U.S. Environmental Protection Agency

Voluntary Guidelines for Methamphetamine Laboratory Cleanup

August 2009

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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 production of meth 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.

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 *Redbook).* 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 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 *Redbook,* updated in 2005, presents national guidelines for safely approaching and securing meth lab sites for first responders and other officials with immediate need to enter the site. The *Redbook* also addresses at length the gross removal of hazardous chemicals and chemical wastes found in former meth labs. Whereas the *Redbook* focuses primarily on procedures related to first-entry and gross *removal* of meth-related chemicals, this document addresses *remediation* (the cleanup of residual contamination after gross removal has occurred), which is necessary to allow unrestricted future use of the former meth lab.

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." Thus, the *Synthetics Strategy* tasked EPA with identifying best practices related to the remediation of former meth labs.

In December 2007, the Methamphetamine Remediation Research Act (Public Law 110-143) was passed, which directed EPA to establish voluntary guidelines for the remediation of former meth labs based on the best currently available scientific knowledge. This document, in addition to new research, will serve 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."[1]

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 municipal, county or state guidance documents, regulations and statutes. This document is not meant to supersede municipal, county or state guidance documents, regulations or statutes (however this document may be useful to municipalities, counties and states as they develop and/or review and revise their own guidelines). EPA did not design this document for real-estate transaction purposes.

Removal vs. Remediation

As stated previously, making a former meth lab safer for reoccupation requires two basic efforts: 1) the removal of the gross contamination (i.e., containers of chemicals and equipment and apparatus that could be used to make illegal drugs) by law enforcement; and 2) the remediation of interior structures and the surrounding land, 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." Remediation always occurs after gross chemical removal, when the site is secured and is no longer subject to criminal investigation.

Synthetic Meth Labs

Synthetic drugs other than meth may be manufactured in clandestine labs, however, these voluntary guidelines specifically address the remediation of former meth labs and the specific dangers and hazards associated with them. These voluntary guidelines may be applied to all meth labs, which vary greatly. 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 different ways to make meth, and the precursor chemicals, by-products and hazards associated with each production method differ (see *Appendix A* for a more detailed description).

Partial 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." While each lab should be evaluated on a case-by-case basis, it is generally recommended that "partial labs" be cleaned with the assumption that meth manufacture (or associated processes) may have taken place in all areas of the structure. Thus, the remediation techniques contained in this document are applicable to partial labs.

Cooking vs. Smoking

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).[2] While EPA intends these guidlines to apply to structures in which meth was manufactured or "cooked," and while it is not EPA's intent to imply that municipalities, counties and states should require cleanup at sites where meth was smoked, the voluntary guidelines contained in this document may be useful for cleaning up all sites contaminated by meth. However, the remediation process described in this document accounts for the possibility that precursor chemicals, in addition to meth, may be present in the structure.

1.3 Methodology

A research team reviewed federal and state meth remediation guidance documents and other relevant studies and noted 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 compiled both the findings from the research effort and the opinions expressed in the meeting to develop these voluntary guidelines.

This document was then revised and 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.

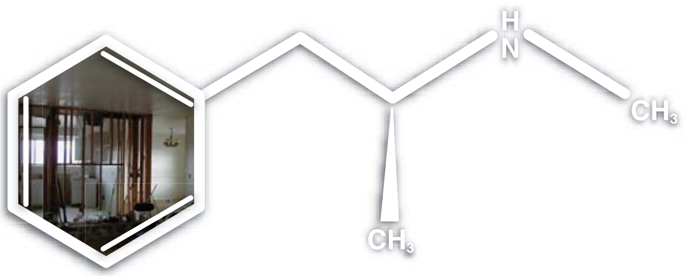
Finally, in August 2008, the National Alliance of Model State Drug Laws (NAMSDL) convened a forum of its Cleanup and Remediation Working Group in Santa Fe, New Mexico to discuss the issues surrounding the cleanup and remediation of properties contaminated by meth labs. As part of the forum, working group members provided feedback on these voluntary guidelines and addressed outstanding questions. These voluntary guidelines were updated as a result of this input and other feedback from experts around the country. A list of key contributors to this document can be found on page 28.

1.4 Need for Future Research

Because state 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. A list of potential research topics is included in Appendix B. These voluntary guidelines will be augmented by EPA's research and development, with support from DEA, NIST and other agencies, as it is made available.

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). Finally, this document provides detailed information on sampling techniques and methods. Additional information and resources are included in the appendices.



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. *[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 manufacture 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 will 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.

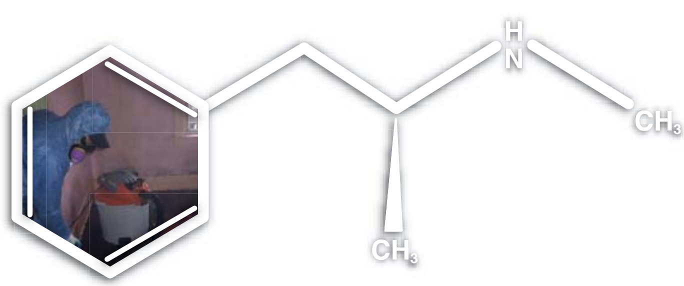
EPA does not intend this document to set, establish or promote quantitative cleanup standards. Many municipalities, counties and states have already established quantitative cleanup standards for meth and chemicals associated with its production. As of June 2009, 22 states require or recommend that meth labs be cleaned to meet certain quantitative meth remediation standards. Current state standards range from 0.05 µg/100 cm^2 to 0.5 µg/100 cm^2. The most common standard is set at 0.1 µg/100 cm^2. Those using this document should consult their appropriate municipal, county or state guidance documents, regulations and statutes.

Because the long-term health effects of exposure to low levels of residual meth have not been studied in-depth, 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*.[3] In other words, remediation standards have been set at what are believed to be conservative levels in order 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* target remediation standard for meth of 1.5 µg/100 cm^2.[4] In February 2009, DTSC finalized the scientific documents that form the basis for this health-based cleanup standard. The development of this health-based standard could help homeowners, cleanup contractors and state legislators reevaluate the question, "How clean is clean?"

In addition to including remediation standards for meth, some state regulatory and/or guidance documents include standards for VOCs, corrosives, lead, mercury and iodine. Cleanup standards for meth and VOCs are deemed applicable 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 June 2009, 10 states include VOC standards for VOC air monitoring of less than 1 ppm. Five states set corrosive standards of a surface pH of 6 to 8 (note the challenges associated with pH sampling described in *Section 5.1).* Fifteen states include lead standards in their remediation guidelines; standards range from 40 µg/ft^2 (or its equivalent of 4.3 µg/100 cm^2) to a more protective standard of 20 µg/ft^2 (or its equivalent of 2 µg/100 cm^2). Fifteen states include mercury standards in their remediation guidelines; standards range from 50 ng/m^3 to 0.3 µg/m^3 of mercury in air. One state set an iodine standard of 20 µg/100 cm^2 for iodine stained surfaces that are cleaned rather than removed. These standards and sampling techniques are addressed in greater detail in *Section 5.0.*



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. Each of the processes highlighted 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. 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* Redbook.]

1. Secure the property to prevent unauthorized entry. The structure should not be reoccupied until after remediation is complete.
2. Hire a contractor to ensure these steps are completed correctly.
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]. Continue ventilation during the remediation process.
4. Ensure worker safety and health.
5. 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 samples.
6. Conduct pre-remediation sampling, if applicable.
7. Develop a work plan using information from the preliminary assessment. This should include a waste disposal plan.
8. Remove contaminated materials. Any materials or objects that will be disposed of should be discarded before cleanup begins.
9. Complete a "once over" or precursory washing of the walls and floors to cut heavy concentrations of contamination.
10. Clean and seal the heating, ventilation and air conditioning (HVAC) system. Do not run this system again until all other cleanup is complete.
11. Flush plumbing traps, unless wastewater from the detergent-water washing process will be flushed through the plumbing system. In this case, wait to flush plumbing until all wastewater has been flushed.
12. Vacuum using a vacuum with a HEPA filter.
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. Encapsulate washed ceilings, walls and floors once they meet remediation standards.
16. Ventilate the structure once more after indoor cleanup is complete.
17. Perform outdoor remediation activities.
18. Secure the property once more to prevent unauthorized entry.
19. Develop a 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 Hazardous Waste Operations and Emergency Response (HAZWOPER) training [Occupational Safety and Health Administration (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 he/she is 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 local health jurisdictions 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 (based on the National Jewish Medical and Research Center's study).[5]

While several state guidance documents recommend "baking," or heating the structure with the doors and windows closed to promote the volatilization of chemicals, its effectiveness has not been documented. 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 the cleanup. A negative air unit equipped with a HEPA filtration system limits or prevents the transfer of airborne contamination from dirty to clean areas.

Post-Remediation Ventilation

Ventilate the property after cleanup is completed. After cleaning and ventilating the property, recheck for new staining and odor (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 or local worker safety and health regulations. 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, and 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. 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 (such as Tyvek®). Decontaminate or discard, as appropriate, all clothing and PPE worn during remediation.

Types and Levels of Personal Protective Equipment (PPE)

Level A—Best respiratory and skin protection [positive pressure self-contained breathing apparatus (SCBA) and fully encapsulated chemical protective suit]

Level B—High level of respiratory protection but less for skin (positive pressure SCBA, splash-resistant chemical suit, chemical-resistant gloves and boots)

Level C—Air-purifying respirators (APR) and modest skin protection (full or half-mask APR and hooded chemical resistive clothing)

Level D—Ordinary work uniform—minimal protection (coveralls, proper boots and eye protection required)

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.[6] Dispose of all needles in a labeled sharps container following local or state regulatory guidance.

Use respiratory protection (full- or half-face respirators) when removing carpet and other flooring or working in highly contaminated areas. Respirators should also be used if the inhalation of sampling materials and cleanup solvents poses a threat to human health. Never eat, drink or smoke 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 review of records, a site survey and other activities.

Record Review

To perform the record review, coordinate with local and/or state 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, 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 of information.

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

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 a site survey. The purpose of the site survey is to confirm the information gathered during the record review, document actual conditions of the site, conduct sampling for chemicals used to produce meth or that might pose a threat to cleanup personnel and provide information for developing the cleanup plan. Whenever possible, document conditions of the site with photographs.

In conducting the assessment, the assessors should always take precautions to ensure their 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.

In order 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. Examine the ventilation system for signs of contamination (e.g., rust, odor). If contamination is suspected, sample the cold air return.
5. 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).
6. Investigate any adjacent or multiple units for avenues of potential contamination (e.g., common spaces, hallways, shared ventilation system). Cross contamination can often occur in townhouses, motels/hotels, apartments, duplexes, etc.
7. Determine if outside disposal occurred (e.g., burning, dumping, burying, drainage to septic system) and caused soil or groundwater contamination. Look for signs of 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 because, although pre-remediation sampling may be useful in some cases (for the reasons that will be described in this section), it is not always necessary and increases costs.

Pre-remediation sampling is necessary to show that contamination is not present in a specific area of a structure, and therefore that area of the structure does not need to be remediated. If pre-remediation sampling is conducted it should be conducted using the same protocols used for post-remediation sampling (see *Section 5.0).* Generally, it is more cost-effective to remediate an entire lab than to take pre-remediation samples in an attempt to avoid having to remediate certain areas of a former lab.

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

- To ensure the safety and health of those working on a site before or during remediation.
- To inform the cleanup plan and process by identifying the extent of contamination in areas of the former lab.
- To corroborate or augment information that law enforcement officers gathered from those directly involved with the meth lab. *(Note: Information gathered from those directly involved with the meth lab should be evaluated carefully because they may not be reliable sources of information.)*
- To help quantify cost estimates for cleanup.
- To sample for lead and mercury, two elements commonly associated with the P2P method of production (if there is suspicion this method was employed).
- To meet pre-remediation sampling requirements of a bank, insurance agency, mortgage holder, other private entity, municipal/county ordinance or state regulation.
- 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.

3.7 Cleanup Plan

The information from the preliminary assessment and pre-remediation sampling (if conducted) should be used to develop a 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 regulations and guidelines and other applicable state or local worker safety and health regulations. The location and route to the nearest hospital or emergency service facility should also 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 local, state and federal statutes 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 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 work plan should be accepted by the 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.

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 (by talking to a neighbor, finding lab paraphernalia or experiencing health symptoms, etc.), and therefore 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.

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, such as 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 located *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.

(Note: Because definitions of "porous," "semi-porous" and "non-porous" in guidance documents differ, the recommendations in Section 4.0 Item and Material-Specific Best Practices *are organized according to item or material.)*

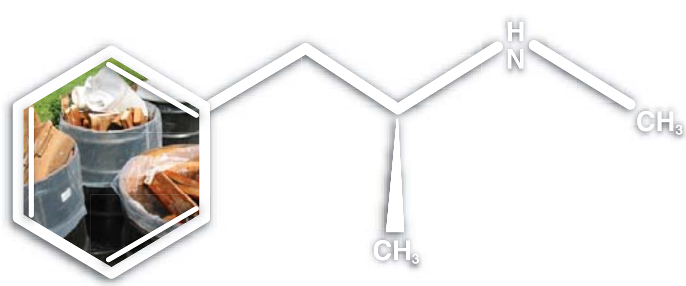
Considering the potential for human contact, the intrinsic and emotional value and the porosity of an item or material may help guide decisions as to whether the item or material should be discarded. For example, carpet should always be discarded because it has a high potential for human contact (especially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

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 or local regulations—and may not be appropriate for disposal at a local landfill. Refer to the appropriate federal, state or 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 guidance documents 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 guidance documents also stress the importance of disposing items in a manner to prevent re-use (i.e., salvaging). For example, couches and other furniture 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 and flooring, using a vacuum with a HEPA filter. Additionally, HEPA filter vacuum walls or other hard surfaces to remove dirt and cobwebs prior to washing with a detergent-water solution (see *Section 3.13).* HEPA filter vacuuming is conducted *in addition to* detergent-water washing.

Use a vacuum cleaner of commercial grade, 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.[7]

Several guidance documents suggest that HEPA filter vacuuming can be used on surfaces that cannot be cleaned with detergent and water (i.e., porous materials such as upholstered furniture). While HEPA filter vacuuming collects some particulate contamination, it does not remove contamination entirely. Therefore, HEPA filter 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 detergent-water washed.

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 HEPA filter vacuuming as an alternative.

3.11 "Once-Over"

After all materials and items that will not be cleaned have been disposed of and the structure has been vacuumed with a HEPA filter vacuum, conduct a "once-over" or precursory washing of the walls and floors to cut contamination using a detergent-water solution (see *Section 3.13).* Conducting a "once-over" will not only help to ensure the safety of those who enter the structure (e.g., contractors, subcontractors), but it will also 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 located 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 "once-over" cleaning has been conducted. Once cleaned, the HVAC system should be sealed at all openings to prevent potential recontamination.

Several state guidance documents 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:[8]

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 regulations and guidelines and other applicable state or local worker safety and health regulations, 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 HEPA exhausted vacuum filters, 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 also be used in the cleaning process, such as brushes, air lances, air nozzles and power washers or HEPA filter vacuuming 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). Therefore, 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.

The first few minutes of system restart after cleaning is usually when the greatest amount of dust is released. Therefore, after remediation is completed, restart the ventilation system but ensure the structure is properly ventilated (i.e., open doors and windows, use fans, blowers, and/or a negative air unit with a HEPA filtration system) so that any dust that is released will have a chance to be moved out of the structure.

3.13 Detergent-Water Solution Washing

Using a detergent-water solution, wash ceilings, walls, floors, furniture and other household items that will not be discarded. Most experts and guidance documents recommend using a household detergent or soap product (such as Simple Green®).

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.

Repeat the cleaning and rinsing process three times, especially if post-remediation sampling will not be conducted before the walls are repainted (i.e., encapsulated). If post-remediation sampling will occur before repainting, the walls should be cleaned until they meet the required remediation standard. Most guidance documents 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. Be advised of the following when using bleach, trisodium phosphate, methanol and peroxide-based or other proprietary chemicals:

Bleach — The interaction of bleach and meth is not fully understood and their by-products are currently unknown.[9] 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 method of production was used to manufacture meth because the reaction between bleach and iodine (which is used in the Red Phosphorus method of production) could produce a toxic gas. If bleach is used (in cases where mold is present), properly ventilate the structure while cleaning.

Trisodium Phosphate (TSP) — The use of TSP is recommended in some guidance documents. TSP is a strong cleaning agent, but it can also be irritating to the person using it.

Methanol — Although some guidance documents 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 and Other Proprietary Chemicals — The effectiveness of peroxide-based and other proprietary chemicals should be verified before they can be recommended for cleaning former meth labs. Additionally, research should be conducted to ensure that these chemicals do not react adversely with meth and its associated precursors and by-products.

Wash Water Disposal

Wash water left over from the detergent-water washing process will usually not be contaminated enough to qualify as hazardous waste. Capturing and testing the water before disposing of it is generally 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 (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 recontaminating 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. Post-remediation sampling provides greater certainty that cleaning was effective. 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, clean items that will not be discarded 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 in plastic those items that are cleaned to prevent recontamination. Items may also be stored off-site if they are properly cleaned, tested and bagged or wrapped in plastic. Do not bring items stored off-site back into the structure until after the structure has met remediation standards (i.e., after it has cleared post-remediation sampling).

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 can also verify that cleaning was actually 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. Areas that were involved directly with meth manufacturing activities should always be sampled after cleanup. Post-remediation sampling may not be required in areas where contamination was deemed to be light, and where adjacent sampling showed no residual contamination. Typically, post-remediation sampling requires more samples than pre-remediation sampling (see *Section 5.0).*

3.15 Encapsulation

Encapsulation (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. Encapsulation should *never* be used as a substitute for cleaning. The extent to which meth and other lab-related chemicals migrate through materials and potentially volatilize is still unknown. For this reason, further research is needed on the effectiveness of encapsulation in preventing the re-surfacing of meth.

Generally, encapsulation should occur after surfaces (e.g., ceilings, walls, floors) have met the applicable (i.e., state or local) 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 cm^2)] 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, epoxies or polyurethane should be used to encapsulate interior surfaces. To encapsulate floors, most experts recommend the use of 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 can 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 VOCs remaining from the meth cooking process.

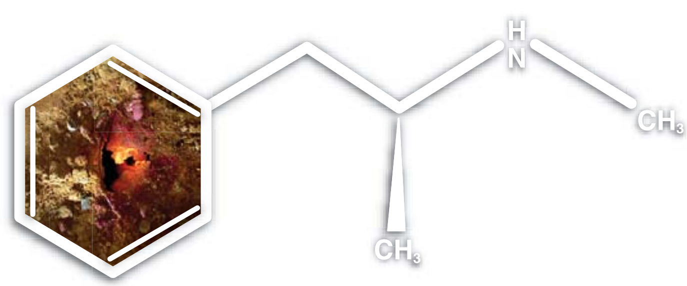
Several guidance documents recommend that products applied to encapsulate surfaces be sprayed on and not hand-rolled. This is a valid recommendation especially for textured surfaces that cannot withstand physical agitation. However, there are no data currently available to suggest the physical motion of using a roller brush agitates residual meth on smooth surfaces. Before an official recommendation can be made on the application method for encapsulation materials, further research is required.

3.16 Plumbing

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).

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. 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 after remediation.



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. Evidence of waste disposal may include, but is not limited to: witness statements; stained or etched 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.

If wastewater from the remediation process will be disposed of in the sewer system, the system should not be flushed until remediation is complete (and wastewater has been flushed). *(Note: Some cleaning agents kill the flora of a septic system, therefore it is not recommended that wastewater be disposed of in a septic system.)*

Systems should generally 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, if required, should comply with local, state and federal disposal requirements. Wastewater sampling from septic tanks may be appropriate in order to characterize waste while using methods that minimize VOC losses.[10] 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 the steps described below should be conducted for wastewater sampling activities:

1. Prior to sampling, sufficiently excavate 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 Judge®. Do not collect any matter in the Sludge Judge®.
   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 Judge®.
5. Insert the Sludge Judge® into the tank, lowering it until you hit the bottom.
6. Trap the sample inside the Sludge Judge®.
7. Remove the Sludge Judge® 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 that are 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 pour waste chemicals outside of 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 or local regulations (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 by the cleanup contractor, CIH/IH or other qualified environmental professional to document that the property has been decontaminated per applicable state or local requirements before the structure can be considered acceptable for reoccupation.

All inspections and assessments that were 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 should also 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 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.

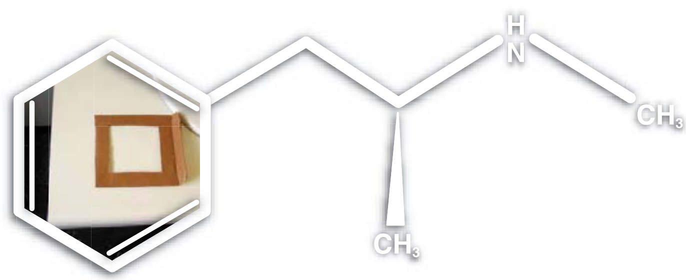
Methods — This section of the final report should document cleanup and disposal activities. The cleanup plan (see *Section 3.7)* and documentation that cleanup was in fact carried out according to the plan should be incorporated in this section. The type of information and documentation in this section 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 description of the location and results of post decontamination samples, including written and graphic descriptions of individual sample locations.
- References to appropriate state or local regulatory requirements.
- 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 or local authority. The property owner and consultant should each retain a copy of the report. The report may be reviewed by the appropriate state or local authority responsible for deeming the property suitable for re-occupancy. Decisions about re-occupancy are made by the appropriate state or local authorities.



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 also 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 guidance documents 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.

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 always 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 will be 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.

Tiled (suspended or attached) ceilings should be sampled for asbestos and meth contamination. Tiled ceilings that show visible signs of contamination or that were in areas of suspected high contamination but do not contain asbestos should be discarded. Tiled ceilings in areas of low contamination that do not contain asbestos should be HEPA filter vacuumed (see *Section 3.10)* and encapsulated.

For both textured and tiled ceilings, if asbestos is present but meth is not, several guidance documents suggest sealing the surfaces with a spray-on asbestos encapsulation product if decontamination would disturb the material containing asbestos. If the ceiling meets neither the remediation standard for meth or 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.

4.3 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.

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

Always vacuum using a HEPA filter after removing any primary flooring (e.g., carpeting, vinyl, laminate) to remove contaminated dust and other debris from the sub-flooring. In addition conduct a "once-over" washing with a detergent-water solution (see *Section 3.13)* to sub-flooring 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 guidance documents suggest the following for various types of countertop materials:

- All countertops with visible signs of contamination (e.g., stained, emitting odors, etched) should be discarded.
- Countertops made of porous materials (e.g., wood, granite) should be discarded.
- Countertops made of solid materials (such as Corian®) 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 brick, concrete and cement should be washed with a detergent-water solution (see *Section 3.13).* Most guidance documents 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 absorbent 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 guidance documents 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 reused 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 located in a former meth lab. Some guidance documents 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, thereby constituting the primary reasons these items may be discarded.[11]

4.7 Wood

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 on wooden materials or items when deciding whether to discard or clean them. As a general principle, discard (in a manner to prevent reuse) any wooden surface or item that shows visible signs of contamination (e.g., stained, emitting odors, etched).

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. Be sure to collect excess water using a wet vac to dry the unfinished wood in order to prevent the growth of mold. 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 it is not removed and replaced. Stainless aluminum tracks and trim are often difficult to clean. If track and 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 also have great potential for repeated human contact.

If electrical fixtures are not discarded, wash them using a detergent-water solution (see *Section 3.13).* Always shut off power before removing electrical fixtures, outlet covers and switch covers. When using wet cleanup methods for electrical fixtures, ensure that the parts handling electricity 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 (i.e., acid etched or chemical staining).

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.

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

4.11 Toys and Other Children's Items

Infant toys that have the potential to be placed in the mouth (e.g., teether, pacifier, rattle) as well as any toys that show visible signs of contamination (e.g., stained, emitting odors, etched) should be disposed of in a manner that prevents reuse. Stuffed 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 HEPA filter vacuum, steam-clean or shampoo carpet. Carpet should always be discarded rather than cleaned because it is extremely difficult to remove all of 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 fabrics with visible staining or contamination. Machine-washable clothing may be safely cleaned in a washing machine. 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. Exceptions may be made in some cases 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).* Always discard plastic furniture. Destroy furniture before discarding it to prevent it from being reused.

4.15 Mattresses

Most guidance documents suggest that mattresses should always be discarded. However, some guidance documents 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 located 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

Generally speaking, mobile residences should 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 the structure. Demolition may be considered a more cost-effective option.

5.0 Potential Sampling Constituents, Theory and Methods

5.1 Sampling Constituents

Depending on the nature of contamination at the site, owners or contractors may decide to sample for a variety of constituents ranging from VOCs to lead, to meth itself. In all cases, persons collecting samples should use approved sampling methods as prescribed by local, state and federal government agencies [including EPA, the National Institute for Occupational Safety and Health (NIOSH) and OSHA].

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 guidance documents suggest using a Summa canister for air monitoring, however Summa canisters are expensive and their results are often difficult to interpret.

Summary of Quantitative State Remediation Standards (as of June 2009)

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/m^3 to .3 μg/m^3 of mercury in air.

Lead
State standards range from 40 μg/ft^2 (or its equivalent of 4.3 μg/100 cm^2) to 20 μg/ft^2 (or its equivalent of 2 μg/100 cm^2).

Meth
State standards range from 0.05 μg/100 cm^2 to 0.5 μg/100 cm^2. The most common standard is set at 0.1 μg/100 cm^2.

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, hypophosphorous 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.]*

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, 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 or state disposal requirements or regulations should be followed. In addition, some materials removed from the site should be tested for asbestos per federal or state guidelines.)

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 typically be removed and will not need to be sampled.

Methamphetamine

Sampling for meth is the most common way to establish whether portions of a structure are contaminated and in need of remediation. Most states encourage property owners to 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 regulatory guidelines that dictate the sampling methodology. All sampling plans should comply with state or local requirements.

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 types of authoritative sampling, both of which are described in the American Society for Testing and Materials Method (ASTM) D6311-98 (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, assuming that 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 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 (DQO). DQOs establish the type, quality and quantity of data needed and specify tolerable levels of potential decision errors.[12] 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 5.6).* 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. Thus, the owner or contractor will seek to prove, through biased sampling, that the site contains contaminant levels that exceed the relevant standard. Statistically speaking, as the site is cleaned, the hypothesis becomes more difficult to prove; and 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.

Many jurisdictions have prescribed methods for collecting wipe samples. Before conducting a sampling effort, be sure to consult and comply with applicable state or local guidelines. In general, collecting discrete wipe samples for surface meth contamination contains 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 cm^2.
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 five discrete samples.

Sample Media

Sample media can consist of a number of materials, which vary according to state or local 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 mine 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 Other Emerging Sampling Methods

New methods are emerging to conduct surface meth sampling. Until additional studies are available, it is not possible to determine the accuracy of these new methods for use in meth lab cleanup.

5.6 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:

- 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 always 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. The timeframe for sample delivery will depend on the sampling method, material and laboratory protocol.

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Front cover inset and photo on page 15 courtesy of Tacoma-Pierce County, Washington Health Department

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Appendix A: Primary Methods of Production and Associated Hazards

	Ammonia Lab Profile
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using anhydrous ammonia and lithium, sodium metal or elemental potassium
Other Names:	"Lithium-Ammonia" Lab, "Birch Reduction" Lab, "Nazi" Lab or "Sodium Metal" Lab
Unique Hazards:	Sodium metal from molten sodium hydroxide flammability
	Irritant toxicity hazard from concentrated ammonia atmospheres
	Reaction of water with sodium or lithium metals
	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

	P2P Lab Profile
Precursor:	Phenyl-2-Propanone
Product:	Mixtures of l-Methamphetamine (50%) and d-Methamphetamine (50%)
Method:	P2P reduction using methylamine and mercuric chloride
Other Names:	"Amalgam" Lab, "Prope Dope" Lab or "Biker" 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
	Lead acetate
	Use of highly toxic mercuric chloride
	Use of acid gas generators
	Occasional use of methylamine compressed gas cylinders
Variations:	Acidify the oil layer directly (i.e., delete solvent washing step)

	Red Phosphorus Lab Profile
Precursor:	Ephedrine or Pseudoephedrine
Product:	d-Methamphetamine
Method:	Ephedrine reduction using red phosphorus and hydriodic 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
	Use of acid gas generators
	Exothermic/incompatible reaction of red phosphorus
	Iodine vapors
Variations:	Use iodine and water instead of hydriodic acid
	Use hypophosphorus acid instead of red phosphorus
	Use liquid from tablet extraction directly in reflux step

From EPA's Office of Emergency Management (OEM)

Appendix B: List of Potential Research Topics

The table below lists potential research topics identified during the development of this document.

Sampling
Study whether meth is a good indicator for contamination by other chemicals used in meth labs.
Test the effectiveness and error of meth "gunner" technologies.
Determine what solvent should be used when taking meth wipe samples (de-ionized water, isopropyl alcohol or methanol).
Remediation
Investigate the dispersion and persistence of chemical contaminants.
Determine whether meth is a good indicator of other contaminants.
Examine possible off-gassing of contaminants from building materials.
Evaluate cleaning agents for remediation of former meth labs including efficacy; time required for them to work; degradation by-products and their potential toxicity; physical effects on materials being cleaned; and potential toxicity to persons using the agents.
Determine whether carpet and flooring can be remediated safely and effectively.
Evaluate methods for skin decontamination — determine whether soap and water washing accelerates the dermal absorption of methamphetamine.
Evaluate the transfer efficiency of meth from unremediated and remediated surfaces to improve estimates of exposure.
Evaluate the effectiveness of performance-based cleanup.
Research the reliability of immunoassay to determine whether it is a reliable alternative to gas chromatography-mass spectrometry (GC/MS).
Study the effectiveness of "baking."
Determine the extent to which meth resurfaces after remediation on walls, floors, ceilings and kitchen countertops made of various materials.
Test the extent to which running the HVAC system after remediation has been completed re-contaminates the structure.
Determine the best way to clean acoustic and "popcorn" ceilings.
Determine the most effective way to clean an HVAC system.
Study the effectiveness of various primers, paints and other sealants used in the encapsulation process in preventing the resurfacing of meth.
Determine how to best encapsulate floors.
Evaluate the effectiveness of encapsulation.
Test whether primer/paint should be rolled-on or sprayed.
Determine whether spray on solutions such as sodium hypochlorite and hydrogen peroxide can decontaminate meth.
Determine the toxicity of meth and the risk residual meth poses in an environmental setting.
Research whether salvaging appliances is safe.
Other
Encourage published reports on remediation of former meth labs.
Examine the effects of long-term, low level exposure to methamphetamine residues on neurological development in children.
Evaluate risks associated with exposure to surface residues resulting from smoking other legal and illegal drugs (e.g., tobacco, marijuana) to determine which poses a greater risk.

Appendix C: 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 recently 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 located 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);* however, it is generally more cost-effective to remediate an entire lab than to take pre-remediation samples in an attempt to avoid having to remediate certain areas of a former lab.
- 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, http://www.iir.com/centf/guide.htm

Appendix D: Properties of Chemicals Associated with Methamphetamine

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Acetic Acid (64-19-7) [manufacture of Phenyl-2-Propanone (P2P)] Ref: 11, 44, 51	Colorless liquid	Corrosive	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) ST 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) (manufacture of P2P) Ref: 11, 44, 51	Colorless liquid	Corrosive	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] Ref: 8, 10, 12, 51	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 1000 ppm (2400 mg/m^3).	Miscible in water. Not persistent. Readily biodegrades in soil or water.
Ammonia (7664-41-7) (Birch/Nazi method) Ref: 11, 44, 45, 51	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) ST 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) Ref: 13	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.	Toxic to aquatic life. 28% solution has high vapor pressure and is likely to evaporate if spilled.
Benzaldehyde (100-52-7) (Precursor for amphetamine or P2P) Ref: 14, 51	Colorless liquid, bitter almond odor	Combustible	Mild irritant to lungs. Central nervous system depressant.	If released in sufficiently large quantities, can migrate to shallow water table. Slightly soluble in water with specific gravity of 1.05. Moderately biodegradable.
Benzyl Chloride (100-44-7) Ref: 7, 15, 51	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.

From EPA's Office of Research and Development (ORD)

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Benzene (71-43-2) (Solvent in meth process) Ref: 8, 10, 44, 51	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 ST 1 ppm; OSHA PEL: (1910.1028) TWA 1 ppm ST 5 ppm.	Mobile in soils. Lighter than water and slightly soluble. Will biodegrade over time. MCL of 5 μg/L.
Chloroform (67-66-3) Ref: 16	Colorless liquid with a pleasant odor		Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver, suspect carcinogen. IDLH: 500 ppm; NIOSH REL: Ca ST 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) (Birch/Nazi and red phosphorus) Ref: 46, 51	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.	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.
Ephedrine (299-42-3) (Precursor for meth) Ref: 1, 51	Odorless white crystal	None	Skin and respiratory irritant.	Not available.
Ethanol (64-17-5) Ref: 8, 44, 51	Clear colorless liquid	Flammable	Respiratory irritant. Central nervous system suppressant. IDLH: 3,300 ppm; NIOSH REL: TWA 1,000 ppm (1900 mg/m^3); OSHA PEL: TWA 1,000 ppm (1900 mg/m^3).	Miscible with water. Large spills may reach water table. Very biodegradable.
Diethyl Ether (60-29-7) [syn: ether, ethyl ether, ethyl oxide] Ref: 9, 11, 44, 51	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 (1200 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.
Formic Acid (64-18-6) Ref: 11, 18, 44, 51	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.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Normal Hexane (110-54-3) Ref: 11, 29, 44	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 (1800 mg/m^3).	When spilled on the ground expected to evaporate. If it penetrates the ground, not likely to leach (Log Kow of $>$ 3.0) to groundwater. Not very soluble and lighter than water. Moderate biodegradation expected.
Cyclohexane (110-82-7) Ref: 11, 17	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 (1050 mg/m^3); OSHA PEL: TWA 300 ppm (1050 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) [syn: muriatic acid] Ref: 19, 51	Clear colorless liquid with pungent odor	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) Red phosphorus method Ref: 20, 51	Clear colorless liquid with pungent odor (hydrogen iodide dissolved in water)	Corrosive and Poison	Vapors cause severe irritation and burns to respiratory tract. Liquid may cause burns to skin.	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) Ref: 41	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 Ref: 21, 51	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.	Not available.
Iodine (7553-56-2) Reagent in making hydriodic acid Ref: 22, 51	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 Ref: 23, 51	Dark Red Solution (Mixture of ethanol, iodine crystals and sodium iodide)	Flammable (ethanol)	See description for ethanol and iodine.	Not available.
Lead Acetate (6080-56-4) Reagent in P2P synthesis Ref: 24, 51	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 affect 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.
Lithium (metal) (7439-93-2) Used in Birch/Nazi method Ref: 6, 47	Soft silvery-white metal	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.	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_2O.
Lithium Aluminum Hydride (16853-85-3) Hydrogenation in multiple processes Ref: 25, 51	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.	Can ignite with friction. LiOH may be mobile in soil.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Mercuric Chloride (7487-94-7) Reagent in meth synthesis using P2P method Ref: 26, 51	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 affects on the biota.
Methyl Alcohol (67-56-1) (HEET Gas Line Antifreeze is 99% methanol) [syn: methanol, wood alcohol, carbinol] Ref: 8, 11, 27, 44, 51	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) ST 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 meth [syn: aminomethane] Ref: 8, 11, 44, 51	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 Kow of −0.57). Methylamine is biodegradable.
Methyl Ethyl Ketone (78-93-3) [syn: 2-butanone, methyl acetone] Ref: 8, 10, 28, 44	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 affects. Chronic exposure may cause dermatitis or central nervous system effects. IDLH: 3,000 ppm; NIOSH REL: TWA 200 ppm (590 mg/m^3) ST 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 Kow of 0.29. If released to the ground it will partially evaporate, and if the release has a sufficient quantity to enter the subsurface will leach to shallow groundwater. It does not biodegrade readily.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Nitric Acid (7697-37-2) Ref: 30	Clear colorless to yellowish liquid with suffocating acrid odor	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) ST 4 ppm (10 mg/m^3); OSHA PEL: TWA 2 ppm (5 mg/m^3).	Incompatible with most materials.
Nitroethane (79-24-3) Precursor in P2P synthesis Ref: 4, 11, 44, 51	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 Kow 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) Ref: 31, 44	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).	
Perchloric Acid (7601-90-3) Ref: 32	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.	May form sensitive explosive mixtures with organic materials.
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. Ref: 44, 51	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 1800 mg/m^3 [15-minute]; OSHA PEL: TWA 500 ppm (2000 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] Ref: 51	Solid white crystal with a floral odor	None	Contact is irritating to skin and eyes. Inhalation may cause upper respiratory tract irritation. Potential teratogen.	Not available.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Phenyl-2-Propanone (103-79-7) Precursor for meth Ref: 51	Clear, moderately viscous liquid	None	Irritating to eyes and skin. Inhalation may lead to headache, nausea and dizziness.	Not available.
Phosphine (7803-51-2) Ref: 44, 48, 50, 51	Colorless gas with a fish- or garlic-like odor. Note: commercially made product has odor phosphine itself is odorless.	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) ST 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 Ref: 33, 44, 51	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 ST 3 mg/m^3; OSHA PEL: TWA 1 mg/m^3.	When released in sufficient quantities may reach shallow groundwater. Neutralization leaves phosphate.
Phosphorus Pentachloride (10026-13-8) Used in Emde method Ref: 5, 44	White to pale yellow crystalline powder with pungent unpleasant odor	Corrosive	Causes severe irritation of respiratory tract and at high concentrations can be fatal. Skin contact results in burns. Chronic exposure can cause liver and kidney damage. IDLH: 70 mg/m^3; NIOSH REL: TWA 1 mg/m^3; OSHA PEL: TWA 1 mg/m^3.	Hydrolyzes in water (even in humid air) to form hydrochloric acid and phosphoric acid.
Pseudoephedrine (90-82-4) Meth precursor Ref: 2, 51	Nearly odorous, white crystalline powder	None	Contact with skin or eyes may result in irritation. Inhalation may result in respiratory irritation.	Completely soluble in water with a log Kow 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 Ref: 8, 11, 42, 44, 51	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 Kow 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) Red phosphorus method for meth production Ref: 49, 51	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.	Harmful to aquatic organisms. Insoluble in water. Will remain on ground surface if released.
Sodium (7440-23-5) Ref: 36, 51	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.	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) Drano® contains 30-60% by weight of sodium hydroxide. Ref: 35, 44, 51	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.
Sulfuric Acid (7664-93-9) Battery acid is sulfuric. Used battery acid may contain high concentrations of lead. Liquid Fire Drain Cleaner contains sulfuric acid. Ref: 37, 44, 51	Colorless to yellow viscous 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.
Thionyl Chloride (7719-09-7) Ref: 38, 44, 51	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 SO2. Not likely to remain in the environment as thionyl chloride.

Chemical and CAS Number	Form	Hazard	Health Effect	Fate and Transport
Thorium Oxide (1314-20-1) Catalyst for P2P synthesis Ref: 3, 51	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 anglosarcoma, liver and kidney tumors, lymphoma and other tumors of the blood system. Chances of developing cancer increase with increased exposure.	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) [syn: methyl benzene, phenylmethane] Ref: 8, 10, 39, 44, 51	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) ST 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) Gun-cleaning solvent Ref: 43, 44	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 Kow 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 Ref: 8, 11, 40, 44, 51	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 (7600 mg/m^3) ST 1250 ppm (9500 mg/m^3); OSHA PEL: TWA 1,000 ppm (7600 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
LogKow — Octanol-Water Partition Coefficient
MCL — Maximum Contaminant Level
NIOSH REL — NIOSH Recommended Exposure Limit
OSHA PEL — OSHA Permissible Exposure Limits
SO2 — Sulphur Dioxide
ST — Short-Term Exposure Limit
TWA — Time Weighted Average

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Appendix E: State Resources

State Resources

Alaska
http://www.state.ak.us/dec/spar/perp/docs/druglab_guidance.pdf

Arizona
http://www.btr.state.az.us/regulations/drug_lab.asp

Arkansas
http://www.healthyarkansas.com/pdf/adh_methguidelines.pdf

California
http://www.dtsc.ca.gov/SiteCleanup/ERP/Clan_Labs.cfm

Colorado
http://www.cdphe.state.co.us/hm/methlab.pdf
http://www.cdphe.state.co.us/regulations/boardofhealth/101403methlabrules.pdf

Connecticut
http://www.ct.gov/dph/LIB/dph/environmental_health/EOHA/pdf/METH_LAB_CLEANUP_PROTOCOL.pdf

Hawaii
http://hawaii.gov/health/environmental/hazard/methlab.html

Idaho
http://www.healthandwelfare.idaho.gov/LinkClick.aspx?fileticket=WBCiSR3b1as%3D&tabid=95&mid=948

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

Indiana
http://www.in.gov/idem/4178.htm

Iowa
http://www.idph.state.ia.us/eh/common/pdf/hseess/meth_lab_cleanup.pdf

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

Kentucky
http://www.waste.ky.gov/NR/rdonlyres/6226B37B-5E46-4037-BC4F-9C324D3AE942/0/
KentuckyMethamphetamineLabDecontaminationGuidanceForInhabitableProperties.pdf

Michigan
http://www.michigan.gov/documents/mdch/CDL_Guidance_6-5-07_Final_198589_7.pdf

Minnesota
http://www.health.state.mn.us/divs/eh/meth/lab/guidance0407.pdf

Missouri
http://www.dhss.mo.gov/TopicsA-Z/MethLabCleanupGuidelines.pdf

Montana
http://data.opi.state.mt.us/bills/mca_toc/75_10_13.htm

Nebraska
http://www.hhs.state.ne.us/puh/enh/EnvironmentalRiskAssessment/docs/DraftRegs.pdf

New Mexico
http://cdli.nmenv.state.nm.us/guidance.php

North Carolina
http://www.methlabcleanup.com/NC%20Standards

North Dakota
http://www.ndhealth.gov/wm/Publications/BestManagementPracticesForCleanupsAtMethamphetamineLabs.pdf

Ohio
http://www.odh.ohio.gov/ASSETS/F66188EC6FAC4E9F80A87D8FE09127BA/MethCleanup.pdf

Oklahoma
http://www.deq.state.ok.us/LPDnew/MethLabs/meth.htm

Oregon
http://www.oregon.gov/DHS/ph/druglab/index.shtml

South Dakota
http://denr.sd.gov/des/wm/hw/documents/MethLabCleanup.pdf

Tennessee
http://www.state.tn.us/environment/dor/pdf/Meth_RAP_Guidance.pdf

Utah
http://health.utah.gov/meth/html/RegulationsandLegislation/392-600.html

Washington
http://www.doh.wa.gov/ehp/cdl/guide-envirsamp.pdf

West Virginia
http://www.state.wv.us/swmb/MethLabHP.htm

Wisconsin
http://www.dhfs.state.wi.us/eh/ChemFS/fs/MethClnUp.htm

Wyoming
http://wdh.state.wy.us/phsd/epiid/methcleanup.html

Appendix F: Acronyms

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
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
DEA	Drug Enforcement Administration
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
HVAC	Heating, Ventilation and Air Conditioning
IH	Industrial Hygienist
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
OEM	U.S. EPA Office of Emergency Management
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
SCBA	Self-Contained Breathing Apparatus
TSP	Trisodium Phosphate
USCG	U.S. Coast Guard
VOCs	Volatile Organic Compounds

United States
Environmental Protection
Agency

Office of Solid Waste
and Emergency Response (5104)

EPA-530-R-08-008
August 2009
www.epa.gov