarded. For example, carpet should be discarded because it has a high potential for human contact (especially since young children tend to crawl on the floor), has relatively low intrinsic and emotional value and is extremely porous (making it difficult to successfully decontaminate).

Items Brought into a Lab After the Cook Has Vacated

In some unfortunate cases, innocent and unsuspecting individuals and families move into former meth labs before the structure has been properly cleaned. These individuals/families later discover that their home was a lab (e.g., by talking to a neighbor, finding lab paraphernalia or experiencing health symptoms, etc.), and their belongings may be contaminated. Given these circumstances, contents brought into a former lab *after the cook has vacated* should be given special consideration. These items are likely to be less contaminated and, therefore, may be easier to clean.

3.9 Waste Characterization and Disposal Procedures

Some items or materials removed from a former meth lab may be classified as hazardous—depending upon federal, state and local requirements—and may not be appropriate for disposal at a local landfill. Refer to the appropriate federal, state and local solid waste authority to determine what disposal procedures are necessary. Additionally, contact the local landfill operator prior to disposal to ensure the facility will accept the wastes.

Several state requirements and guidelines suggest that all contaminated materials be wrapped and sealed before they are removed from the site to avoid spreading the contamination to unaffected areas. Most states also stress the importance of disposing items in a manner to prevent re-use (i.e., salvaging). For example, couches, other furniture and appliances should be physically destroyed so that they cannot be re-used.

Bear in mind that asbestos and lead-based paint may be present in the structure. This possibility should be considered during the preliminary assessment, and all suspect building materials should be properly sampled and tested prior to disturbance or removal. If asbestos and lead-based paint are present, and it is determined that they should be removed, their removal and disposal should be compliant with all federal, state and local requirements.

3.10 High Efficiency Particulate Air (HEPA) Vacuuming

Vacuum the floors of the structure after removing carpets, pads and other flooring (as necessary), using a vacuum with a HEPA filter. Additionally, use a vacuum equipped with a HEPA filter on walls or other hard surfaces to remove dirt and cobwebs prior to washing with a detergent-water solution (see *Section 3.13*). This step is conducted in *addition* to detergent-water washing.

Use a commercial grade vacuum cleaner, equipped with a HEPA dust collection system (HEPA filter). Bag-less vacuum cleaners and household vacuums equipped with HEPA filters, such as those purchased at retail stores, are not recommended.¹²

Several states suggest that vacuuming with a machine equipped with a HEPA filter can be used on surfaces that cannot be cleaned with detergent and water (e.g., porous materials such as upholstered furniture). While vacuuming collects some particulate contamination, it does not remove contamination entirely. Therefore, vacuuming is not encouraged as a stand-alone

remediation technique but may be useful in select cases when the decision has been made to save an item of intrinsic or emotional value that cannot be washed with a detergent-water solution.

While it is generally recommended that contaminated unfinished structural wood be power-washed (and that a wet vac be used to draw out excess water), power-washing exposed wood may not be advisable in structures susceptible to mold. In these cases, use vacuuming as an alternative.

3.11 Initial Wash

After all materials and items that will not be cleaned have been disposed of and the structure has been vacuumed (with a machine equipped with a HEPA filter), conduct an initial washing of the walls and floors to remove most of the contamination using a detergent-water solution (see *Section 3.13*). Conducting this initial wash will not only help to ensure the safety of those who enter the structure (e.g., contractors, subcontractors), but it also will lessen the possibility that contamination on the walls and floors will re-contaminate other areas of the structure later in the remediation process.

3.12 Heating, Ventilation and Air Conditioning (HVAC)

If a meth lab is in a structure with an HVAC system or other residential forced air system (e.g., kitchen or bathroom exhausts) it can be expected that fumes, dust and other contaminants have collected in the vents, ductwork, filters and on walls and ceilings near the ventilation ducts. It should be noted that a single HVAC system can service multi-unit structures (e.g., apartments, storage facilities), and allow contamination to be spread throughout. To limit this possibility, the HVAC system should be shut down and remain off until remediation of the former meth lab is complete. During the preliminary assessment, sampling should be conducted in all areas/rooms/units serviced by the HVAC system to determine the spread of contamination and should be noted in the cleanup plan.

Contractors who specialize in cleaning ventilation systems—or who have experience cleaning ventilation systems in former meth labs—should be used to clean HVAC systems. These contractors have specialized tools and training to ensure thorough cleanup.

It is important to remember that not all ventilation system ducts can be cleaned. For example, some ducts are lined with fiberglass or other insulation (which, if damaged during cleaning, can release fiberglass into living areas). Also, flexible ductwork frequently has a porous inner

surface and in most cases cannot be cleaned economically. For this reason, the ductwork should be discarded and replaced after the ventilation system is cleaned.

If it is determined that the HVAC system can be cleaned, it should be cleaned early in the remediation process, after the initial wash has been conducted. Once cleaned, the HVAC system should be sealed at all openings to prevent potential recontamination.

Several states offer a step-by-step explanation of the ventilation system cleaning process. At a minimum, when approaching a ventilation system constructed of non-porous materials, ventilation contractors should:¹³

1. Perform a walk-through of the structure to establish a specific plan for decontamination of the ventilation system.
2. Follow safety and health procedures, in accordance with OSHA and other applicable state and local worker safety and health requirements or guidelines, to protect workers and others in the vicinity of the structure during the decontamination process.
3. Place protective coverings in areas where work is being performed, including plastic or drop cloths around each area where the duct is penetrated.
4. Shut off and lock out all air handler units before working on each air conveyance system.
5. Perform a visual inspection of the interior ductwork surfaces and internal components.
6. Draw a negative pressure on the entire ductwork, using a negative air unit with a HEPA filtration system, throughout the cleaning process.
7. Remove and clean all return air grilles.
8. Clean the ventilation system using pneumatic or electrical agitators to agitate debris into an airborne state (beginning with the outside air intake and return air ducts). Additional equipment may be used in the cleaning process, such as brushes, air lances, air nozzles and power washers or vacuums equipped with HEPA filters followed by washing with a detergent-water solution (see *Section 3.13*). Controlled containment practices should be used to ensure that debris is not dispersed outside the air conveyance system during cleaning.
9. Open and inspect air handling units, and clean all components.
10. Remove and clean all supply diffusers.
11. Clean the supply ductwork using the techniques described in item 8 above.
12. Reinstall diffusers and grilles after cleaning is complete.

13. Seal shut access points that were opened.
14. Bag and label all debris, including all air filters, and properly dispose of at a landfill.

[Note: There are various types of forced-air systems, therefore, the above steps may need to be modified based on the type of system being cleaned.]

Controlling moisture in ventilation systems is one of the most effective ways to prevent biological growth (such as mold). Consequently, if wet cleaning methods are used (detergent-water washing or power-washing), ventilation systems need to be checked to ensure they have dried thoroughly.

Cleaning methods should be left to the discretion of ventilation contractors at each lab. Experts agree, however, that no chemicals should be added to either break down meth or disinfect ducts. Further research is needed to define the most effective method for cleaning ventilation systems.

Another consideration is whether any residual contamination in the HVAC system can re-contaminate the structure after remediation is complete. The first few minutes of system restart after cleaning is usually when the greatest amount of dust is released. The potential exists for this dust to cause post-remediation samples to exceed state standards. Owners and cleanup contractors should be aware of, and plan for, this possibility. As an added measure of caution, the HVAC system should be turned on prior to post-remediation sampling.

3.13 Detergent-Water Solution Washing

Wash ceilings, walls, floors, furniture and other household items that will not be discarded with a detergent-water solution. Most states recommend using a household all-purpose cleaner. Follow the detergent manufacturer's recommendation to determine the concentration of the solution. Cleaning should thoroughly cover the entire surface, not just spots. The wash water does not have to be hot. Hot water has not been proven more effective than cold water for cleaning.

Where post-remediation sampling is required, the walls should be cleaned until they meet the required remediation standard. In states or local jurisdictions that do not require post-remediation sampling, repeat the cleaning and rinsing process three times before the walls are repainted (i.e., encapsulated). Most states recommend cleaning from ceiling to floor.

Follow each wash with a thorough rinse using clean water and a clean cloth rag. When washing, change cloth rags and detergent-water solutions frequently. After washing, dispose of cloth rags appropriately.

The use of harsh chemicals should be avoided. Consider the following before using bleach, trisodium phosphate (TSP), methanol and peroxide-based proprietary cleaners:

Bleach — The interaction of bleach and meth is not fully understood and their by-products are currently unknown.¹⁴ Until further research is conducted to identify these by-products and their health effects, bleach should not be used as a cleaning agent in a former meth lab. The use of bleach should be specifically avoided if the Red Phosphorus/Hydriodic Acid method of production was used to manufacture meth, as the reaction between bleach and iodine (used in this method) could produce a toxic gas.

Trisodium Phosphate (TSP) — The use of TSP is recommended by some states. TSP is a strong cleaning agent, but it can also be irritating to the person using it. There is also a phosphate-free TSP (TSP-PF) that may offer the power of TSP without the phosphates. It should be noted that TSP-PF is a skin and eye irritant that may cause burns.

Methanol — Although some states recommend using methanol as a cleaning agent, the use of methanol should be avoided because it produces flammable vapors and has a low flash point.

Peroxide-based Proprietary Cleaners — While some studies indicate the use of peroxide-based proprietary cleaners may be effective at eliminating meth, it is possible that the meth oxidizes to another compound.¹⁵ Because it is unclear if any by-products remain after the use of peroxide-based proprietary cleaners, the true effectiveness of peroxide-based proprietary cleaners should be verified before they can be recommended for cleaning former meth labs.

Wash Water Disposal

Wash water left over from the detergent-water washing process usually will not be contaminated enough to qualify as hazardous waste. In most cases, capturing and testing the water before disposing of it is not necessary (except in the case of a P2P lab where meth production uses mercury and lead and where the wash water may pose additional hazards) and will increase cleanup costs. However, some states may require the testing of wash water depending on the sensitivity of their hazardous waste criteria. Generally, wash water can be disposed of via the wastewater system (i.e., sanitary sewer).

Sequence of Remediation to Prevent Recontamination

While some states advocate cleaning the areas of highest contamination first, it is often impossible to know where those areas are. Instead of attempting to clean the most contaminated areas first and the least contaminated last

(or alternatively the least contaminated first and the most contaminated last), clean the rooms and areas in the structure from the back to the front, sealing those areas and continuing through the structure.

To avoid re-contaminating a room that has been cleaned, seal the room and do not re-enter it. The room can be cordoned off at doors and other openings using plastic sheeting 4 to 6 mm thick. This practice will not only help to minimize potential tracking of contamination into already-cleaned rooms, but also could save time and money spent re-cleaning areas. Taking these steps to prevent recontamination is especially important when post-remediation sampling will not be conducted. By sealing each area/room after it has been cleaned, there can be more confidence that recontamination will not occur.

Cleaning Items On-site

To avoid contaminating another structure, items that will not be discarded should be cleaned on-site. Once items are cleaned, store the items in an already-cleaned room of the structure. It may be beneficial to bag or wrap cleaned items in plastic to prevent recontamination. If allowed by state and local regulations, items may also be stored off-site if they are properly cleaned, sampled (if required) and bagged or wrapped in plastic. Do not bring items stored off-site back into the structure until after the structure has met remediation requirements or guidelines. Follow state and local requirements or guidelines when cleaning or disposing of items.

3.14 Post-Remediation Sampling

The purpose of post-remediation sampling is to show that cleanup effectively reduced contamination and, thus, the potential for exposure. Post-remediation sampling also can verify that cleaning was completed and that previously contaminated areas were cleaned to applicable standards. If post-remediation samples return results that exceed standards, the site should be cleaned again. In some cases, when portions of the site or structure cannot be cleaned, owners may consider encapsulation or removal if allowed by the oversight agency (see *Section 3.15*). Because the selection of sampling sites greatly influences the results of post-remediation sampling, having an independent third-party conduct the sampling may be appropriate and is a requirement in some states. See *Section 5.0* for more information.

3.15 Encapsulation

The extent to which meth and other lab-related chemicals migrate through materials and potentially volatilize is still unknown, though some research has shown that oil-based paint can effectively encapsulate methamphetamine contamination for up to 4.5 months.¹⁶ Encapsulation should never be used as a substitute for cleaning. However, sealing with primers, paints and other sealants may provide a protective barrier to help prevent the migration of volatile chemicals to the surface of the material.

Generally, encapsulation should occur after surfaces (e.g., ceilings, walls, floors) have met the applicable remediation standards (i.e., after post-remediation sampling). If post-remediation sampling will not be conducted (although this is not advised), all surfaces and materials should still be encapsulated after they have been washed as thoroughly as possible.

If allowed by the oversight agency, encapsulation may be performed before the remediation standard has been met if the remediation standard cannot be met after at least three repeated washings [especially in states with exceptionally protective clearance levels (such as 0.05 µg/100 cm²)] or if the removal of the contaminated material (such as concrete foundations) would compromise the integrity of the structure. If contamination is left in place under these circumstances, it should be fully disclosed in the final report and communicated to the proper authority and property owner.

Oil-based paint, oil-based polyurethane or epoxies should be used to encapsulate interior surfaces. To encapsulate floors, most experts recommend the use of oil-based polyurethane. It is generally recommended that a primer that will not deteriorate over time be applied first in order to provide a firm bond between the surface and the finish coat. Though finish coats are often applied for aesthetic purposes, they also offer additional protection.

To achieve complete coverage, it may be necessary to apply more than one coat of primer, paint or sealant. Allow primers, paints or sealants to dry for the time stipulated by the manufacturer before applying additional coats. Further, encapsulated areas should be ventilated thoroughly prior to sampling for meth lab wastes remaining from the meth cooking process.

Several states recommend that products applied to encapsulate surfaces be sprayed on and not hand-rolled. This is a valid recommendation especially for textured surfaces that cannot withstand physical agitation. Initial research suggests that sprayed on paint better encapsulates methamphetamine contamination, though additional research in this area is warranted.¹⁷

3.16 Plumbing

Odors emanating from materials or household systems (e.g., plumbing, HVAC) in former meth labs may indicate contamination. When in doubt about the source, owners should take precautions to protect occupant and/or worker safety and health. Because meth chemicals are frequently poured down the drain during active cooking, concentrations of these chemicals may remain in the traps of sinks and other drains. As a result, plumbing in structures may be compromised and require attention during remediation. Furthermore, plumbing connections and outfalls for wastewater and/or gray water should be verified. Because VOCs are often corrosive or flammable, test plumbing for these chemicals during pre-remediation sampling using a photoionization detector (PID). When remediation of plumbing fixtures begins, all plumbing traps should be flushed. If wastewater from detergent-water washing is disposed of down drains within the structure, the system should be flushed again after remediation.

Visibly contaminated (etched or stained) sinks, bathtubs and toilets should be removed and properly disposed of as they are difficult to clean. Porcelain and stainless steel, unless pitted or damaged, may be cleaned in the same manner as other hard, non-porous surfaces. When staining is noted around sinks, toilets or tubs, or if a strong chemical odor is coming from household plumbing, the plumbing system should be flushed with generous amounts of water to reduce the concentration of residual chemicals.

3.17 Sewer/Septic

Generally, meth lab waste chemicals discarded in sewer systems are flushed from the system within minutes or hours of disposal. However, chemicals may remain in the system longer if connections are on a line of very low flow. During the preliminary assessment, it should be noted if the flow in the line is low.

Large volumes of meth lab wastes can pose a problem if they are flushed and end up in on-site septic systems or in privately-owned wastewater treatment systems or those shared by small communities (e.g., trailer parks, apartment complexes). If there is evidence that meth lab wastes may have been disposed of into the septic system or privately-owned system, field screening of the septic tank or privately-owned system should be performed by an industrial hygienist, cleanup contractor or other qualified person. VOCs and/or a pH that is too high or too low may indicate the presence of hazardous waste from the production process. Because some

cleaning agents kill the flora of a septic system, it is not recommended that wastewater be disposed of in a septic system. Evidence of waste disposal may include, but is not limited to: witness statements; etched or stained sinks, bathtubs or toilets; chemical odors coming from plumbing or septic tank; visual observations of unusual conditions within the tank (dead tank); or stressed or dead vegetation in the leach field.

Systems generally should not be pumped if they contain only VOCs. However, if the leach field is not functioning due to wastes previously sent to the system, pumping may be necessary. Monitoring for VOCs will determine the proper course of action, and disposal of contaminated material should comply with federal, state and local disposal requirements. Wastewater sampling from septic tanks may be appropriate in order to characterize waste while using methods that minimize VOC losses.¹⁸ Field screening of septic systems should include pH testing which may provide an indication of potential issues with the leach field. Field screening should be used to evaluate septic system contamination and should follow the steps described below:

1. Prior to sampling, sufficiently evaluate the septic tank to determine whether the tank consists of one or two chambers.
2. Remove the access cover from the first (or only) chamber and locate the outlet baffle.
3. Move any floating surface matter away from the insertion point of the sludge sampler. Do not collect any matter in the sludge sampler.
 - a. For sampling locations in tanks with one chamber, collect samples from the baffle on the outlet end of the chamber.
 - b. For sampling locations in tanks with two chambers, collect samples from the baffle on the outlet end of chamber one.
4. Follow instructions for correct usage of a sludge sampler.
5. Insert the sludge sampler into the tank, lowering it until you hit the bottom.
6. Trap the sample inside the sludge sampler.
7. Remove the sludge sampler and fill two 40 mL vials.
8. Samples may be taken without preservative or with preservative in the vial. Sampling procedure is determined by the sampler's confidence and ability to maintain sample integrity.
9. Place sample containers in a cooler with enough ice or ice packs to maintain a temperature of 4° C.
10. Replace the access cover.

Remediation of septic systems should occur at the end of the remediation process in order to ensure that any chemicals disposed of into the septic system are appropriately removed. However, if the leach field is not functioning, remediation of the system should occur as soon as possible, and no wash water or wastes should be added to the system.

3.18 Outdoor Remediation

Meth cooks often discard waste chemicals outside the structure. For this reason, the preliminary assessment may include some outdoor sampling, especially if the ground is visibly stained or otherwise affected (e.g., odors, burn piles, dead vegetation or remnants of reaction waste). If burn or trash pits, discolored soil or dead vegetation are found, refer to state and local requirements or guidelines (related to hazardous and/or solid waste) to determine the appropriate authority and/or agency responsible for outdoor remediation.

3.19 Final Report

A final report should be prepared to document that the property has been decontaminated per applicable state and local requirements or guidelines before the structure can be considered acceptable for re-occupancy.

All inspections and assessments conducted during the remediation process should be fully documented in writing. The report should include the dates that activities were performed and the names of the people/companies who performed the work. Photographic documentation of pre- and post-decontamination property conditions and all sample locations also should be included. Any documents such as drawings, handwritten notes and photographs should be signed, dated and included as part of these cleanup records.

The final report should include, at a minimum, the following information:

Introduction — The introduction should include a case narrative, site description and site assessment. This information should have been collected prior to the start of remediation during both the record review and site assessment. The information should be documented in the Preliminary Assessment (see *Section 3.5*). The type of information and documentation in this section should include:

- Physical address of property, number and type of structures present and description of adjacent and/or surrounding properties.

- Law enforcement reports, documented observations and pre-remediation sampling results (if pre-remediation sampling occurred) that provide information regarding the manufacturing method, chemicals present, cooking areas, chemical storage areas and observed areas of contamination or waste disposal.
- Cleanup contractor, CIH/IH or other qualified environmental professional statement of qualifications, including professional certification and description of experience in assessing contamination associated with meth labs.

Methods — This section of the final report should document cleanup and disposal activities. The cleanup plan (see *Section 3.7*) and documentation that cleanup was carried out according to the plan should be incorporated in this section. The type of information and documentation in this section should include:

- Worker safety and health information.
- Decontamination (e.g., removal, encapsulation) procedures for each area that was decontaminated.
- Waste management procedures, including handling, final disposition of wastes and waste disposal records.

Results — This section of the final report should document that the structure was cleaned to acceptable levels. The type of information and documentation in this section should include:

- A sampling plan, including sample collection, handling and QA/QC.
- A description of the analytical methods used and laboratory QA/QC requirements.
- A written description of the location and results of post-decontamination samples, including landmarks for referencing individual sample locations.
- References to appropriate state and local requirements or guidelines.
- Sampling results, in writing, certified by the laboratory that performed the analyses.

The final report should be signed by the cleanup contractor, CIH/IH or other qualified environmental professional who prepared it and submitted to the appropriate state and local authority. The property owner and decontamination contractor should each retain a copy of the report. The report may be reviewed by the appropriate state and local authority responsible for deeming the property suitable for re-occupancy. Decisions about re-occupancy are made by the appropriate state and local authority.

4.0 Item- and Material-Specific Best Practices

Section 4.0 provides possible best practices.

4.1 Walls

Remove and replace wall surfaces (especially those made of absorbent materials, such as drywall or plaster) that show visible signs of staining or are emitting chemical odors. Exceptions may be made if removal of the contaminated material threatens the integrity of the structure.

Clean smooth, painted walls (i.e., those without “popcorn” texture) using a detergent-water solution (see Section 3.13). After cleaning, conduct post-remediation sampling (if applicable) and encapsulate walls (see Section 3.15).


Before textured walls are cleaned or removed, they should be sampled for asbestos. Textured walls that do not contain asbestos should be washed with a detergent-water solution and encapsulated. If asbestos is present but meth is not (or it has been cleaned to an acceptable level), several states suggest sealing the surface with a spray-on asbestos encapsulation product. If the wall meets neither the remediation standard for meth nor asbestos, a certified asbestos abatement contractor should remove the material.

Remove any absorbent building material (such as insulation) that shows visible signs of staining or is emitting chemical odors.

4.2 Ceilings

Ceilings contain some of the heaviest concentrations of residual meth. Although they have a low potential for human contact, ceilings should be cleaned thoroughly in case they are disturbed in the future. When present, ceiling fans should also be cleaned (or discarded). Any ceiling surface that shows visible signs of staining or is emitting chemical odors should be removed and replaced.

Smooth, painted ceilings that were not removed should be washed with a detergent-water solution and then encapsulated (see Sections 3.13 and 3.15). Encapsulating ceilings should not be used as an initial attempt to reduce meth levels below clearance standards. The exception to this are surfaces that are not amenable to cleaning (such as textured “popcorn” ceilings).



Textured (i.e., “popcorn” or spray-on) ceilings should be sampled for asbestos and meth contamination. Textured ceilings that do not contain asbestos should be encapsulated.

Because ceiling tiles (suspended or attached) are relatively inexpensive, discard tiles that show visible signs of contamination or that were in areas of suspected high contamination. Tiled ceilings should be sampled for asbestos.

For both textured and tiled ceilings, if asbestos is present and decontamination would disturb the material, several states suggest sealing the surfaces with a spray-on asbestos encapsulation product. A certified asbestos abatement contractor should be consulted, following state and local requirements or guidelines.

4.3 Floors

Before removing or cleaning floors, consider the type of material from which it was made. Resilient flooring such as sheet, laminate or vinyl tile can be kept unless it is stained or melted. *[Note: Vinyl flooring or underlying mastic may contain asbestos. If it is removed, removal and disposal should be compliant with all federal, state and local requirements.]* Porous flooring material, such as cork or unfinished wood, should be removed and discarded.

Consider disposing of floors in high-traffic areas, even when distant from cooking areas, as they often contain high levels of contamination.

After removing any primary flooring (e.g., carpeting, vinyl, laminate) vacuum with a machine equipped with a HEPA filter to remove contaminated dust and other debris from the sub-flooring. In addition, conduct an initial washing of sub-flooring with a detergent-water solution (see Section 3.13) prior to beginning the cleanup of the rest of the structure.

Wash floors that will not be replaced with a detergent-water solution and re-seal the floors with a product such as polyurethane. Do not cover potentially contaminated flooring with new flooring, as this remediation approach does not prevent unrestricted future use of the structure.

If ceramic or stone tiles are not removed, they should be washed with a detergent-water solution and then re-glazed depending on the porosity of the tile. It is recommended that grout be ground down, re-grouted and then sealed, or at a minimum, encapsulated with an epoxy-based sealant.

4.4 Kitchen Countertops

Because kitchen countertops have high potential for human contact and are food preparation surfaces, there is debate as to whether they should be automatically discarded or whether they can be kept as long as they meet remediation standards. Thus, further research is needed to determine the migration potential of meth (and precursor chemicals) through common types of kitchen countertops.

Currently, several states suggest the following for various types of countertop materials:

- All countertops with visible signs of contamination (e.g., etched, stained, emitting odors) should be discarded.
- Countertops made of porous materials (e.g., wood, granite) should be discarded.
- Countertops made of non-porous, solid materials can be sanded down and washed with a detergent-water solution (see *Section 3.13*).
- Countertops made of stainless steel can be washed with a detergent-water solution.
- Countertops made of ceramic and stone tile should be removed when in high-contact areas. If ceramic or stone tiles are not removed, they should be washed with a detergent-water solution and possibly re-glazed (depending on the porosity of the tile). At a minimum, grout should be encapsulated with an epoxy-based sealant or ground down, re-grouted and then sealed.

4.5 Concrete, Cement and Brick

Exposed painted or unpainted concrete, cement and brick should be washed with a detergent-water solution (see *Section 3.13*). Most states also recommend power-washing concrete and cement as long as a water collection system such as a wet vac is used to absorb excess moisture. Because brick is an especially pervious material, it can absorb cleaning solutions used in the wet cleaning

method. *[Note: It may not be possible (even following adequate remediation) to achieve a neutral pH with concrete since it is normally very basic.]*

Other states discuss the use of HEPA microvacuums rather than wet cleaning methods. However, HEPA microvacuuming is very time consuming and does not remove contamination entirely (see *Section 3.10*).

In areas of suspected high contamination, the removal of concrete, cement and brick materials should be left to the discretion of the cleanup contractor if the removal could impact the integrity of the structure. In such cases, encapsulation methods can be used after washing procedures to add an extra layer of protection.

4.6 Appliances

Discard all appliances, electronics and tools that show visible signs of contamination. Also dispose of large and small appliances that could have been used in the production of meth or storage of meth products (e.g., refrigerators, stoves, ovens, microwaves, hotplates, toaster ovens, coffee makers). In order to protect handlers at waste or recycling facilities who may come into contact with appliances, the outside of appliances should be washed before the items are discarded. Be sure to render appliances unusable so that they will not be salvaged even if they are brought to a recycling facility.

It is generally agreed that large appliances, electronics and other tools should be evaluated on a case-by-case basis. Further research is needed to determine whether it is safe to continue to use appliances that were in a former meth lab. Some states suggest washing with a detergent-water solution (see *Section 3.13*) the exteriors and interiors of large appliances that were not exposed to high concentrations of meth and show no visual contamination. All appliances with insulation should be sampled and discarded if clearance standards are not met (e.g., dishwashers, refrigerators, storage freezers).

Sampling and cleaning inside motors and circuitry of appliances or electronics is extremely difficult and expensive; therefore, it is usually more practical to discard these items than to attempt to salvage them.¹⁹

4.7 Wood

When deciding whether to discard or clean wooden materials or items, consider the porosity, the degree of exposure (e.g., a wooden hand rail vs. a section of wainscoting high on the wall), level of contamination and the quality of the finish. As a general principle, discard (in a manner to prevent reuse) any wooden surface or item that shows visible signs of contamination (e.g., etched, stained, emitting odors).

If wooden materials or items are not discarded, wash the items using a detergent-water solution (see *Section 3.13*). Additionally, cleaned surfaces should be encapsulated with a non-water based sealant.

Untreated wood will absorb moisture if detergent-water washing or power-washing techniques are used. To prevent the growth of mold, be sure to collect excess water using a wet vac to dry the unfinished wood. Encapsulate the wood after cleaning and sampling.

4.8 Windows

Window glass can be cleaned at the same time as walls. Glass should be triple-washed using a standard household glass cleaner. Clean cloths and solution should be used for each washing.

Wooden trim and hard plastic trim and tracking should be washed with a detergent-water solution (see *Section 3.13*) and sealed. If window trim cannot be adequately cleaned it should be removed and replaced.

4.9 Electrical Fixtures, Outlets and Switch Plate Covers

It is generally agreed that electrical outlet covers and wall switch plate covers should be replaced. These items are low in cost, tend to be high collection points for meth and have great potential for repeated human contact.

If electrical fixtures are not discarded, wash them using a detergent-water solution (see *Section 3.13*). Shut off power before removing electrical fixtures, outlet covers and switch covers. When using wet cleanup methods for electrical fixtures, ensure that electrical contact points do not get wet, and that the fixtures are completely dry before reassembly.

4.10 Dishes, Flatware and Other Hard Non-Porous Household Goods

Dishes, flatware and other hard non-porous household goods including ceramics, hard plastics, metals and glass should be discarded to prevent reuse if they show any signs of having been used during the meth cooking process (e.g., etched, stained, emitting odors).

Dispose of all plastic infant bottles, nipples and any infant/toddler eating utensils or dishes in a manner to prevent reuse, regardless of their contamination level.

Using a detergent-water solution (see *Section 3.13*) wash all items made of ceramic, metal, hard plastic or glass that were not used in the meth cooking process.

4.11 Toys and Other Children's Items

Infant toys that have the potential to be placed in the mouth (e.g., teething ring, pacifier, rattle) as well as any toys that show visible signs of contamination (e.g., etched, stained, emitting odors) should be disposed of in a manner that prevents reuse. Stuffed animals and other porous toys are very difficult to clean and should be discarded. It is generally agreed that toys made of metal or hard plastic may be washed using a detergent-water solution (see *Section 3.13*). The decision to decontaminate or dispose of softer plastic toys, items with electronic features or toys that have small crevices should be left to the discretion of the cleanup contractor (but disposal is highly recommended). Exceptions can be made for medical items (e.g., eye glasses, artificial limbs) if they are effectively cleaned to the prescribed clearance levels.

4.12 Carpets

Remove all carpet and discard it in a manner that prevents reuse. Do not vacuum, steam-clean or shampoo carpet. Carpet should be discarded rather than cleaned because it is extremely difficult to remove all the contamination from the fibers and weave of the carpet.

Additionally, carpet padding and flooring beneath carpet in a former meth lab are often contaminated. Leaving the carpet in place could pose a threat to future occupants who may decide to remove the carpet and unknowingly come into contact with this contaminated padding or flooring.

4.13 Clothing and Other Fabrics

Discard clothing or other fabrics with visible staining or contamination. Machine-washable clothing may be safely cleaned in a washing machine.²⁰ If a washing machine is used to wash potentially contaminated fabric, consider the following:

- Use the washing machine available on-site. Do not wash contaminated fabric off-site.
- Run an empty load before washing the fabric.
- Wash fabric three times in small- to medium-sized loads using the cycle setting that is normally recommended for the fabric type.
- Use a standard laundry detergent. Do not use detergents with bleach, oxidizing detergents or fabric softener.

- Do not dry items between washes. After washing items three times, bag the items and take them off-site to dry.
- Run an empty load after contaminated items have been washed before using the washing machine again.

Discard non-machine-washable fabrics in a manner that prevents reuse. In some cases, exceptions may be made for items of intrinsic value, such as a wedding dress, if the owner understands and accepts the risk associated with keeping it. Do not dry clean items, as doing so could contaminate other people's clothing.

4.14 Leather or Fabric Upholstered Furniture

Discard upholstered furniture. In some cases, however, furniture can be stripped of its upholstery (including cushions) and cleaned like hard furniture with a detergent-water solution (see *Section 3.13*). Destroy furniture before discarding it to prevent it from being reused.

4.15 Mattresses

While most states suggest that mattresses should be discarded, some note that a mattress can be saved when:

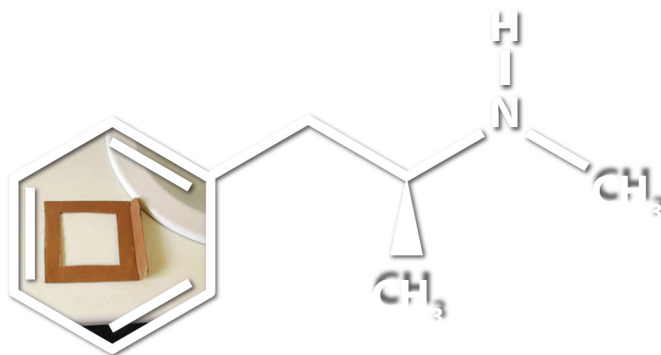
- pre-remediation samples indicate low levels of meth in the structure;
- the mattress was far removed from the area of cooking; and
- the mattress was not in a room serviced by the same HVAC system as the room in which meth was cooked.

4.16 Paper Items/Books

Discard paper items and books found in the former meth lab. Exceptions may be made for important legal documents or photographs, papers or books of historical value.

4.17 Mobile Residences

Mobile residences should generally be cleaned like any other structure identified as a meth production site. However, past experience with the cleanup of mobile homes, campers and other mobile residences (such as vehicles) indicate that they may contain more porous/absorbent materials than fixed structures. For this reason, in some states, it has been found to be cost-prohibitive to clean mobile residences. Demolition may be considered a more cost-effective option.



5.0 Potential Sampling Constituents, Theory and Methods

5.1 Sampling Constituents

Sampling for meth is the most common way to establish whether portions of a structure are contaminated. Most states suggest property owners hire a qualified environmental or health professional to conduct sampling and testing. Because every meth manufacturing site is unique, sampling plans will differ and should be tailored to each specific case. In most cases, samples for meth are collected by wipe sampling; however, many states have established requirements or guidelines that dictate the sampling methodology. In all cases, persons collecting samples should use approved sampling methods as prescribed by federal, state and local government agencies (including EPA, NIOSH and OSHA). Some states require sampling for other constituents described below.

Volatile Organic Compounds (VOCs)

VOCs are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may

have both short- and long-term adverse health effects. VOCs are emitted by a wide array of chemicals found in former meth labs, which include but are not limited to: acetone, benzene, ether, freon, hexane, isopropanol, methanol, toluene, Coleman fuel, naphtha, ronsonol and xylene.

Monitoring for VOCs should be done for indoor air quality (in the adult and child breathing zones), in the plumbing and/or septic system and over outdoor areas with suspected soil contamination. VOC monitoring should be conducted using a PID. Some states suggest using a Summa canister for air monitoring; however, Summa canisters are expensive and sensitive enough to detect compounds from normal household cleaning activities, making the results difficult to interpret.

pH

pH is a term used to indicate the corrosiveness of a substance as ranked on a scale from 1.0 to 14.0. Corrosives commonly found in former meth labs include, but are not limited to: hydrochloric acid, hypo phosphorous acid, sodium hydroxide, sulfuric acid, anhydrous ammonia, phosphoric acid and other common acids and bases. pH sampling should be used to confirm that levels of acids and bases do not pose a health hazard. pH sampling should be conducted during pre-remediation sampling and is done onsite with pH paper.

pH testing should occur on food preparation countertops, stained materials (where there is visible contamination) and anything that leads to the septic system. pH testing should also occur within the septic system, on at least three locations in each room within the areas with visible contamination and within areas known to have been used for storage or handling of chemicals. *[Note: It may not be possible (even following adequate remediation) to achieve a neutral pH with concrete since it is normally very basic.]*

Quantitative State Remediation Standards

VOCs

States that set VOC standards for VOC air monitoring in their remediation guidelines set the standard at less than 1 ppm.

pH

States that set corrosive standards in their remediation guidelines set a surface pH standard of 6 to 8.

Mercury

State standards range from 50 ng/m³ to 3.0 µg/m³ of mercury in air. One state has a surface standard for mercury of 0.0054 µg/100 cm².

Lead

State standards range from 40 µg/ft² (or its equivalent of 4.3 µg/100 cm²) to 10 µg/ft² (or its equivalent of 2 µg/100 cm²).

Meth

State standards range from 0.05 µg/100 cm² to 1.5 µg/100 cm². The most common standard is set at 0.1 µg/100 cm².

See *Appendix D: Meth Resources* for links to individual state requirements and guidelines.

Lead, Mercury and Asbestos

Lead and mercury are commonly associated with labs where the P2P method was used to produce meth. If the P2P method was used, it is recommended to sample for airborne mercury and take surface samples for lead. In addition, former labs where meth is known to have been manufactured for several years should be tested for lead and mercury. Sampling for these constituents may be complicated because lead-based paints may be present in structures built prior to 1978, and mercury can be found in structures built prior to 1990. A variety of common household items also can contain small amounts of mercury.

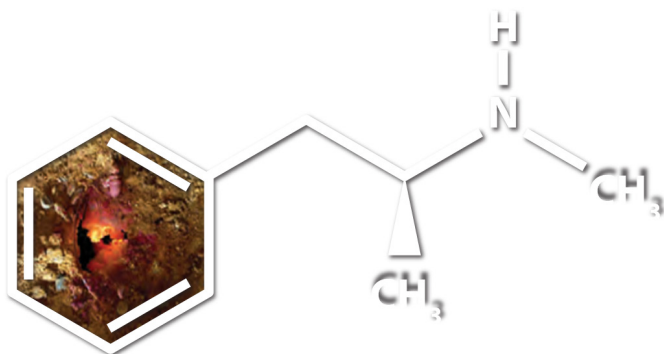
When conducting sampling for lead and mercury, be sure to test the plumbing and septic systems, in addition to the structure. If either mercury or lead is detected in pre-remediation sampling, test for it after completing cleanup activities.

Asbestos can be found in a variety of construction materials in homes and other structures. Many construction products on the market today still contain asbestos. In cases where portions of the structure (e.g., walls, floors, ceilings) will be removed, an asbestos survey should be performed. If a structure has a sprayed-on, “popcorn” ceiling, it should be sampled for meth-related contamination. If not contaminated, it should be left intact and/or encapsulated because of the potential presence of asbestos.

[Note: When removing any materials contaminated with lead or mercury, federal and state disposal requirements should be followed. In addition, materials removed from the site should be tested for asbestos per federal and state requirements.]

Iodine and Red Phosphorous

Sampling for iodine and red phosphorous generally is not necessary, since these chemicals leave visible stains that should be detected during the site survey. In most cases, surfaces or appliances that are visibly stained will be removed and will not need to be sampled.



5.2 Sampling Theory

When conducting sampling for meth contamination, follow an *authoritative* sampling approach. This process does not assign an equal probability of being sampled to every part of the structure. Instead, authoritative sampling targets areas suspected to have the highest levels of contamination. The validity of this sampling method depends on the professional judgment, knowledge and qualifications of the person conducting the sampling, who should have a detailed understanding of the individual site conditions and the suspected manufacturing method.

Several states reference two methods of authoritative sampling, both of which are described in ASTM D631198 (2003), *Standard Guide for Generation of Environmental Data Related to Waste Management Activities: Selection and Optimization of Sampling Design*. A description of the two methods, *biased sampling* and *judgmental sampling*, follows:

Biased sampling seeks to identify the “best” and “worst” locations at the site, rather than find the average concentration of contamination. By sampling at locations that are highly suggestive of contamination (e.g., cook sites, spill sites), this approach helps identify the maximum levels of contamination expected to be present at the site. Biased sampling also is useful in post-remediation sampling, since samples will be taken at the locations known or expected to be most contaminated before a site meets standards for reuse.

Judgmental sampling relies heavily on the experience of the person conducting the sampling to gauge the “average” concentration of contamination present in the structure. Judgmental sampling can be useful if the person conducting the sampling has sufficient information on the former manufacturing activities at the site and the necessary experience to select appropriate sampling locations. Judgmental sampling can become less accurate when only partial or incomplete information exists about past activities at the site or when the person conducting the sampling intentionally or accidentally selects sampling locations that misrepresent the site.

Hypothesis Testing

Both biased and judgmental sampling should be informed by data quality objectives (DQOs). DQOs establish the type, quality and quantity of data needed and specify tolerable levels of potential decision errors.²¹ DQOs should be established before environmental data collection activities begin. Sampling plans should be designed to meet DQOs, be cost-effective and minimize the likelihood of error. *[Note: For additional information on QA/QC see Section 5.5.]* Each sampling plan should set forth a hypothesis, and sampling should be conducted to either prove or disprove that hypothesis. The hypothesis

initially set forth will be different for pre-remediation and post-remediation sampling.

For pre-remediation sampling, the hypothesis being tested is that the site is clean and that there is no evidence of meth or its production. To test this hypothesis, a sampling plan is devised to answer the question, “Is there evidence of the presence of meth production in this area?” All data gathered will be weighed against this question, including information from the preliminary assessment as well as samples collected. Data that disprove the hypothesis suggest that the area is contaminated with meth or other associated materials.

In post-remediation sampling, the hypothesis is that the site has not been thoroughly cleaned. The owner or contractor will seek to prove, through biased sampling, that the site contains contaminant levels that exceed the relevant standard. As the site is cleaned, the hypothesis will become more difficult to prove; instead, the site will prove to be compliant. Once every habitable structure on the site is deemed compliant, the site can be released. Post-remediation sampling can be used as an oversight mechanism to ensure cleaning was adequate. Post-remediation sampling can also provide owners with a liability shield, quantifying that the structure meets the applicable standards.

5.3 Wipe Sampling Methods

Wipe sampling is the most often recommended method for sampling surface concentrations of meth. There are two conventional methods for wipe sampling: discrete and composite. In many remediation efforts, a combination of both composite and discrete sampling will be needed.

In *discrete sampling*, also known as “individual” sampling, single samples are taken at spatially discrete locations. This sampling technique should be used in areas that are “hot spots” highly suggestive of contamination. Discrete sampling should be performed in areas where there is a high probability of exposure (e.g., countertops, ventilation systems).

In *composite sampling*, multiple discrete samples are combined and treated as a single sample for analytical purposes. This sampling technique can be useful because it is more cost-effective. Composite sampling strategies should be used when the distribution of contamination is expected to be homogeneous. Composite sampling can be used on personal items (e.g., furniture, photo albums) and other belongings that the owner would like to save.

NIOSH wipe sample methods 9106 and 9109 could be consulted for additional information.²²

Many jurisdictions have prescribed methods for collecting wipe samples. Before conducting a sampling effort, be

sure to consult and comply with applicable state and local requirements or guidelines. In general, collecting discrete wipe samples for surface meth contamination includes the following steps:

1. Document the area(s) of the structure to be sampled in a map or sketch.
2. Make a template of each individual area to be sampled. This template should be made with chalk, masking tape, Teflon or another material that will not contaminate the sample and is resistant to the solvent being used. Most guidance documents suggest a minimum sample area of 100 cm².
3. Use a new set of clean, non-powdered impervious gloves for each sample collected.
4. Wet the sample media with solvent.
5. Press firmly with the sample media, using caution to avoid touching the surface within the template. Smooth surfaces should be wiped; rough surfaces should be blotted.
6. When wiping the sampling area, two methods may be used:
 - a. The square method involves wiping in a square around the outside edge of the sample site and wiping in concentric squares towards the center.
 - b. The “S” method involves wiping from side-to-side in an overlapping “S” motion until the entire sample surface is covered.
7. Fold the sample media with the sampled side in without allowing the media to contact any other surfaces.
8. Repeat the wiping method with the folded sample media. If using the “S” method, wipe from top-to-bottom on the second pass.
9. Again, fold the media in half with the sampled side in. Seal the sample media in a sample container and label with the sample number and location.
10. Collect at least one sample media blank for every 10 samples collected. This media should be treated with solvent and folded but not wiped.

For composite samples, the same procedure should be used with the following considerations:

1. Use a single pair of gloves to collect all component samples that will make up a composite sample.
2. All component samples that will make up a composite sample should be placed in the same sample container.
3. Use enough solvent on the sampling media to properly collect all samples. The composite sample should consist of no more than four discrete samples.

Sample Media

Sample media can consist of a number of materials, which vary according to state and local requirements or guidelines. Examples of recommended sample media include:

- rayon/polyester or cotton general-purpose medical sponges;
- 11 cm filter paper (Whatman™ 40 ashless or equivalent);
- filter paper, including Whatman™ 40, 41, 42, 43, 44, 540, 541, Ahlstrom 54, VWR 454, S&S WH Medium or other filter paper with equivalent performance; and
- cotton gauze pad, including Johnson & Johnson cotton squares or equivalent.

Solvent

Agreement has not yet been reached as to which solvent should be used in sampling for meth. The three most common lifting agents—deionized water, isopropyl alcohol and methanol—are described below:

- Deionized water is safe for use and is generally adequate for sampling surface concentrations of meth. However, the use of deionized water as a solvent requires an additional extraction step once the sample is sent to the lab for analysis.
- Methanol is very effective at picking up meth; however, it may remove paint from wipe surfaces and over-represent the levels of contamination available through normal exposure pathways (such as touching a wall).
- In terms of safety and effectiveness for meth sampling, isopropyl alcohol lies somewhere between deionized water and methanol.

It is important that sampling methods be performed in a consistent fashion throughout the site. The degree to which various solvents lift or extract contaminants from the sampling surface will become more important as remediation standards become health-based.

5.4 Microvacuum Sampling Methods

Microvacuum sampling can be used to determine the presence of meth contamination on porous materials (e.g., furniture, upholstery) that cannot be sampled by wiping. This method does not quantitatively represent the mass of meth in the material, but the results may be used qualitatively to indicate the presence of meth. Though less sensitive than wipe sampling, microvacuums can be useful

for site-screening purposes or the evaluation of personal items. Microvacuuming is not recommended for post-remediation sampling when wipe sampling is possible. When conducting microvacuuming, follow the appropriate prescribed guidelines (e.g., EPA, NIOSH, ASTM).

5.5 Quality Assurance/Quality Control (QA/QC)

QA/QC in sample analysis does not begin in the lab, but rather in the field. The following practices should be considered to maximize the integrity of samples:

- Coordinate with analytical laboratory to ensure proper sample specifications prior to conducting sampling.
- Collect samples in a uniform manner.
- Ensure as few people as possible handle the samples.
- Collect at least one sample media blank, treated in the same fashion but without wiping, for every 10 samples collected.
- Handle sample media with stainless steel forceps, tweezers or gloved fingers.
- Change gloves with each sample to avoid cross-contamination.
- Complete a sample label for each sample with waterproof, non-erasable ink and note sample number, date, time, location and sampler's ID.
- Seal samples immediately upon collection and document when seals are broken or replaced and reseal open boxes of unused containers.
- Keep samples in a secure (locked) location.
- Properly store samples until they are transported to the lab for analysis per the laboratory's specifications.
- Deliver samples to the laboratory in a timely manner.
- The appropriate time frame for sample delivery will depend on the sampling method, material and laboratory protocol.

6.0 Clandestine Fentanyl Laboratory Cleanup

6.1 Background

Fentanyl is a highly potent synthetic opioid; approximately 100 times stronger than morphine.²³ Pharmaceutical fentanyl was first developed as pain management treatment for cancer patients and is generally obtained for abuse by theft or prescription fraud. However, the most recent cases of fentanyl-related harm, overdose and death in the United States are linked to illegally manufactured fentanyl or clandestine fentanyl. See *Appendix F: Fentanyl Resources* for more information.

In this document, “fentanyl” means fentanyl, fentanyl analogs and any chemical structure modification to fentanyl (or its analogs), including, but not limited to, isomers, esters, ethers and salts. See *Appendix G: Common Fentanyl Analogs* for information related to specific analogs.

“Clandestine fentanyl laboratory” means any location involved in the illegal manufacturing or storage of fentanyl. This may include manufacturing, compounding, converting, producing, deriving, processing or preparing, either directly or indirectly by chemical extraction, pill pressing, distribution, cutting, diluting, synthesis or other activity that has the potential to contaminate the property with fentanyl or any of its precursors.

While clandestine fentanyl is not yet widely manufactured in the United States, it is processed in the United States (cut with heroin or pressed into tablets) and is an emerging concern that poses significant dangers to those who encounter the substance.

Clandestine fentanyl is predominantly synthesized illicitly in China and trafficked into the United States via international mail, express consignment or across the Southwest or Northern borders.²⁴ Fentanyl is sold through illegal drug markets for its heroin-like effect. Fentanyl is often added to heroin or cocaine to increase its potency, or it can be disguised as highly potent heroin. Many users believe that they are purchasing heroin and do not know that they are instead purchasing fentanyl-laced heroin – which often results in accidental overdose deaths. Some common street names of fentanyl are Apache, China Girl, China Town, China White, Dance Fever, Goodfellas, Great Bear, He-Man, Poison and Tango & Cash.

In addition to the high toxicity, one of the dangers of encountering fentanyl is the particle size, which ranges from 0.2-2.0 microns (2.0 microns is 0.002 millimeters).²⁵ This small particle size means fentanyl is easily airborne. Because fentanyl can be encountered as a very fine dust or aerosol and toxic dose may depend on the type of fentanyl (analog), extra caution should be used when fentanyl is present. To a great extent, solubility of opioids are pH dependent with most analogs having favorable pHs in the 5-7 range. Fentanyl powders are slightly soluble in water, with an aqueous solubility of 0.2g/L.

6.2 Prevalence

Pharmaceutical fentanyl products are currently available as lozenges (lollipops), tablets, sublingual and nasal sprays, transdermal patches and injectables. Clandestine fentanyl is typically found in powders or pressed tablet forms. Clandestine fentanyl is the most prevalent and the most significant synthetic opioid threat (not including heroin) in the United States and will very likely remain the most prevalent synthetic opioid threat in the near term. As previously noted, fentanyl availability is primarily by itself or mixed with heroin.

According to the Centers for Disease Control and Prevention (CDC), in 2018 there were more than 31,000 deaths in the United States involving synthetic opioids (other than methadone), which includes fentanyl. Synthetic opioid-involved death rates increased by 10% from 2017 to 2018 and accounted for 67% of opioid-

involved deaths in 2018.²⁶ A CDC report published in 2019 notes that the number of drug overdose deaths involving fentanyl was stable in 2011 and 2012, with just over 1,600 each year. From 2013 through 2016, the number of deaths approximately doubled each year, rising sharply to 18,335 deaths in 2016.²⁷

Illicit fentanyl drug operations present multiple exposure pathways and various forms of fentanyl including powders, tablets and solutions. Makeshift laboratories are often found in apartments, houses, garages and storage facilities. These operations are known as cutting houses, and are commonly associated with heroin. As a result, it should be assumed that heroin-repackaging operations likely have fentanyl derivatives present as well.

Synthesizing Fentanyl

Fentanyl is a completely synthetic μ receptor-stimulating opioid that was first synthesized by the Janssen Company in the 1960s. Because the Janssen method requires advanced chemistry knowledge and skills, illicit fentanyl is generally manufactured using the Siegfried method (first synthesized in the early 1980s) or a modified version of the Siegfried method. While the number of fentanyl synthesis laboratories in the United States is low, hazards may include:²⁸

Flammability hazards:

- Solvent vapors;
- Water-reactive solids; and
- Explosive salts.

Corrosivity hazards:

- Hydrochloric acid;
- Glacial acetic acid; and
- Sodium hydroxide.

Toxicity hazards:

- Fentanyl itself;
- Chlorinated solvents (potential carcinogens); and
- Inhalation and/or dermal hazard.

6.3 Protection/Precautions/Planning

As discussed in *Section 1.2*, EPA does not intend this information to set, establish or promote quantitative cleanup standards but rather provide guidance and suggestions for addressing clandestine fentanyl contamination. Those using this information also should

consult the appropriate state and local requirements or guidelines for fentanyl remediation.

Clandestine fentanyl use has risen sharply in the United States in the last few years so it is possible that home purchasers or retail space renters could encounter clandestine fentanyl. Workers can potentially encounter powder, pill or liquid forms of clandestine fentanyl. Additionally, the small particle size and water solubility of fentanyl means exposure can occur via fine dust or aerosol. Exposure to fentanyl can happen through:

- Inhalation;
- Ingestion;
- Mucosal (touching eyes, nose or mouth with contaminated hands or glove or airborne particles) or
- Dermal (absorbed through the skin).

As when dealing with any hazardous substances, it is recommended that all procedures adhere to OSHA HAZWOPER Standard, 29 CFR 1910.120 and other applicable state and local worker safety and health requirements. EPA suggests that remediation work not begin until gross chemical removal is complete and law enforcement personnel have cleared the structure of defense measures placed by the lab operators (such as anti-personnel devices or “booby traps”). Use the “buddy system” when making initial entry for remediation work, in case unforeseen dangers are encountered. In addition, conduct air quality monitoring to ensure the atmosphere is safe for entry.

It is recommended that personnel who enter a former clandestine lab have safety and health training (40-hour HAZWOPER training), and use the appropriate level of PPE based on the site-specific conditions. Hazards and risks associated with any planned work should be assessed on a case-by-case basis (see *Appendix H: Fentanyl Lab Remediation Diagrams*). This assessment will help determine how to minimize exposure to fentanyl. As when dealing with other hazardous substances it is recommended that personnel:

- Wear appropriate PPE for the planned work tasks.
- Use appropriate remediation work practices.
- Use appropriate decontamination processes.
- Follow standard operating procedures established for handling, transporting and disposing of fentanyl and fentanyl-contaminated materials.
- Avoid eating, drinking or smoking after handling fentanyl-contaminated surfaces or material until they have exited the work area and followed all the steps required for personal decontamination.

First Responders

First responders [i.e., law enforcement, firefighters and emergency medical services (EMS) personnel] are exposed to a slightly different set of risks compared to the public. See the following resources for more information specific to first responders:

Preventing Occupational Exposure to Emergency Responders:
<https://www.cdc.gov/niosh/topics/fentanyl/toolkit.html>

ACMT and AACT Position Statement: Preventing Occupation Fentanyl and Fentanyl Analog Exposure to Emergency Responders:

https://www.acmt.net/_Library/Positions/Fentanyl_PPE_Emergency_Responders_.pdf

When illicit drugs may be present, PPE might include at a minimum nitrile gloves, eye protection and proper respiratory protection (properly fit-tested N95 mask or similar level of protection). It might also include foot coverings, long-sleeved coveralls or a disposable protective suit. PPE needs will depend on specific site conditions and might change from site to site. In addition to wearing appropriate PPE it is recommended that workers also:

- Avoid performing tasks or operations that may cause fentanyl to become airborne (using fans or running HVAC units).
- Do not touch the eyes, nose or mouth after touching any surface that may be contaminated, even if wearing gloves.
- Wash hands with soap and water after working in an area that may be contaminated, even if gloves were worn.
- Cover all open wounds.
- Do not use hand sanitizer (or any alcohol based cleaner) or bleach to clean skin that may have come into contact with illicit drugs.
- Wash hard surfaces with water and household cleaner. Change the water frequently to prevent spreading contamination. Rinse surfaces with clean water after washing.
- Only use a HEPA-filtered vacuum on carpet, upholstery and fabric surfaces.

Even with proper precautions, accidental exposure is still possible. Workers need to be aware of fentanyl exposure symptoms, which may include:

- Slowed, shallow breathing;
- Pale, clammy skin;

- Decreasing consciousness, increasing drowsiness, confusion;
- Low blood pressure;
- Pinpoint pupils; or
- Euphoria.

It is important to be aware of exposure symptoms and seek medical attention as appropriate for those working in a suspected clandestine fentanyl lab. Additionally, the American College of Medical Toxicology (ACMT) and the American Academy of Clinical Toxicology (AACT) recommends having naloxone kits with syringes or pre-packaged naloxone applicators containing enough doses and individual applicators for all personnel available on site.²⁹

6.4 Remediation Standards

Clandestine fentanyl labs differ from meth labs because fentanyl is not widely manufactured in the United States at this time. Fentanyl is typically processed by cutting the fentanyl with heroin, cocaine or other more benign adulterants and pressing it into tablets. However, meth is manufactured or cooked in labs in the United States. As such, meth labs have multiple hazardous substances of concern. With clandestine fentanyl labs, the contaminant of concern is typically only fentanyl.

Small amounts of fentanyl are extremely dangerous; the lethal dose of fentanyl is generally accepted to be 2 milligrams (mg),³⁰ see *Figure 1*. For more information on analogs including lethal doses, see *Appendix G: Common Fentanyl Analogs*. The lowest limit of detection currently available for fentanyl by laboratory analysis is 1 nanogram (ng). As of August 2021, there are no state or federal standards in the United States for determining when a closed fentanyl laboratory has been successfully remediated. The Province of Alberta, Canada established



Figure 1: Lethal Dose of Fentanyl

a remediation benchmark of less than 1.0 ng of fentanyl particulate per cubic meter of air (ng/m³). This benchmark could be considered successful for air samples and <1.0 ng per 100 square centimeters (ng/100 cm²) for wipe samples (1,000,000 ng = 1 mg).³¹ This is not a health-based clearance value. Health-based clearance levels may be lower and would depend primarily on the fentanyl analog.

6.5 Remediation Techniques

Many of the same steps and techniques that are utilized for meth lab cleanup may apply to clandestine fentanyl lab cleanup. The remediation techniques provided below reference the appropriate sections of the meth cleanup guidelines discussed earlier in this document and note any specific differences between the remediation sequence and techniques.

Alberta Health's *Fentanyl Remediation: Guidance for Remediators, Regulatory Agencies and Professionals* includes a great deal of relevant information intended to assist agencies and professionals needing to manage risks related to property or materials contaminated with fentanyl. The report outlines assessment and remediation procedures of property or materials contaminated with fentanyl.

For more information, visit:

<https://open.alberta.ca/publications/fentanyl-remediation>

Remediation Sequence and Techniques

The clandestine fentanyl remediation sequence is very similar to what is described for methamphetamine in *Section 3.0*. With the following exceptions: **the area should not be ventilated and a neutralization solution should be applied to inactivate fentanyl before vacuuming or removing of items.** Care should also be taken not to agitate areas or surfaces where fentanyl may be found before applying the neutralization solution. The high toxicity and small particle size of fentanyl when compared to methamphetamine can make ventilation a potentially dangerous situation for those performing remediation (for example rather than reducing the concentration of fentanyl in the air, disturbing the fine powders may increase the concentration and risk of exposure).

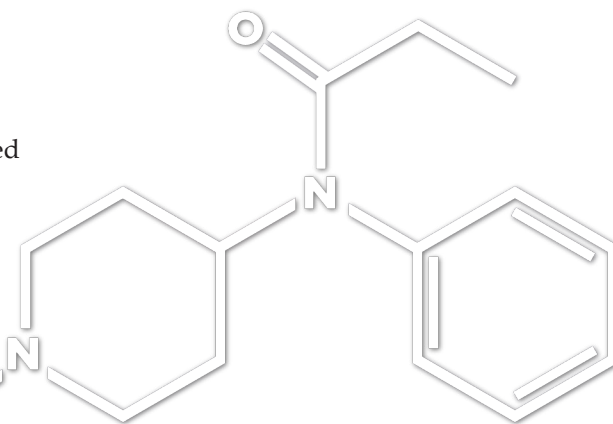


Similar to what is outlined in *Section 3.2*, one of the first suggested steps in clandestine fentanyl remediation is hiring the appropriate contractor. Consider hiring a contractor who has hazardous waste expertise and is certified (if certification is required by the state) to conduct cleanup operations at known or suspected clandestine fentanyl labs. Contractors should, at a minimum, complete the 40-hour HAZWOPER training (OSHA 29 CFR 1910.120).

The main remediation technique used for fentanyl is applying a neutralization solution. This solution is used to destroy or inactivate fentanyl. To be effective, the neutralization solution should remain on contaminated surfaces for the prescribed contact time. *[Note: Neutralization solutions should not be used on skin.]* Use low-pH soap and water to decontaminate skin surfaces. When a neutralization solution is used on respirators, other PPE or other sensitive equipment, rinse the equipment with water after the prescribed contact time.

Similar to meth, the sequence in the list below begins after gross removal has occurred and any law enforcement investigation has concluded. When cleaning clandestine fentanyl labs (depending on the level of contamination), the following may be considered:³²

1. Do **not** use compressed air or dry sweeping to clean the contaminated work area.
2. Use a low-pressure sprayer filled with neutralization solution.
3. Gently spray the entire contaminated work area, including all surfaces of all porous and non-porous materials and all items marked "for disposal."
4. Spray visible powders, solids, liquids and gels until they are fully wetted. Spray the surface of building



materials and nonporous contents on site until they are fully coated. Spray porous contents on site until the surface is wetted.

5. Spray surfaces adjacent to any area where fentanyl was detected or suspected to be present, based on the results of the preliminary site assessment. The spray should cover a radius of at least 3 feet beyond the known/suspected contamination. Be careful while spraying, to avoid making the powders or liquids airborne: be mindful of the spray velocity, angle, application method, etc.
6. Spray the surfaces of all fixtures or coverings that could absorb airborne fentanyl powder or that could hide or contain spaces where airborne fentanyl powder could have settled and cannot be easily or safely decontaminated (e.g., electrical outlets, outlet covers and electrical boxes, baseboards, trim, light fixtures, vent covers/grilles, appliance filters, etc.). [Note: Ensure that all other hazards have been isolated (e.g., lock-out and tag-out electrical power supply to electrical sockets and boxes).]
7. Allow the recommended neutralization time per product direction for all steps.
8. Make sure to spray surfaces behind and inside the removed fixtures and coverings.
9. Consider using 6-mil waste bags and using either a goose-neck or overhand knot to secure the bags before sealing with duct tape.
10. Apply neutralization solution to the exterior of the waste bags and allow the necessary neutralization per product direction before the next step.
11. Place waste bags inside a second waste bag (i.e., double-bag) and immediately transfer waste to the equipment and waste decontamination unit.

After the fentanyl is neutralized with the solution for the proper amount of time, these general residual decontamination procedures may be followed:³³

1. Do **not** use compressed air or dry sweeping to clean the contaminated work area.
2. Use a vacuum equipped with a HEPA filter to clean loose dry material.
3. Clean all surfaces in the work area by damp-wiping and mopping with warm water until there is no visible residue.
4. Start damp-wiping at the ceiling of the room and work toward the floor.
5. Minimize water pooling in the work area by collecting wash water with a wet vacuum equipped with a HEPA filter.

6. Cordon off areas after each area is cleaned to avoid re-contamination.
7. Place waste into tear-proof waste bags (6-mil minimum) at regular intervals, secure bag with a goose-neck or overhand knot and seal with duct tape.
8. Dispose of hazardous waste in accordance with state and local requirements or guidelines.

6.6 Item- and Material-Specific Best Practices

In general, the guidance provided in *Section 4.0* applies to clandestine fentanyl labs as well. The main difference, following the guidelines stated above is, **everything should be sprayed with a neutralizing solution before cleaning or disposal**. It is suggested that items not be vacuumed until they have been sprayed with the neutralizing solution. Similar items are recommended for disposal due to porosity, difficulty cleaning or future use.

6.7 Potential Sampling Constituents, Theory and Methods

Sampling constituents for clandestine fentanyl labs differs a bit from what is discussed in *Section 5.1* primarily because at the time of publication of this document, the main source of clandestine fentanyl in the United States is from illicit international labs. Within the United States, traffickers typically acquire synthetic opioids and process them by cutting, mixing or pressing into pill form. As such, clandestine fentanyl labs would not be expected to have the same constituents as associated with meth labs. Air and surface sample wipes to detect fentanyl and not other constituents are suggested when determining the level of fentanyl contamination of a site.

Similar to meth remediation sampling, sample locations for fentanyl should be selected based on areas suspected to have the highest level of contamination using authoritative sampling methods. See *Section 5.2* for more information.

The same sampling methods described in *Section 5.3* should be used. Additionally, Appendix E of Alberta Health, Government of Alberta (2020) *Fentanyl Remediation Guidance for Remediators, Regulatory Agencies and Professionals* provides useful information related to sampling. NIOSH wipe sample methods 9106 and 9109 could be consulted for additional information.

When sampling, quality assurance and quality control measures should be considered to maximize the integrity of samples. For more information, see *Section 5.5*.

Endnotes

1. White House Office of National Drug Control Policy (2006) *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39
https://www.justice.gov/archive/olp/pdf/synthetic_strat2006.pdf
2. White House Office of National Drug Control Policy (2006) *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39
https://www.justice.gov/archive/olp/pdf/synthetic_strat2006.pdf
3. United States Drug Enforcement Administration (2021) *2020 Drug Enforcement Administration NDTA National Drug Threat Assessment*, pg. 25
<https://www.dea.gov/documents/2021/03/02/2020-national-drug-threat-assessment>
4. National Jewish Medical and Research Center (2004) *Methamphetamine Contamination on Environmental Surfaces Caused by Simulated Smoking of Methamphetamine*
<http://www.wvdhhr.org/rtia/pdf/smoked%20meth.pdf>
5. United States Drug Enforcement Administration (2021) *2020 Drug Enforcement Administration NDTA National Drug Threat Assessment*, pg. 23
<https://www.dea.gov/documents/2021/03/02/2020-national-drug-threat-assessment>
6. White House Office of National Drug Control Policy (2006) *Synthetic Drug Control Strategy: A Focus on Methamphetamine and Prescription Drug Abuse*, pg. 39
https://www.justice.gov/archive/olp/pdf/synthetic_strat2006.pdf
7. United States Environmental Protection Agency (EPA) *Office of Children's Health Protection*
<https://www.epa.gov/children>
8. Colorado Department of Public Health (2005) *Support for Selection of a Cleanup Level for Methamphetamine at Clandestine Drug Laboratories*
https://www.colorado.gov/pacific/sites/default/files/HM_clean-up-level-support.pdf
9. California Department of Toxic Substances Control (2007) *Development of a Health-Based Meth Cleanup Standard*
<https://dtsc.ca.gov/erp/drug-lab-removals-erp/>
10. National Jewish Medical and Research Center (2005) *A 24-Hour Study to Investigate Chemical Exposures Associated with Clandestine Methamphetamine Laboratories*
<https://pubmed.ncbi.nlm.nih.gov/19065282/>
11. North Carolina Department of Health and Human Services (2005) *Illegal Methamphetamine Laboratory Decontamination and Re-Occupancy Guidelines*, pg. 13
<https://www.methlabcleanup.com/NC%20Standards.pdf>
12. Alaska Department of Environmental Conservation (2007) *Guidance and Standards for Cleanup of Illegal Drug-Manufacturing Sites*, pg. 27
<https://dec.alaska.gov/media/11560/drug-lab-guidance.pdf>
13. Colorado Department of Public Health and Environment (2005) *6 CCR 1014-3, Regulations Pertaining to the Cleanup of Methamphetamine Laboratories*, Appendix C
<https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=1464&fileName=6%20CCR%201014-3>
14. California Department of Toxic Substances Control (2004) *Preliminary Analysis of the Efficacy of Using Cleaning Products to Break Down Methamphetamine*
Link Unavailable
15. Serrano, Martyny, Kofford, Contreras, and Van Dyke (2012) *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197
https://www.researchgate.net/publication/259912612_Decontamination_of_Clothing_and_Building_Materials_Associated_with_the_Clandestine_Production_of_Methamphetamine
16. Serrano, Martyny, Kofford, Contreras, and Van Dyke (2012) *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197
https://www.researchgate.net/publication/259912612_Decontamination_of_Clothing_and_Building_Materials_Associated_with_the_Clandestine_Production_of_Methamphetamine

17. Serrano, Martyny, Kofford, Contreras, and Van Dyke (2012) *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197
https://www.researchgate.net/publication/259912612_Decontamination_of_Clothing_and_Building_Materials_Associated_with_the_Clandestine_Production_of_Methamphetamine
18. Washington State Department of Health, Division of Environmental Health (2005) *Guidelines for Environmental Sampling at Illegal Drug Manufacturing Sites*, pg. 12
<https://www.doh.wa.gov/portals/1/Documents/Pubs/334-106.pdf>
19. American Industrial Hygiene Association (2007) *Clandestine Methamphetamine Laboratory Assessment and Remediation Guidance*, pg. 22
https://online-ams.aiha.org/amsssa/ecssashop.show_product_detail?p_mode=detail&p_product_serno=1322
20. Serrano, Martyny, Kofford, Contreras, and Van Dyke (2012) *Decontamination of Clothing and Building Materials Associated with the Clandestine Production of Methamphetamine*, *Journal of Occupational and Environmental Hygiene*, vol. 9:3, pgs. 185-197
https://www.researchgate.net/publication/259912612_Decontamination_of_Clothing_and_Building_Materials_Associated_with_the_Clandestine_Production_of_Methamphetamine
21. United States Environmental Protection Agency (2000) *Data Quality Objectives Process for Hazardous Waste Site Investigations*
<https://www.epa.gov/quality/data-quality-objectives-process-hazardous-waste-site-investigations-epa-qag-4hw-january-2000>
22. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH) (2011) *Manual of Analytical Methods (NMAM), Fifth Edition*
<https://www.cdc.gov/niosh/docs/2003-154/pdfs/9106.pdf>
<https://www.cdc.gov/niosh/docs/2003-154/pdfs/9109.pdf>
23. Drug Enforcement Administration (2020) *Drug Fact Sheet – Fentanyl*, pg. 1
<https://www.dea.gov/factsheets/fentanyl>
24. Office of National Drug Control Policy (2019) *Advisory to the Chemical Manufacturing Industry on Illicit Activity and Methods Related to the Manufacturing of Fentanyl and Synthetic Opioids*, pg. 2
<https://www.state.gov/wp-content/uploads/2020/02/Fentanyl-Advisory-Manufacturing-Tab-A-508.pdf>
25. Alberta Health, Government of Alberta (2020) *Fentanyl Remediation Guidance for Remediators, Regulatory Agencies and Professionals*, pg. 9
<https://open.alberta.ca/publications/fentanyl-remediation>
26. Centers for Disease Control and Prevention (2020) *Synthetic Opioid Overdose Data*
<https://www.cdc.gov/drugoverdose/data/fentanyl.html>
27. Spencer MR, Warner M, Bastian BA, Trinidad JP, Hedegaard H. (2019) *Drug overdose deaths involving fentanyl, 2011–2016* *National Vital Statistics Reports*, vol 68 no 3. Hyattsville, MD: National Center for Health Statistics
https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_03-508.pdf
28. Drug Enforcement Administration (2019) *Guidelines for Law Enforcement – Cleanup of Illicit Hazardous Environments*
Law Enforcement Sensitive/For Official Use Only information; not available for widespread release
29. American College of Medical Toxicology (ACMT) and American Academy of Clinical Toxicology (AACT) (2018) *Position Statement: Preventing Occupational Fentanyl and Fentanyl Analog Exposure to Emergency Responders*
www.acmt.net/_Library/Positions/Fentanyl_PPE_Emergency_Responders_.pdf
30. United States Environmental Protection Agency (2018) *Fact Sheet for OSCs: Fentanyl and Fentanyl Analogs*
https://www.epa.gov/sites/production/files/2018-07/documents/fentanyl_fact_sheet_ver_7-26-18.pdf
31. Alberta Health, Government of Alberta (2020) *Fentanyl Remediation Guidance for Remediators, Regulatory Agencies and Professionals*, pg. 72
<https://open.alberta.ca/publications/fentanyl-remediation>
32. List modified from Alberta Health, Government of Alberta (2020) *Fentanyl Remediation Guidance for Remediators, Regulatory Agencies and Professionals*, pg. 33
<https://open.alberta.ca/publications/fentanyl-remediation>
33. List modified from Alberta Health, Government of Alberta (2020) *Fentanyl Remediation Guidance for Remediators, Regulatory Agencies and Professionals*, pg. 34
<https://open.alberta.ca/publications/fentanyl-remediation>

Key Contributors

- Leigh Anderson, Utah Department of Environmental Quality
- Curry Blankenship, Cherokee Nation Environmental Programs
- Lisa Boynton, U.S. Environmental Protection Agency
- Colleen Brisnehan, Colorado Department of Public Health and Environment
- Jeff Burgess, MD, MPH, University of Arizona
- Steven Connolly, New Mexico Environment Department
- Ryan Costello, Agency for Toxic Substances and Disease Registry
- Jace Cujé, U.S. Environmental Protection Agency
- Jim Faust, Idaho Department of Health and Welfare
- Anna Fernandez, Hawaii Department of Health
- Sherry Green, National Alliance of Model State Drug Laws
- Deb Grimm, Montana Department of Environmental Quality
- Leo Henning, Kansas Department of Health and Environment
- Thomas Hunting, Arkansas Department of Environmental Quality
- Erik Janus, University of Maryland University College
- James Justice, U.S. Environmental Protection Agency
- Larry Kaelin, U.S. Environmental Protection Agency
- Karen Keller, Utah Department of Environmental Quality
- Shalece Koffard, Utah Department of Health
- Kim Leingang, Kentucky Division of Waste Management
- Kathy Marshall, Illinois Department of Public Health
- John Martyny, PhD, CIH, National Jewish Health
- Greg McKnight, Washington State Department of Health
- James Michael, U.S. Environmental Protection Agency
- Terrel Mitchell, Cherokee Nation Environmental Programs
- Jim Morrison, Tennessee Department of Environment and Conservation
- Lukas Oudejans, U.S. Environmental Protection Agency
- Robert Pangelinan, Drug Enforcement Administration
- Marilyn Parker, North Carolina Department of Health and Human Services
- Bill Rees, Utah Department of Environmental Quality
- Rick Rosky, National Meth Chemicals Initiative Southwest Meth Initiative
- Charles Salocks, California Environmental Protection Agency
- Will Service, North Carolina Division of Waste Management
- Brett Sherry, Oregon Health Authority
- Kent Schierkolk, Kansas Department of Health and Environment
- Brian Schlienger, U.S. Environmental Protection Agency
- Larry Souther, Minnesota Department of Health
- Ed Thamke, Montana Department of Environmental Quality
- Scot W. Tiernan, Alaska Department of Environmental Conservation
- Ellen Treimel, U.S. Environmental Protection Agency
- Greg Art Vollmer, New Mexico Environment Department
- Corey Yep, California Department of Toxic Substances Control
- Cathy Young, U.S. Environmental Protection Agency

Appendix A: Primary Methods of Meth Production and Associated Hazards

Precursor:	Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using ammonium nitrate, lithium metal, sodium hydroxide, ether and hydrochloric acid
Other Names:	"Shake and Bake" Lab or "Six Pack" Lab
Unique Hazards:	Heat generated by reaction can degrade structural integrity of plastic reaction vessel and may result in a release of flammable liquids and vapors
	Reaction of water with sodium or lithium metals can cause lithium to tear through plastic vessel and ignite the flammable liquids and vapors, resulting in fire
	Discarded reaction vessels carry residual chemicals that are muddy brown in color and can be toxic and flammable
	Use of acid gas generators
Variations:	Use of other non-polar solvent in place of ether
	Use of other ammonium salts

Nazi/Birch Reduction Lab Profile	
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using anhydrous ammonia and lithium, sodium metal or elemental potassium and hydrochloric acid
Other Names:	"Lithium-Ammonia" Lab or "Sodium Metal" Lab
Unique Hazards:	Reaction of water with sodium or lithium metals as well as mixing sodium metal with sodium hydroxide increases flammability potential
	Irritant toxicity hazard from concentrated ammonia atmospheres
	Use of corrosive acids and bases
	Use of acid gas generators
Variations:	Use of an acetone/dry ice bath to keep original anhydrous ammonia mixture from evaporating prematurely
	Recovery of lithium ribbon from camera batteries

Red Phosphorus/Hydriodic Acid Lab Profile	
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using red phosphorus, hydriodic acid and hydrochloric acid
Other Names:	"Red P" Lab, "Tweaker" Lab, "HI" Lab or "Mexican National" Lab
Unique Hazards:	Phosphine gas production
	Conversion of red phosphorus to white phosphorus
	Iodine and hydriodic acid vapors
	Use of corrosive acids and bases
Variations:	Use of acid gas generators
	Use iodine and water to make hydriodic acid
	Use hypophosphorus acid instead of red phosphorus
	Use liquid from tablet extraction directly in reflux step

P2P Amalgam Lab Profile	
Precursor:	Phenyl-2-Propanone (phenylacetone)
Product:	Mixture of l-Methamphetamine (50%) and d-Methamphetamine (50%)
Method:	P2P reduction using methylamine, mercuric chloride and hydrochloric acid
Other Names:	"Biker" Lab or "Prope Dope" Lab
Unique Hazards:	Methylamine could cause severe eye and skin irritation and may cause blindness, flammable in high concentrations, a skin absorbent and a central nervous system (CNS) toxicant
	Use of lead acetate and highly toxic mercuric chloride
	Use of corrosive acids and bases
	Occasional use of methylamine compressed gas cylinders
	Use of acid gas generators
Variations:	Acidify the oil layer directly (i.e., delete solvent washing step)

Appendix B: Costs Associated with Meth Lab Cleanup

As explained previously in this document, meth labs range from crude makeshift operations to technologically advanced facilities and are found almost anywhere: in private residences, motel and hotel rooms, apartments and trailers. Because no two meth labs are alike, the cost of cleanup varies. The Institute for Intergovernmental Research estimated that the average cost of cleanup can range from \$5,000–\$150,000.* The following variables may impact the cost of meth lab remediation:

Size of Property and Structure

- Larger labs are usually more costly to remediate simply because there is more surface area to clean.

Property Accessibility

- Meth labs are sometimes found in remote locations. If the lab is in an area that is difficult to access, costs will increase.

Contractor Rates

- Contractor rates vary depending on geographical location.

Amount of Debris

- A considerable amount of debris is generated during meth lab cleanup (e.g., carpet, contaminated household items).
- The more contaminated debris that needs to be discarded, the more the cleanup will cost.

Presence of Asbestos

- If asbestos is found in materials that have to be cleaned or removed, the cost of the cleanup may increase.

Contamination Level

- Labs with high levels of contamination may cost more to clean than labs with lower levels of contamination.

Pre- and Post-Remediation Sampling

- Pre-remediation sampling may be useful in some cases (see *Section 3.6*); others may not require pre-remediation sampling.
- The results of post-remediation samples demonstrate whether previously contaminated areas have been cleaned to an acceptable level. Although post-remediation sampling may increase costs, it is an important step in meth lab remediation and should not be skipped.

Inclusion of Refurbishment Costs

- The cost of cleanup will increase if one includes refurbishment activities (e.g., repainting, re-carpeting) within the scope of “cleanup.”

*The *Methamphetamine Problem: Question and Answer Guide*, Institute for Intergovernmental Research

Appendix C: Properties of Chemicals Associated with Meth

The tables below provide high-level information about the properties of the chemicals associated with meth production. These chemicals may be extremely hazardous and toxic; and exposure to them can cause significant health effects. [Note: Taken from documentation developed by EPA's Office of Research and Development (ORD).]

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Acetic Acid (64-19-7) [Reacts with phenylacetic acid to yield Phenyl-2-Propanone (P2P)] [syn: ethanoic acid, glacial acetic acid]	Colorless liquid with pungent odor.	Corrosive and flammable.	Vapors cause eye irritation. Exposure to high concentrations causes inflammation of airway and ulcers of eyes. IDLH: 50 ppm; NIOSH REL: TWA 10 ppm (25 mg/m ³) STEL 15 ppm (37 mg/m ³); OSHA PEL: TWA 10 ppm (25 mg/m ³).	Miscible in water. While reacting with soil components, likely to be neutralized or diluted in soil. Readily biodegrades by aerobic or anaerobic mechanisms.
Acetic Anhydride (108-24-7) (Reacts with phenylacetic acid to yield of P2P) [syn: acetic oxide, acetyl oxide]	Colorless liquid with strong acetic odor.	Corrosive and flammable.	Vapors cause eye irritation. Exposure to high concentrations may lead to ulcerations of the nasal mucosa and can severely damage the eye. IDLH: 200 ppm. NIOSH REL: C 5 ppm (20 mg/m ³); OSHA PEL: TWA 5 ppm (20 mg/m ³).	Dissolves slowly in water. Specific gravity is greater than 1 so there is potential that it will sink in ground/surface water. Will degrade over time to acetic acid.
Acetone (67-64-1) (Solvent) [syn: dimethyl ketone, 2-propanone]	Colorless liquid with fragrant odor.	Flammable.	Vapors may cause skin irritation. Prolonged exposure to high concentration may lead to blurred vision, fatigue, convulsions and death. IDLH: 2,500 ppm; NIOSH REL: TWA 250 ppm (590 mg/m ³); OSHA PEL: TWA 1,000 ppm (2,400 mg/m ³).	Miscible in water. Not persistent. Readily biodegrades in soil or water.
Ammonia (7664-41-7) (Used in Nazi/Birch method) [syn: anhydrous ammonia]	Colorless gas with pungent odor anhydrous form is liquid under pressure.	Corrosive.	Liquid anhydrous ammonia causes severe skin burns on contact. Lung irritant at low concentrations. IDLH: 300 ppm; NIOSH REL: TWA 25 ppm (18 mg/m ³) STEL 35 ppm (27 mg/m ³); OSHA PEL: TWA 50 ppm (35 mg/m ³).	Lighter than air gas, likely to dissipate into atmosphere.
Ammonium Hydroxide (1336-21-6) (Found during synthesis in Nazi/Birch and One-Pot methods)	Clear colorless solution with ammonia odor.	Corrosive and poison.	Ammonium solution (10-35% ammonia) can cause upper respiratory irritation. Exposure to greater than 5,000 ppm can be fatal. Can cause irritation and burns to skin. Ingestion of as little as 2-3 mL can also be fatal. ACGIH TLV: TWA 25 ppm; OSHA PEL: TWA 50 ppm, STEL 35 ppm NIOSH REL: TWA 25 ppm, STEL 35 ppm.	Toxic to aquatic life. 28% solution has high vapor pressure and is likely to evaporate if spilled.
Ammonium Sulfate (7783-20-2) (Used with sodium hydroxide to produce anhydrous ammonia for use in One-Pot method) [syn: sulfuric acid diammonium salt]	Brownish gray to white odorless granules or crystals.	Corrosive.	Irritant and corrosive to the skin, eyes, respiratory tract and mucous membranes. Exposure to liquid or rapidly expanding gases may cause severe chemical burns and frostbite to the eyes, lungs and skin. Skin and respiratory related diseases could be aggravated by exposure. Exposure limits N/A.	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Benzaldehyde (100-52-7) (Precursor for amphetamine or P2P) [syn: benzoic aldehyde, artificial essential oil of almond, benzenecarbonal]	Colorless liquid, bitter almond odor.	Combustible.	Mild irritant to lungs. Central nervous system depressant. Exposure limits N/A.	If released in sufficiently large quantities, can migrate to shallow water table. Slightly soluble in water with specific gravity of 1.05. Moderately biodegradable.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Benzyl Chloride (100-44-7) (Precursor for P2P) [syn: chloromethyl benzene, alpha- chlorotoluene]	Colorless to pale yellow liquid with pungent aromatic odor.	Combustible.	Eye, skin and respiratory irritant. IDLH: 10 ppm; NIOSH REL: C 1 ppm (5 mg/m ³) [15-minute]; OSHA PEL: TWA 1 ppm (5 mg/m ³).	Not persistent. Hydrolysis in moist conditions. Readily biodegradable.
Benzene (71-43-2) (Solvent)	Colorless liquid with aromatic odor.	Flammable.	Vapor in high concentrations may cause dizziness, headache, coughing. Chronic exposure may cause anemia or leukemia. IDLH: 500 ppm; NIOSH REL: Ca TWA 0.1 ppm STEL 1 ppm; OSHA PEL: (1910.1028) TWA 1 ppm STEL 5 ppm.	Mobile in soils. Lighter than water and slightly soluble. Will biodegrade over time. MCL of 5 µg/L.
Chloroform (67-66-3) (Solvent)	Colorless liquid with a pleasant odor.	May explode if it comes into contact with certain materials, including aluminum powder, lithium and perchlorate.	Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver, suspect carcinogen. IDLH: 500 ppm; NIOSH REL: Ca STEL 2 ppm (9.78 mg/m ³) [60-minute]; OSHA PEL: C 50 ppm (240 mg/m ³).	Chloroform has a high vapor 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.
Coleman Fuel (68410-97-9) (Used in Nazi/Birch reduction, Red Phosphorus/Hydriodic Acid and One-Pot methods) [syn: petroleum ether, petroleum naphtha, petroleum, distillate]	Clear colorless liquid with odor of rubber cement. Mixture of light petroleum distillates containing up to 25% n-hexane and 15% cyclohexane.	Flammable.	Skin irritant. Central nervous system suppressant (dizziness, nausea, blurred vision, drowsiness, loss of coordination). Chronic exposure can cause damage to sensory and motor nerve cells, kidneys and liver. IDLH: 1,100 ppm; NIOSH REL: TWA 350 mg/m ³ C 1,800 mg/m ³ [15-minute]; OSHA PEL: TWA 500 ppm (2,000 mg/m ³).	Vapors are heavier than air and may accumulate in low spots. Small spills are likely to evaporate. Large spills can penetrate soil and may reach groundwater. Will biodegrade over time.
Diethyl Ether (60-29-7) (Solvent) [syn: ether, ethyl ether, ethyl oxide]	Clear colorless liquid with sweet pungent odor.	Highly flammable.	Inhalation may cause headache, drunkenness and vomiting. IDLH: 1,900 ppm; NIOSH REL: none; OSHA PEL: TWA 400 ppm (1,200 mg/m ³).	Spilling of small amounts to ground or soil will likely result in volatilization. Expected to be mobile in soil and resistant to biodegradation.
Ephedrine (299-42-3) (Precursor for meth)	Odorless white crystal.	None.	Skin and respiratory irritant. Exposure limits N/A.	Not available.
Ethanol (64-17-5) (Solvent) [syn: ethyl alcohol, ethanol, anhydrous alcohol, ethyl hydroxide, methyl carbinol]	Clear colorless liquid with pleasant odor.	Highly flammable.	Respiratory irritant. Central nervous system suppressant. IDLH: 3,300 ppm; NIOSH REL: TWA 1,000 ppm (1,900 mg/m ³); OSHA PEL: TWA 1,000 ppm (1,900 mg/m ³).	Miscible with water. Large spills may reach water table. Very biodegradable.
Ethylamine (75-04-7) (Used in P2P method) [syn: ethanamine, monoethylamine]	Gas with ammonia-like odor.	Highly flammable and corrosive liquid.	Vapor irritates the mucous membranes, respiratory system and eyes; in high concentrations it may affect the central nervous system; liquid may irritate eyes and skin; if ingested may be irritating and poisonous. OSHA: TWA 10 ppm (18 mg/m ³).	If released to soil, ethylamine is expected to have very high mobility. Volatilization from moist soil surfaces is not expected to be an important fate process based upon its cationic state.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Formic Acid (64-18-6) (Reacts with phenyl-2-propanone and methylamine to produce methamphetamine)	Colorless fuming liquid with a pungent odor.	Corrosive and moderate fire hazard.	Highly toxic with inhalation for short duration. Produces blisters and burns on contact with skin. Prolonged exposure to low concentrations may cause liver and kidney damage. IDLH: 30 ppm; NIOSH REL: TWA 5 ppm (9 mg/m ³); OSHA PEL: TWA 5 ppm (9 mg/m ³).	Miscible in and heavier than water. When released in quantity to soil is expected to leach to shallow groundwater with moderate biodegradation. Because of its fire hazard and tendency to react explosively with oxidizing agents should not be flushed into sanitary sewer.
Normal Hexane (110-54-3) (Solvent)	Clear colorless liquid with slight odor.	Highly flammable.	May cause skin irritation. Inhalation irritates respiratory system and overexposure may cause light headedness, nausea, headache and blurred vision. Chronic inhalation may cause peripheral nerve disorders and central nervous system damage. Potential teratogen. IDLH: 1,100 ppm; NIOSH REL: TWA 50 ppm (180 mg/m ³); OSHA PEL: TWA 500 ppm (1,800 mg/m ³).	When spilled on the ground expected to evaporate. If it penetrates the ground, not likely to leach (log K _{ow} of > 3.0) to groundwater. Not very soluble and lighter than water. Moderate biodegradation expected.
Cyclohexane (110-82-7) (Solvent)	Clear colorless liquid with faint ether-like odor.	Highly flammable.	Causes irritation to respiratory tract. High concentrations have a narcotic effect. Chronic exposure may cause skin effects. IDLH: 1,300 ppm; NIOSH REL: TWA 300 ppm (1,050 mg/m ³); OSHA PEL: TWA 300 ppm (1,050 mg/m ³).	When spilled on the ground expected to evaporate. If it penetrates the ground, may leach to groundwater. Not very soluble, lighter than water. Moderate biodegradation expected.
Hydrochloric Acid (7647-01-0) (Used to gas out meth product) [syn: muriatic acid, hydrogen chloride]	Clear colorless liquid with pungent odor (hydrogen chloride dissolved in water).	Corrosive and poison.	Skin exposure will cause burns. Long-term exposure to concentrated vapors may cause erosion of teeth. Inhalation can lead to permanent lung and respiratory tract damage. IDLH: 50 ppm as HCl gas; NIOSH REL: C 5 ppm (7 mg/m ³); OSHA PEL: C 5 ppm (7 mg/m ³).	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.
Hydriodic Acid (10034-85-2) (Used in Red Phosphorus method) [syn: hydrogen iodide (aqueous solution)]	Clear colorless liquid with pungent odor (hydrogen iodide dissolved in water). Yellow to brown upon exposure to light and air.	Corrosive and poison.	Vapors cause severe irritation and burns to respiratory tract. Liquid may cause burns to skin. Exposure limits N/A.	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 leaching process.
Hydrogen Sulfide (7783-06-4) (Reacts with iodine suspended in water to yield hydriodic acid for use in the Red Phosphorus method; sometimes mistakenly used as substitute for hydrogen chloride gas)	Clear colorless gas with rotten egg odor. Heavier than air.	Flammable and poison.	If in gas cylinder, escaping gas can cause frostbite. Short term inhalation exposure depending upon concentration can cause irritation, cough, eye sensitivity to light, changes in blood pressure, nausea, vomiting, breathing difficulty, headache, drowsiness, dizziness, disorientation, tremors, hallucinations, coma and death. Long-term exposure can cause loss of appetite, weight loss, irregular heart beat, headache, nerve damage, lung congestion, paralysis and brain damage. IDLH: 100 ppm; NIOSH REL: C 10 ppm (15 mg/m ³) [10-minute]; OSHA PEL: C 20 ppm 50 ppm [10-minute maximum peak].	Hydrogen sulfide is heavier than air and may accumulate in low-lying areas.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Hypophosphorus Acid (6303-21-5) (Used in place of red phosphorus)	Clear colorless and odorless liquid.	Corrosive and reactive. Strong reducing agent, heat may cause fire or explosive decomposition liberating phosphine gas (poison).	Destructive to mucus and upper respiratory tract tissue. Symptoms may include coughing, wheezing, laryngitis, shortness of breath, headache, nausea and vomiting. May cause redness and burning of skin tissue. Exposure limits N/A.	Not available.
Iodine (7553-56-2) (Reagent in synthesis of hydriodic acid)	Solid purple crystals or flakes with sharp odor.	Corrosive, reactive and poison.	Inhalation may result in severe irritation and burns to respiratory tract. Inhalation of concentrated vapors may be fatal. Highly toxic to eye tissue. Chronic exposure may cause insomnia, tremors, conjunctivitis, bronchitis, diarrhea and weight loss. IDLH: 2 ppm; NIOSH REL: C 0.1 ppm (1 mg/m ³); OSHA PEL: C 0.1 ppm (1 mg/m ³).	Slightly soluble in water (300 mg/L) with very low vapor pressure.
Iodine, Tincture (No CAS number) (Reagent in synthesis of hydriodic acid)	Dark red solution (mixture of ethanol, iodine crystals and sodium iodide).	Flammable (ethanol).	See description for ethanol and iodine.	Not available.
Isopropyl Alcohol (67-63-0) (Solvent) [syn: 2-propanol, isopropanol, dimethyl carbinol]	Colorless liquid with slightly bitter taste.	Flammable.	Inhalation of the vapor in high concentrations and ingestion of the liquid may result in headache, dizziness, mental depression, nausea, vomiting, narcosis, anesthesia and coma; liquid may damage eyes severely. OSHA: TWA 400 ppm (980 mg/m ³).	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Lead Acetate (6080-56-4) (Reagent in P2P synthesis)	Solid white crystals or grey, brown in commercial grades with slight acetic acid odor.	Poison.	Unless a large amount is ingested, lead acetate is a chronic poison that accumulates lead through ingestion and inhalation of dust. Chronic exposure symptoms are like those of ingestion poisoning: restlessness, irritability, visual disturbances and hypertension. Can have a negative effect on the mental development of children (lower IQ). IDLH: 100 mg/m ³ as lead.	As a solid, unlikely to move into ground but could be spread by wind. If left exposed to weathering is very soluble (60gm per 100gm water) and will likely move with precipitation into the subsurface. Subsurface mineral content will determine whether it stays in solution. Lead bioaccumulates.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Lithium (metal) (7439-93-2) (Used in Nazi/Birch and One-Pot methods)	Soft, odorless silvery-white metal. Yellowish upon exposure to moist air.	Flammable, water-reactive to give off hydrogen gas and form LiOH, a strong, highly corrosive base and corrosive lithium oxide fumes.	The moisture-reactive property of lithium makes it corrosive to any tissue it contacts. Inhalation of fumes generated from a water reaction will irritate or damage upper respiratory tract tissues. Exposure limits N/A.	Only small quantities of lithium are likely to be used in a meth laboratory and should not present an environmental problem. In a release scenario, the metal will likely be transformed to LiOH and Li ₂ O.
Lithium Aluminum Hydride (16853-85-3) (Hydrogenation in multiple processes)	Solid white to grey odorless powder.	Flammable, reactive (water to form hydrogen gas and corrosive LiOH) and corrosive.	When inhaled is destructive to mucus membranes and tissues of respiratory tract. Corrosive to skin, may cause redness or burns. Exposure limits N/A.	Can ignite with friction. LiOH may be mobile in soil.
Mercuric Chloride (7487-94-7) (Reagent in meth synthesis using P2P method)	Solid white crystals.	Poison and corrosive.	Vapor inhalation can burn the mucus membranes of nose and throat as well as allow mercury sorption in blood stream. Causes irritation and burns to the skin. Chronic exposure can result in mercury poisoning: muscle tremors, personality and behavior changes, memory loss, metallic taste, loosening of the teeth, digestive disorders, skin rashes, brain and kidney damage. IDLH: 10 mg/m ³ as mercury.	As a solid, unlikely to move into ground but could be spread by wind. If left exposed to weathering is very soluble (7.6gm per 100gm water) and will likely move with precipitation into the subsurface. Subsurface mineral content will determine whether it stays in solution. Mercury bioaccumulates; if mercuric chloride is disposed of into surface water it will have negative effects on the biota.
Methyl Alcohol (67-56-1) (Solvent; HEET Gas Line Antifreeze is 99% methanol) [syn: methanol, wood alcohol, carbinol]	Clear colorless liquid.	Flammable and poison.	Inhalation acts on nervous system. Overexposure symptoms may include headache, drowsiness, nausea, vomiting, blindness, coma and death. Usual fatal ingestion dose is 100-125 mL. Chronic exposure may cause marked impairment of vision. IDLH: 6,000 ppm; NIOSH REL: TWA 200 ppm (260 mg/m ³) STEL 250 ppm (325 mg/m ³); OSHA PEL: TWA 200 ppm (260 mg/m ³).	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.
Methylamine (74-89-5) (Precursor for P2P method) [syn: methanamine, aminomethane]	Clear colorless gas with rotten fish/ammonia odor (Usually encountered in dissolved state in water).	Flammable and corrosive.	Exposure to vapors may cause irritation to eye and mucus membranes. Skin contact may result in irritation or burns. Symptoms may include coughing, shortness of breath and headaches. IDLH: 100 ppm; NIOSH REL: TWA 10 ppm (12 mg/m ³); OSHA PEL: TWA 10 ppm (12 mg/m ³).	A spill of methylamine (dissolved in water) to the ground will tend to evaporate. If it enters the soil it is likely to leach rapidly through the soil to groundwater (log K _{ow} of -0.57). Methylamine is biodegradable.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Methyl Ethyl Ketone (78-93-3) (Solvent) [syn: 2-butanone, methyl acetone]	Clear, colorless liquid with a sharp mint-like odor.	Extremely flammable.	Inhalation causes irritation to nose and throat at high concentrations. May cause headache, dizziness, nausea, shortness of breath and nervous system depression. Contact with skin and eyes may cause irritation—skin absorption with possible systemic effects. Chronic exposure may cause dermatitis or central nervous system effects. IDLH: 3,000 ppm; NIOSH REL: TWA 200 ppm (590 mg/m ³) STEL 300 ppm (885 mg/m ³); OSHA PEL: TWA 200 ppm (590 mg/m ³).	Methyl Ethyl Ketone is fairly soluble in water (239,000 mg/L) and has a log K _{ow} 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.
Nitric Acid (7697-37-2) (Used with sodium hydroxide to produce anhydrous ammonia for use in One-Pot method) [syn: ammonium nitrate, ammonium saltpeter, ammonium salt]	Clear colorless to yellowish liquid with suffocating acrid odor/white, odorless solid crystals.	Corrosive oxidizer.	Inhalation causes extreme irritation of upper respiratory tract. Skin contact can result in deep ulcers and staining of skin. IDLH: 25 ppm; NIOSH REL: TWA 2 ppm (5 mg/m ³) STEL 4 ppm (10 mg/m ³); OSHA PEL: TWA 2 ppm (5 mg/m ³).	Incompatible with most materials.
Nitroethane (79-24-3) (Precursor for P2P synthesis)	Colorless oily liquid with a mild fruity odor.	Flammable.	Skin contact may cause dermatitis. Eye contact may cause corneal damage. Inhalation causes respiratory irritation and may cause dizziness and suffocation. IDLH: 1,000 ppm; NIOSH REL: TWA 100 ppm (310 mg/m ³); OSHA PEL: TWA 100 ppm (310 mg/m ³).	With small spills on an impervious or wet ground, evaporation may be significant. After entering the subsurface, likely to move through the soil to shallow groundwater (log K _{ow} of 0.18) or pond on low permeability soils. Slightly denser than water; water solubility of 4.5% by weight. Biodegradable under aerobic conditions.
Nitromethane (75-52-5) (Used in P2P method)	Clear oily liquid.	Flammable.	Vapors may cause irritation to respiratory tract. A weak narcotic, higher concentrations may cause nausea, vomiting, diarrhea and headaches. Skin contact can cause irritation, pain and redness. Absorbed through skin. Prolonged exposure can cause dermatitis and liver damage. IDLH: 750 ppm; NIOSH REL: none; OSHA PEL: TWA 100 ppm (250 mg/m ³).	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The products of degradation are more toxic.
Perchloric Acid (7601-90-3) (Used in P2P method)	Clear to yellowish odorless liquid.	Corrosive oxidizer. Unstable at normal pressure and temperature and may decompose explosively.	Inhalation may cause irritation to upper respiratory tract. Skin contact may result in burns and discoloration. Exposure limits N/A.	May form sensitive explosive mixtures with organic materials.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Petroleum Distillates (Naphtha) (8002-05-9) Note that there are many Naphthas and they contain different ratios of petroleum hydrocarbons and have somewhat different properties in terms of toxicity. CAS 8002-05-9 is the one characterized by OSHA. Rosonol, a lighter fluid, is made up of Naphthas (Solvent)	Clear colorless liquid with a hydrocarbon odor.	Flammable.	Inhalation may cause dizziness, drowsiness, headache and nausea. Skin contact will cause defatting and cracking. Vapors are an irritant to eyes nose and throat. IDLH: 1,100 ppm; NIOSH REL: TWA 350 mg/m ³ C 1,800 mg/m ³ [15-minute]; OSHA PEL: TWA 500 ppm (2,000 mg/m ³).	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.
Phenylacetic Acid (103-82-2) (Precursor for P2P synthesis) [syn: benzeneacetic acid, alpha-toluic acid]	Solid white crystal with a floral odor.	None.	Contact is irritating to skin and eyes. Inhalation may cause upper respiratory tract irritation. Potential teratogen. Exposure limits N/A.	Not available.
Phenyl-2-Propanone (103-79-7) (Precursor for meth or amphetamine synthesis)	Clear, moderately viscous liquid.	None.	Irritating to eyes and skin. Inhalation may lead to headache, nausea and dizziness. Exposure limits N/A.	Not available.
Phosphine (7803-51-2) (Unintended byproduct of Red Phosphorous method)	Colorless gas with a fish- or garlic-like odor. [Note: <i>commercially made product has odor phosphine itself is odorless.</i>]	Flammable and poison.	Inhalation may cause dizziness, drowsiness, nausea, chest pressure, tremors, convulsions and central nervous system damage. Exposure symptoms can be delayed for up to 48 hours. IDLH: 50 ppm; NIOSH REL: TWA 0.3 ppm (0.4 mg/m ³) STEL 1 ppm (1 mg/m ³); OSHA PEL: TWA 0.3 ppm (0.4 mg/m ³).	Heavier than air. May accumulate in low spots. High reactivity will minimize environmental effects.
Phosphoric Acid (7664-38-2) (Precursor for meth)	Thick, odorless crystalline solid often used in an aqueous solution.	Corrosive.	Not an inhalation hazard unless misted or heated to high temperatures. Skin contact may cause burns. IDLH: 1,000 mg/m ³ ; NIOSH REL: TWA 1 mg/m ³ STEL 3 mg/m ³ ; OSHA PEL: TWA 1 mg/m ³ .	When released in sufficient quantities may reach shallow groundwater. Neutralization leaves phosphate.
Pseudoephedrine (90-82-4) (Precursor for meth)	Nearly odorous, white crystalline powder.	None	Contact with skin or eyes may result in irritation. Inhalation may result in respiratory irritation. Exposure limits N/A.	Completely soluble in water with a log K _{ow} of 1.74. As crystal may be transported by wind. Dissolved in water or subjected to water (rain) will leach through soil. Moderately biodegradable.
Pyridine (110-86-1) (Reagent in the synthesis of P2P from phenylacetic acid in the presence of acetic anhydride)	Colorless to yellow liquid with a nauseating fish-like odor.	Flammable.	Skin and eye irritant. Short-term inhalation may cause irritation, headache, drowsiness, dizziness and loss of coordination. Long-term inhalation may cause nausea, vomiting, diarrhea, stomach pain, loss of appetite, dizziness, sleep and emotional disturbances, loss of coordination, nerve, heart, kidney and liver damage. IDLH: 1,000 ppm; NIOSH REL: TWA 5 ppm (15 mg/m ³); OSHA PEL: TWA 5 ppm (15 mg/m ³).	Pyridine is miscible in water and has a log K _{ow} of 0.65. As such, when released in sufficient quantity it should move freely through the subsurface, and lesser amounts will leach with rainfall. Very biodegradable.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Red Phosphorus (7723-14-0) (Used in Red Phosphorus method for meth production)	Odorless red to violet solid.	Less reactive than white or yellow phosphorus. Flammable and explosive when mixed with organic materials. In the presence of water vapor and oxygen decomposes to form phosphine gas.	May cause eye and skin irritation. Inhalation may cause respiratory tract irritation. Chronic ingestion or inhalation may induce systemic phosphorous poisoning. Liver damage, kidney damage, jaw/tooth abnormalities, blood disorders and cardiovascular effects can result. Exposure limits N/A.	Harmful to aquatic organisms. Insoluble in water. Will remain on ground surface if released.
Sodium (7440-23-5) (Catalyst in Nazi/Birch method)	Silvery white solid.	Flammable and Corrosive. Severe fire risk in contact with water in any form. Reaction forms hydrogen gas and sodium hydroxide. Ignites spontaneously in dry air when heated.	Reacts with moisture on skin, mucus membranes and eyes to cause chemical and heat burns. Exposure limits N/A.	High reactivity with air and moisture will quickly eliminate the metallic form. In a lab, it should be found as solids under a hydrocarbon solution.
Sodium Hydroxide (1310-73-2) (Used to make sodium, a catalyst in Nazi/Birch method; Drano® contains 30-60% by weight of sodium hydroxide)	Colorless to white solid (flakes, beads, pellets).	Corrosive and poison.	Contact with skin will cause irritation to severe burns. Inhalation depending upon concentration can cause mild irritation to severe damage to upper respiratory tract. IDLH: 10 mg/m ³ ; NIOSH REL: C 2 mg/m ³ ; OSHA PEL: TWA 2 mg/m ³ .	Dissolves in water with release of heat, creating a high pH solution.
Sodium Thiosulfate (7772-98-7) (Used in Red Phosphorous method to remove remaining iodine from solution) [syn: sodium hyposulfite, "hypo", antichlor, sodothiol, sulfothiorine, ametox]	Powder; odorless crystals or granules.	None.	Moderately toxic by subcutaneous routes Exposure limits N/A.	Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise. The product itself and its products of degradation are not toxic.
Sulfuric Acid (7664-93-9) (Reagent and main component in generating HCl; Battery acid is sulfuric. Used battery acid may contain high concentrations of lead. Liquid Fire Drain Cleaner contains sulfuric acid) [syn: oil of vitriol, hydrogen sulfate]	Colorless to yellow viscous, odorless liquid.	Corrosive.	Contact with skin or eyes can cause severe deep burns. Inhalation of fumes can result in severe damage to upper respiratory tract. IDHL: 15 mg/m ³ ; NIOSH REL: TWA 1 mg/m ³ ; OSHA PEL: TWA 1 mg/m ³ .	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 and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Thionyl Chloride (7719-09-7) (Reacts with ephedrine or pseudoephedrine to form intermediary) [syn: sulfurous oxychloride]	Pale yellow to red liquid with a pungent characteristic odor.	Corrosive and poison.	Extremely destructive to tissues of the mucous membranes and upper respiratory tract when inhaled; can be fatal. Skin and eye contact may cause irritation and blistering burns. Prolonged or repeated exposure may cause conjunctivitis, dermatitis, rhinitis and pneumonitis. IDLH: none; NIOSH REL: C 1 ppm (5 mg/m ³); OSHA PEL: none.	Reacts violently with water to form HCl and SO ₂ . Not likely to remain in the environment as thionyl chloride.
Thorium Oxide (1314-20-1) (Catalyst for P2P synthesis)	White heavy crystalline powder.	None.	Irritant to skin and eyes. May cause mild irritation to respiratory system when inhaled. Thorium is a confirmed human carcinogen producing angiosarcoma, liver and kidney tumors, lymphoma and other tumors of the blood system. Chances of developing cancer increase with increased exposure. Exposure limits N/A.	Thorium oxide may spread through the environment by runoff or wind. It is insoluble in water and will likely remain where it is spilled.
Toluene (108-88-3) (Solvent) [syn: methyl benzene, phenylmethane]	Clear colorless liquid with an aromatic odor.	Flammable and poison.	Toluene is a central nervous system depressant and an irritant of the eyes, mucous membranes and skin in humans. In contact with the eyes, toluene causes reversible corneal injury; prolonged skin contact causes defatting and dermatitis. Exposure while pregnant may affect fetal development. IDLH: 500 ppm; NIOSH REL: TWA 100 ppm (375 mg/m ³) STEL 150 ppm (560 mg/m ³); OSHA PEL: TWA 200 ppm C 300 ppm 500 ppm [10-minute maximum peak].	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 (Howard Vol. II).
1,1,2-Trichloroethane (79-00-5) (Solvent)	Colorless liquid with sweet odor.	None.	Inhalation may cause irritation, irregular heartbeat, headache, symptoms of drunkenness and kidney and liver damage. IDLH: 100 ppm; NIOSH REL: Ca TWA 10 ppm (45 mg/m ³) [skin]; OSHA PEL: TWA 10 ppm (45 mg/m ³) [skin].	Slightly soluble in water (4,420 mg/L). Has a log K _{ow} of 2.07; unlikely to sorb to soil. If released in sufficient quantities may migrate to shallow ground water. Heavier than water and will sink through the water table. Not likely to biodegrade. Small spills likely to evaporate.
1,1,2-Trichloro-1,2,2-Trifluoroethane (76-13-1) (Solvent)	Clear colorless liquid with a slight ethereal odor.	None.	Eye and skin contact may cause redness and pain. Causes irritation to upper respiratory tract. Air concentrations above 2,500 ppm may cause feeling of excitement and incoordination. Fatal arrhythmias are possible at high concentrations. IDLH: 2,000 ppm; NIOSH REL: TWA 1,000 ppm (7,600 mg/m ³) STEL 1,250 ppm (9,500 mg/m ³); OSHA PEL: TWA 1,000 ppm (7,600 mg/m ³).	1,1,2-Trichloro-1,2,2-Trifluoroethane has a very high vapor pressure and releases to soil or water will evaporate quickly. In the subsurface, it is hydrophobic (solubility in water of 1,100 ppm) and denser than water (1.56 specific gravity), it should move through the subsurface and with sufficient head, through the water table. 1,1,2-Trichloro-1,2,2-Trifluoroethane does not readily biodegrade.

C — Ceiling REL
Ca — Potential Carcinogen
CAS — Chemical Abstracts Service
HCl — Hydrochloric Acid
HI — Hydrogen Iodide

IDLH — Immediately Dangerous to Life or Health
LiOH — Lithium Hydroxide
Li₂O — Lithium Oxide
logK_{ow} — Octanol-Water Partition Coefficient
MCL — Maximum Contaminant Level

NIOSH REL — NIOSH Recommended Exposure Limit
OSHA PEL — OSHA Permissible Exposure Limits
SO₂ — Sulphur Dioxide
STEL — Short-Term Exposure Limit
TWA — Time Weighted Average

Appendix D: Meth Resources

Because state requirements and guidelines change frequently, please consult your appropriate municipal, county, or state agency for the most up to date information. States with ** reference EPA guidance on clandestine drug lab cleanup. Links provided below were active at the time of publication.

State Resources

Alaska

<https://dec.alaska.gov/spar/csp/meth-lab/>

Arkansas

<https://www.adeq.state.ar.us/poa/cscpc/>

California

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

Colorado

<https://www.colorado.gov/pacific/cdphe/methlabcleanup>

Connecticut

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

Florida

[http://www.floridadec.org/webfiles.nsf/WF/KGRG-6UJQUQ/\\$file/METHAMPHETAMINEGuideline.pdf](http://www.floridadec.org/webfiles.nsf/WF/KGRG-6UJQUQ/$file/METHAMPHETAMINEGuideline.pdf)

Georgia

https://dph.georgia.gov/sites/dph.georgia.gov/files/related_files/site_page/EnvHealthChemHazMethLabBrochure.pdf

Hawaii

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

Idaho

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

*Illinois***

<http://www.idph.state.il.us/envhealth/factsheets/meth-cleanup.htm>

Indiana

<https://www.in.gov/meth/2335.htm>

Iowa

http://publications.iowa.gov/9239/1/meth_lab_cleanup.pdf

Kansas**

http://www.kdheks.gov/methlabs/ml_cleanup.html

Kentucky

<https://eec.ky.gov/Environmental-Protection/Waste/superfund/methamphetamine-lab-cleanup/Pages/default.aspx>

Louisiana

https://internet.deq.louisiana.gov/portal/Portals/0/remediation/meth_cleanup_guidelines.pdf

Michigan

https://www.michigan.gov/documents/mdch/MI_Guidelines_459934_7.pdf

Minnesota**

<https://www.health.state.mn.us/communities/environment/meth/>

Missouri**

<https://health.mo.gov/atoz/pdf/MethLabCleanupGuidelines.pdf>

Montana

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

Nebraska

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

New Mexico**

<https://www.env.nm.gov/hazardous-waste/ clandestine-drug-laboratories-cleanup-guidance-3/>

North Carolina**

https://epi.publichealth.nc.gov/oe/a_z/meth.html

<https://epi.publichealth.nc.gov/oii/pdf/methguidelines.pdf>

Ohio**

https://odh.ohio.gov/wps/wcm/connect/gov/b5bc46c7-2138-4115-9e46-426690c1bbe6/methlabcleanup.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_M1HGGIK0N0JO00QO9DDDDM3000-b5bc46c7-2138-4115-9e46-426690c1bbe6-mjNgGNd

Oklahoma

<https://www.deq.ok.gov/wp-content/uploads/land-division/Guidelines-for-Cleaning-Up-Former-Methamphetamine-Labs.pdf>

Oregon

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/HEALTHYNEIGHBORHOODS/CLANDESTINEDRUGLABS/Pages/index.aspx>

South Dakota**

<https://denr.sd.gov/des/wm/hw/hwmeth.aspx>

Tennessee

<https://www.tn.gov/environment/program-areas/rem-remediation/meth.html>

Utah

<https://deq.utah.gov/environmental-response-and-remediation/cercla-comprehensive-environmental-response-compensation-and-liability-act/clandestine-drug-lab-cleanup-program>

Virginia**

<https://www.vdh.virginia.gov/home/guidelines-for-cleanup-of-residential-property-used-to-manufacture-methamphetamine/>

Washington

<https://www.doh.wa.gov/AboutUs/ProgramsandServices/EnvironmentalPublicHealth/EnvironmentalHealthandSafety/DrugLabCleanup/>

West Virginia

<http://www.wvdhhr.org/rtia/Meth.asp>

Wisconsin**

<https://www.dhs.wisconsin.gov/chemical/clean-lab.htm>

Other Resources

Association of State and Territorial Solid Waste Management Officials (2006) *Clandestine Drug Laboratory Remediation: A Guide to Post Emergency Response*
http://www.astswmo.org/files/policies/CERCLA_and_Brownfields/removals/Drug-Lab-Paper-final.pdf

Arbuckle, Shawn L., Eric J. Esswein, Nicola Erb, John W. Martyny, Charles S. McCammon Jr., Mike Van Dyke (2007) *Chemical concentrations and contamination associated with clandestine methamphetamine laboratories*, *Journal of Chemical Health & Safety*, pgs. 40-52
<https://www.sciencedirect.com/science/article/abs/pii/S187155320700014X#:~:text=Reference%20Levels%20%20%20%20Chemical%20%20,%20%20None%20%201%20more%20rows%20>

Contreras, John, Shalece Kofford, John W. Martyny, Kate A. Serrano, Mike V. Van Dyke (2011) *Variability and Specificity Associated with Environmental Methamphetamine Sampling and Analysis*, *Journal of Occupational and Environmental Hygiene*, vol. 8:11, pgs. 636-641
<https://pubmed.ncbi.nlm.nih.gov/21962231/>

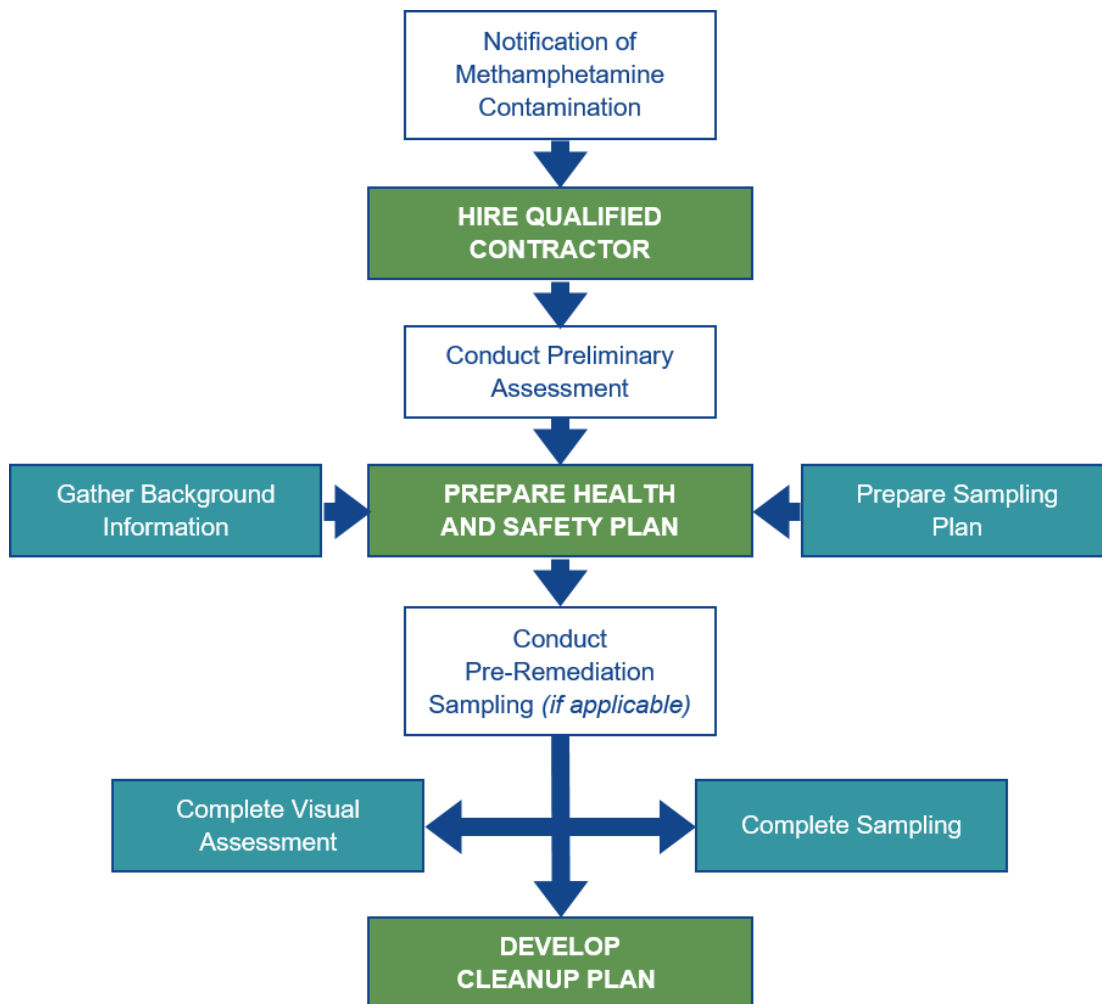
National Jewish Medical and Research Center (2004) *Chemical Exposures Associated with Clandestine Methamphetamine Laboratories Using the Anhydrous Ammonia Method of Production*
https://www.env.nm.gov/wp-content/uploads/sites/12/2019/10/Ammonia_Meth.pdf

United States Department of Justice/Drug Enforcement Administration (2020) *Methamphetamine Fact Sheet*
<https://www.dea.gov/factsheets/methamphetamine>

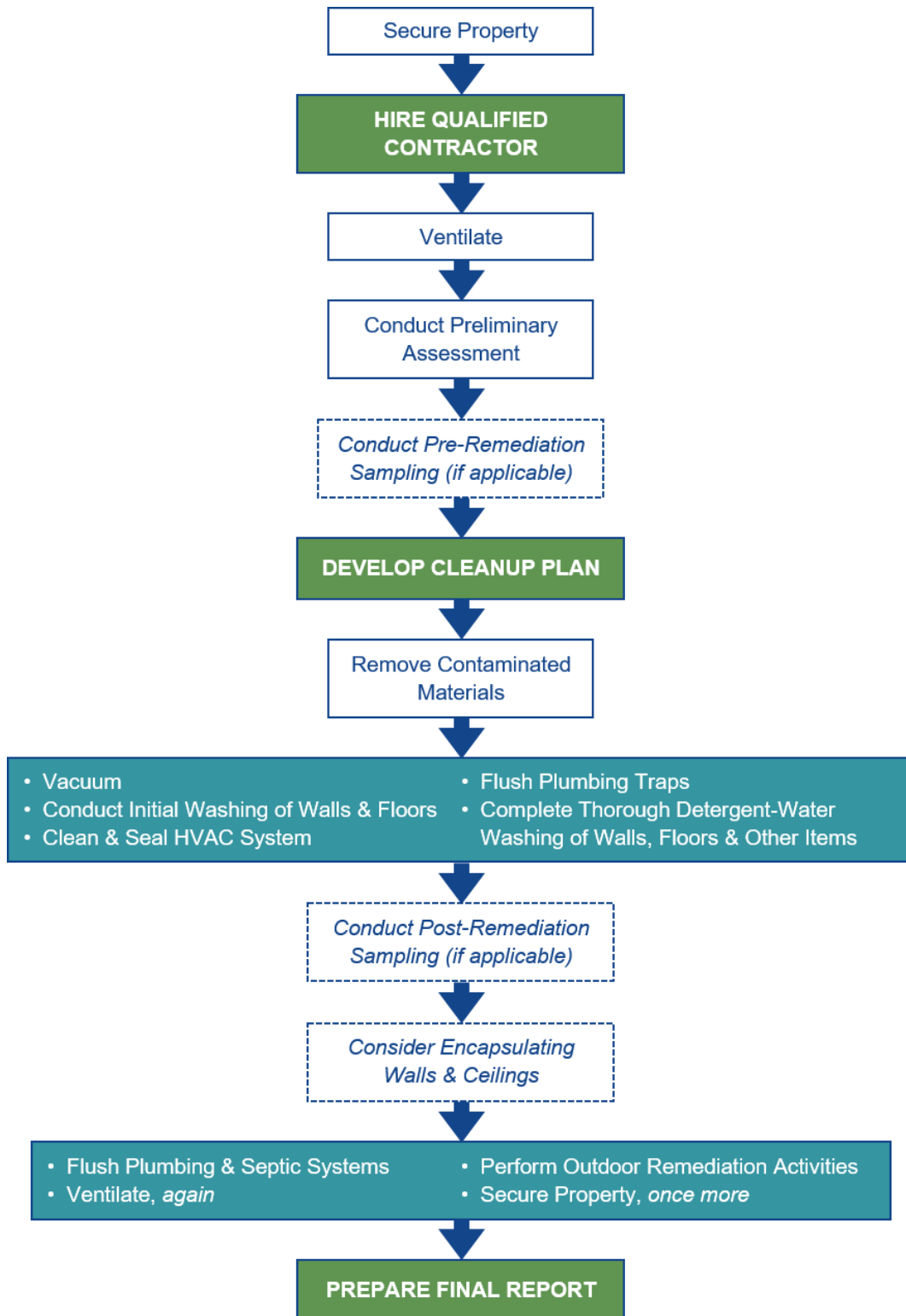
United States Environmental Protection Agency (2008) *RCRA Hazardous Waste Identification of Methamphetamine Production Process By-products*
<https://archive.epa.gov/epawaste/hazard/web/pdf/rtc-meth.pdf>

Appendix E: Meth Lab Remediation Diagrams

Cleanup Plan Development



Site Remediation



Appendix F: Fentanyl Resources

Federal Resources

U.S. Environmental Protection Agency (EPA)

United States Environmental Protection Agency (2018) *Fact Sheet for OSCs: Fentanyl and Fentanyl Analogs*
https://www.epa.gov/sites/production/files/2018-07/documents/fentanyl_fact_sheet_ver_7-26-18.pdf

United States Environmental Protection Agency (2018) *Fentanyl Toxicity, Exposure and Risk*
https://www.epa.gov/sites/production/files/2018-11/documents/decon_presentation_010.pdf

Centers for Disease Control and Prevention (CDC)

Centers for Disease Control and Prevention (2020) *Synthetic Opioid Overdose Data*
<https://www.cdc.gov/drugoverdose/data/fentanyl.html>

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (2019) *Illicit Drug Tool-Kit for First Responders*
<https://www.cdc.gov/niosh/topics/fentanyl/toolkit.html>

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (2020) *Illicit Drugs, Including Fentanyl*
<https://www.cdc.gov/niosh/topics/fentanyl/risk.html>

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (2019) *Using Naloxone to Reverse Opioid Overdose in the Workplace: Information for Employers and Workers*
<https://www.cdc.gov/niosh/docs/2019-101/pdfs/2019-101.pdf?id=10.26616/NIOSH PUB2019101>

Spencer MR, Warner M, Bastian BA, Trinidad JP, Hedegaard H. 2019) *Drug Overdose Deaths Involving Fentanyl, 2011–2016. National Vital Statistics Reports; vol. 68 no 3. Hyattsville, MD: National Center for Health Statistics*
https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_03-508.pdf

Drug Enforcement Administration (DEA)

United States Department of Justice/Drug Enforcement Administration (2020) *Fentanyl Fact Sheet*
<https://www.dea.gov/factsheets/fentanyl>

United States Department of Justice/United States Drug Enforcement Administration, Strategic Intelligence Section (2018) *Fentanyl Remains the Most Significant Synthetic Opioid Threat and Poses the Greatest Threat to the Opioid User Market in the United States* <https://www.dea.gov/sites/default/files/2018-07/PRB-DIB-003-18.pdf>

National Institutes of Health (NIH)

National Institutes of Environmental Health Sciences (2018) *Prevention of Occupational Exposure to Fentanyl and Other Opioids*
https://tools.niehs.nih.gov/wetp/public/hasl_get_blob.cfm?ID=11206

State Resources

California

California Legislative Information (2019) *AB-1596 Hazardous Substances: Contaminated Property: Fentanyl Cleanup*
https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200AB1596

Minnesota

Minnesota Department of Health (2019) *Fentanyl Exposures and Cleanup*
<https://www.health.state.mn.us/communities/environment/hazardous/docs/fentanylexpcln.pdf>

Appendix G: Common Fentanyl Analogs

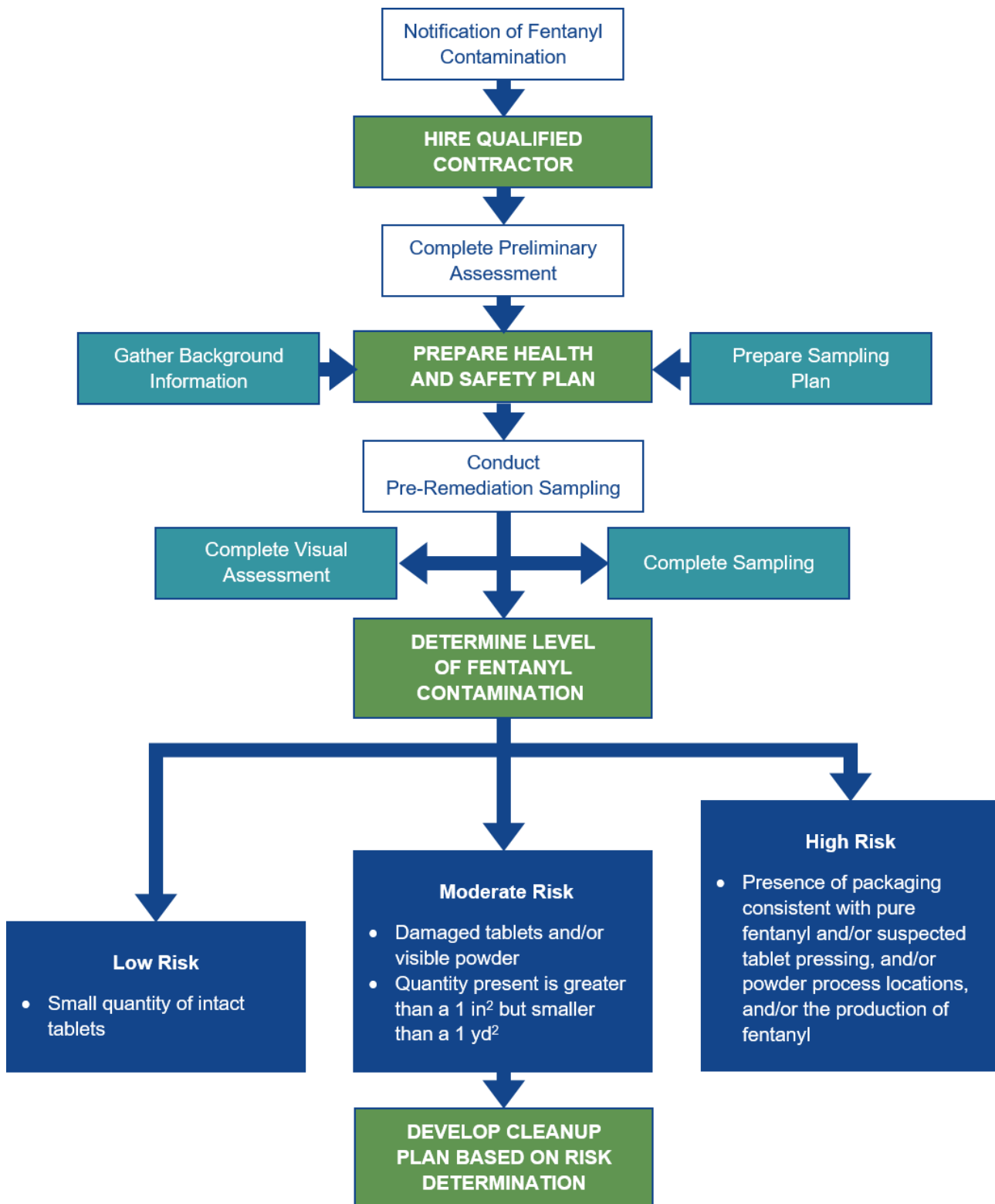
Fentanyl analogs have a similar chemical structure to fentanyl with similar effects. Small structural changes in the compound can result in a seemingly endless number of variations of the drug with potentially unknown potency. The following are a few of the more common analogs known at the time of publishing.

Analog	Description
Carfentanil	Extremely potent fentanyl analog, 10,000 times more potent than morphine (100 times more potent than fentanyl). Not intended for human use, but for use as large mammal tranquilizers. The lethal dose of carfentanil is generally accepted to be approximately 0.02 mg.
3-Methylfentanyl	Approximately 6,300 times stronger than morphine and 28 times more potent than fentanyl. A "designer" opiate that has caused more than 100 overdose deaths in California since 1979. High potency makes it an attractive target to clandestine drug producers.
Sufentanil	Approximately 7.5 times as potent as fentanyl. Typically used to help relieve pain.
Remifentanil	Remifentanil is used in anesthesia and to manage pain.
Furanylfentanyl	Estimates of the potency of furanylfentanyl vary but suggest that they are less potent than fentanyl. Has no currently accepted medical use in the United States. Over the course of 4 months in 2016, seven fatal intoxications involving furanylfentanyl occurred in Sweden.
Acetylfentanyl	Estimates of the potency of acetylfentanyl vary but suggest that they are less potent than fentanyl. Never licensed for medical use.

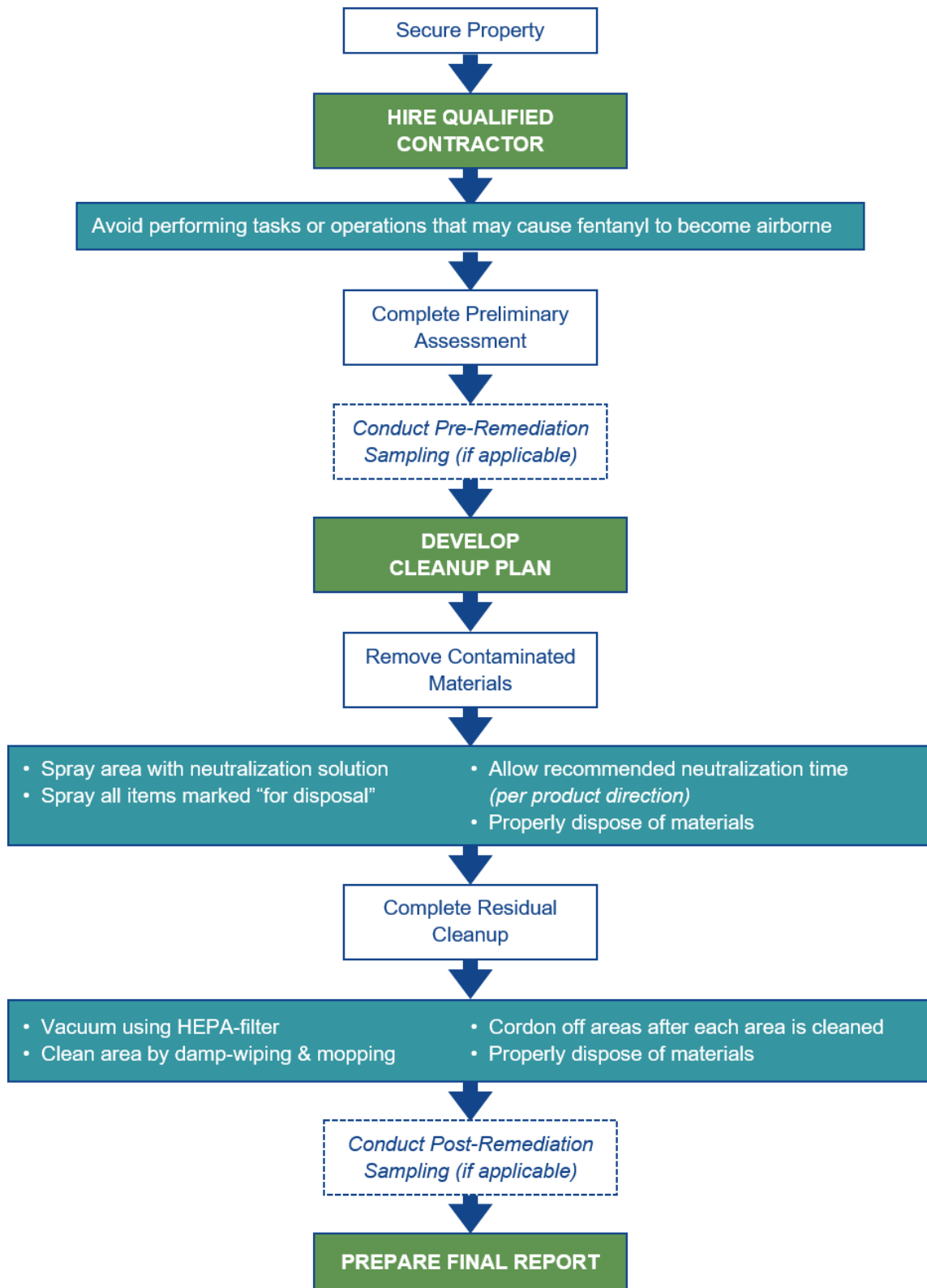
Sources: *PubMed* and *ChemMed*

Appendix H: Fentanyl Lab Remediation Diagrams

Cleanup Plan Development



Site Remediation



Appendix I: Photo Credits

Front cover inset and page 8 photo credit: Tacoma-Pierce County, Washington Health Department.

Pages 9 and 25 photos credit: National Jewish Health.

Page 32 photo credit: U.S. Drug Enforcement Administration (DEA).

