Technical Guide for Wildfire Restoration

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A. Foreword

This technical guide presents the current and common methodology of prudent wildfire restoration practices on behalf of the Institute of Inspection, Cleaning, and Restoration Certification (IICRC), the Restoration Industry Association (RIA), and the Cleaning Industry Research Institute (CIRI) whom represent thousands of restoration companies and related professionals who have returned families to their homes safely and effectively for decades using proven, science-based methodologies in accordance with peer reviewed industry standards.

It has come to the attention of our organizations that a growing unfounded sentiment is emerging, suggesting that homes affected by wildfire smoke and its byproducts are categorically uncleanable and unrestorable. According to this viewpoint, wildfire damaged homes should be stripped down to the studs and rebuilt. This position is unsupported; it is not grounded in science, established work standards, or represented by the common, reasonably prudent and proven restoration practices utilized in the restoration community.

The categorical disposal of porous materials and soft items, as opposed to the prioritization of cleaning a structure post-wildfire, appears to lack support from any authoritative industry guideline document. The California Air Resources Board, the United States Environmental Protection Agency, the South Coast Air Quality Management District, the California Department of Public Health, nor any other public health agency make recommendations that occupants of wildfire smoke infiltrated residences should dispose of all of their furnishings and personal items nor demolish and rebuild their homes.

Wildfire smoke, together with its volatile and semi-volatile compounds and metals, which can adsorb or condense on the surfaces of particles, infiltrate structures and settle on the surfaces of interior materials. This is a superficial occurrence that can generally be cleansed. Specialized cleaning methodologies have been successfully used to remove infiltrated and deposited wildfire smoke residues and other potentially hazardous contaminates to typical background levels for decades by the thousands of professional cleaners and restorers our organizations represent.

Disposal may be considered where cleaning costs surpass the item's value or where heavily impacted porous materials such as apparel, bedding, infant items, and toys exhibit hand to mouth contact risks. However, the presumption that all materials and structures are unrestorable is inconsistent with science, successful restoration projects, and accredited industry standards.

Professional restoration provides significant consumer and public benefits:

- It preserves property and reduces unnecessary demolition.
- It minimizes loss and replacement of contents and personal items.
- It mitigates environmental waste by restoring salvageable materials.
- It provides a science-based pathway to safe reoccupation.

For these reasons, we urge any and all wildfire restoration recommendations be science-based, consensus driven methods that recognize the professional restoration of fire and smoke damaged homes is not only possible but is an established and proven practice.

B. Executive Summary

The increasing frequency and scale of wildfires have brought the challenge of smoke and ash impact into sharp focus for property owners, insurers, and restorers.[2] While the visual and olfactory presence of wildfire residue can be alarming, a scientific and methodical approach reveals that in many cases, "impact" does not necessarily equate to "damage."[1,2] Impact and the potential for damage is a function of time and distance from the fire (i.e., burn zone), fuel source, and the chemical decay and dilution of Combustion By-Products (CBCs). For structures that have not sustained direct flame, radiant heat damage, or hot turbulent smoke plume impact, restoration is overwhelmingly a matter of thorough and professional cleaning.[1]

This technical guide presents a framework for the effective restoration of wildfire-impacted buildings. It is based on the following core principle processes:

1. **Pre-Restoration Evaluation (PRE)** is the critical first step performed by the restorer to establish the degree of impact from a wildfire event. The goal of the PRE is to identify the presence of wildfire related combustion byproducts through visual and sensory inspection and identify key risk factors. This initial evaluation determines whether restoration can begin immediately or if a more detailed, scientific assessment by a qualified third-party professional is necessary.
2. **Pre-Restoration Assessment (PRA)** is a formal, third-party process, typically performed by an Industrial Hygienist (IH) or other qualified Occupational and Environmental Health and Safety (OEHS) professional. It is triggered by specific findings in the PRE, by stakeholder request, or when required by Authorities Having Jurisdiction (AHJ). The strategic purpose of the PRA is to use scientific sampling and laboratory analysis to definitively characterize the type and extent of combustion byproducts present and to establish a data-driven, defensible scope of work for the restoration contractor.
3. **The Restoration Phase** is the physical process of removing the wildfire-related combustion byproducts that were identified in either the Pre-Restoration Evaluation or the Pre-Restoration Assessment. The overarching goal is to return the structure, its systems, and contents to a clean, safe, and odor-free condition. This requires a systematic approach that includes detailed source-removal cleaning, indoor air quality management, and the proper documentation and disposal of non-salvageable items.
4. **Project Completion** is the final, critical phase. The objective of the completion phase is to establish the success of the restoration efforts. Its purpose is to collect evidence that wildfire-related combustion byproducts have been effectively removed and the structure is clean and safe for re-occupancy. The process includes an evaluation by the restorer, and may include a verification:
    a. **Restoration Completion Evaluation (RCE)** the standard process for completing a restoration project; conducted by the restorer.
    b. **Post Restoration Verification (PRV)** performed by an independent third party; performed when necessary or required.

This technical guide details the application of these four core procedural principles. By adhering to this framework, restoration professionals can systematically restore impacted properties, manage stakeholder expectations, and provide a clear, defensible standard for "clean." For more information on the process of Assessment (Pre-Restoration Assessment, Post Restoration Verification), refer to the AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2nd edition (2025).

C. Important Definitions

Important terms used throughout this guide are presented with specific meanings that are critical to understanding the process of wildfire restoration and assessment contained herein. Adherence to these definitions is therefore required for the proper application of this guide.

C.1 Trigger Words

The following terms are used to express the level of importance attached to certain practices, procedures and methods.

Standard of Care: A practice, procedure, or method used to deliver or affect a necessary outcome, which is common among reasonably prudent members of the trade who are trained and qualified to perform wildfire restoration and assessment.

Shall: when a practice or procedure is required by Authorities Having Jurisdiction (AHJ).

Should: when a practice or procedure is Standard of Care, according to the provided definition.

May: when a practice or procedure is optional and permissive.

Can: when an outcome or result is possible or likely.

Recommended: when a practice or procedure is not necessarily common, but meets the rest of the criteria for Standard of Care and is therefore recommended by this guide.

C.2 Core Terminology

Burn Zone (The) A wildfire impact zone where properties can experience direct flame impingement or significant radiant heat. Structures here can be affected by the hot, turbulent smoke plume, forcing particulates and gaseous combustion byproducts (VOCs) into the building envelope.

Combustion By-Products (CBP) The resulting substances (e.g., char, ash, smoke) created from a fire event. The goal of a Pre-Restoration Evaluation (PRE) is to identify the presence of these byproducts.

Combustion Byproducts of Concern (CBC) wildfire related combustion byproducts that can pose a potential for continued damage to structures and contents, or a potential for elevated human health risks.

Far-Field Zone (The) A wildfire impact zone that extends beyond the Near-Field Zone, potentially for hundreds of miles. In this area, the primary impact is the infiltration of fine particulate matter (PM2.5) after the smoke plume has cooled and heavier particles have fallen out. The impact is often surface-level and highly correctable.

Near-Field Zone (The) A wildfire impact zone extending from the fire perimeter to approximately 1–10 kilometers (0.6 to 6.2 miles). Structures here can be affected by the hot, turbulent smoke plume, forcing particulates and gaseous combustion byproducts (VOCs) into the building envelope.

PRA (Pre-Restoration Assessment) A formal, third-party process, typically performed by an Industrial Hygienist (IH), that uses scientific sampling and laboratory analysis to definitively characterize

combustion byproducts and establish a data-driven, defensible scope of work for the restoration contractor.

PRE (Pre-Restoration Evaluation) The critical first step performed by the restorer to establish the degree of impact from a wildfire event. The goal is to identify the presence of combustion byproducts through visual and sensory inspection and to assess key risk factors.

PRV (Post-Restoration Verification) An optional, specialized process that is separate from the restorer's standard evaluation. It is a formal, scientific assessment that involves sampling and laboratory analysis performed by an independent third party, such as a Certified Industrial Hygienist (CIH). It is reserved for specific circumstances like dispute resolution or occupant health concerns.

RCE (Restoration Completion Evaluation) The Restoration Completion Evaluation is the standard process for completing a restoration project. It is performed by the restoration contractor to ensure the scope of work has been successfully met.

Risk Factors Key elements assessed during the PRE, such as proximity to the burn zone, heavy visible residue, or strong persistent odors, that may trigger the need for a formal PRA.

1. Introduction

In the last decade, wildfires have burned millions of acres annually in the United States alone.[2] This trend has expanded the "Wildland-Urban Interface" (WUI), bringing smoke, char, and ash into contact with more residential and commercial structures than ever before.[1]

This has created a critical need for coherent, evidence-based protocols for evaluating and remediating smoke impact.[2] Property owners are often concerned that any presence of wildfire residue constitutes irreversible damage. However, research and field data confirm this is rarely the case.

"Damage" is often defined subjectively as an alteration resulting in a loss of appearance, utility, or value.[1,2] In contrast, "impact" is the presence of Combustion By-Products (CBCs) above background that are consistent with the fire event.[1] A core goal of the restoration professional is to remove the *impact* and thereby prevent or reverse the *damage*. For most properties, the goal of returning to a pre-fire condition is achievable through systematic cleaning and remediation.[1,3]

This technical guide presents a four-step process to achieve a *scientific path to restoration* from wildfire impact, using the framework of impact zones, thorough evaluation, restoration and project completion confirmation.

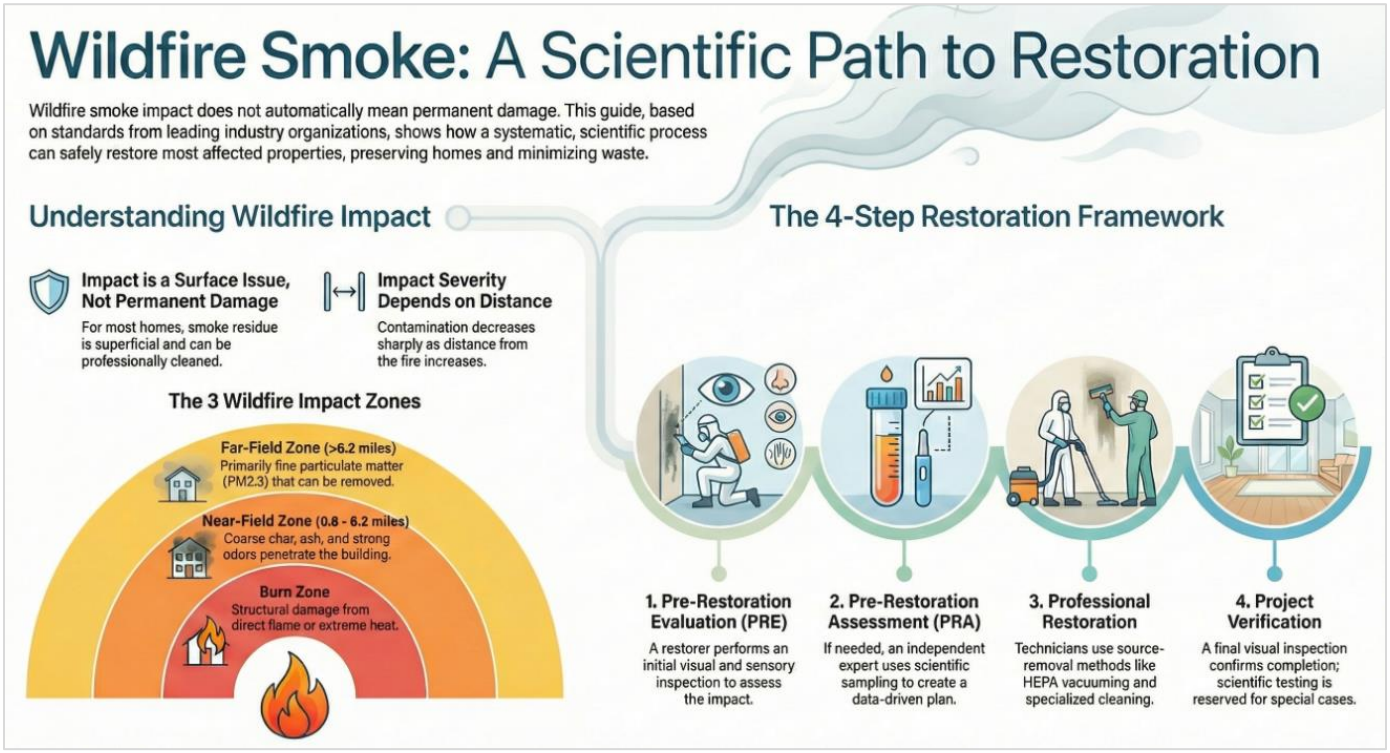

Figure 1: Wildfire Smoke: A Scientific Path to Restoration

2. Combustion Byproducts of Concern (CBC)

Wildfire related combustion byproducts that impact a property vary depending upon a number of factors. An important element in establishing the scope of restoration and assessment activity is identifying how these factors influence the potential for high-risk combustion byproducts, or Combustion Byproducts of Concern (CBC). Wildfire related CBCs are those that pose known potential health risks.

In some cases, no chemical testing is needed to identify the presence of CBCs. However, where a reasonably high risk for CBCs is identified during the Pre-Restoration Evaluation (PRE), the restoration process should include a Pre-Restoration Assessment (PRA), which can involve specific chemical testing.

More than 350,000 chemicals are in commercial use today. All structures, and the products and materials they contain, are composed of chemical substances. When fires occur, these materials can generate a complex mixture of combustion by-products.

Given the vast range of possible chemicals, it is not feasible to test all substances in the environment following a wildfire. Decisions regarding if testing is required, and what to test must therefore be based on what is reasonable, feasible, hazard-relevant, and plausibly present at concentrations high enough to demonstrate impact, structure damage, or health hazards.

Wildfire related Combustion By-Products (CBCs) that may be considered Combustion Byproducts of Concern (CBCs) includes Soot, Char and Ash (SCA). Additionally, CBCs can include but are not necessarily limited to those listed in the table below.

Table 1: Wildfire Related Combustion By-Products (CBCs)

Substance	Description
Volatile Organic Compounds (VOCs)	Gaseous or vapors generally produced during combustion. These are gaseous combustion byproducts that can be forced into the building envelope in the Near-Field Zone. Examples include benzene and formaldehyde. Most VOCs dissipate quickly through ventilation.
Semi-Volatile Organic Compounds (SVOCs)	Heavy organic molecules that adsorb or condense onto particulates (soot, char, ash) and solid surfaces. They cause odors that can linger for extended periods (hours to weeks or months). Examples include Polycyclic Aromatic Hydrocarbons (PAHs), dioxins, furans, and creosol.
Heavy Metals	Metals that adsorb or condense on the surfaces of particles that infiltrate structures. Concentrations are found to be higher at burnt residential structures. Examples include copper, lead, barium, zinc, and arsenic. Levels drop off sharply over 400 meters from the fire boundary.
Asbestos	A potential concern for structures built before approximately 1970 that were fully or partially burned and show structural damage, particularly in the Burn Zone. Levels found outside the immediate fire zone have been concluded to be less than actionable levels set by regulatory agencies.

Hazards related to Combustion Byproducts of Concern (CBC) include either continued damage to structures and contents, or potential human health effects. The need for testing and the selection of specific analytes are made on a case-by-case basis, taking into account:

- The specific circumstances of the fire event and fuels consumed
- The conditions observed at the site
- Interests of the property owner
- Requirements of the insurance provider
- Regulatory mandates
- Professional judgment of the assessment specialist

Refer to section 4.2 *Pre-Restoration Assessment (PRA)* for more information on specific testing methodology, and the AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2nd edition (2025).

3. Impact Zones

Not all smoke-impacted properties are affected equally. The single most important factor in determining the scope of restoration is the property's distance from the fire.[1,3] A study of the 2011 Bastrop, Texas wildfire, for example, found that ash, char, and heavy metal concentrations "fell off sharply" at approximately 400 meters (about 1,300 feet) from the fire's boundary. The results of this study provide essential context for restoration professionals:

- **Higher Concentration in Burn Zone:** As expected, heavy metal concentrations (including copper, lead, barium, zinc, and arsenic) were found to be higher at the sites of burnt residential structures than in areas away from the fire.
- **Rapid Decrease with Distance:** The levels of heavy metals deposited in the fire ash "dropped off sharply" at distances over 400 meters (approx. 1,300 feet) downwind from the fire's boundary.
- **Combustion Byproducts of Concern (CBC) Above Background:** The study concluded that the levels of deposited "heavy metals, SVOCs, asbestos and acidic compounds" found on surfaces outside of the immediate fire zone were "all less than 'action levels' set by any regulatory agency".

Understanding this "time and distance" effect allows restorers to correctly anticipate the type of and extent of impact. Wildfire impact is generally categorized into three zones:[1]

- **The Burn Zone:** Properties within this zone can experience direct flame impingement or significant radiant heat. In such cases, the primary concern is structural integrity. Structures in this zone can also be affected by the hot, turbulent smoke plume, forcing particulates and gaseous combustion byproducts (VOCs) into the building envelope Restoration may involve both structural repair and remediation of heavy impact from Combustion By-Products (CBC).
- **The Near-Field Zone:** This area, extending from the fire perimeter to approximately 1-10 kilometers (0.6 to 6.2 miles), is affected by the hot, turbulent smoke plume. Structures can experience pressurization, forcing not only particulates (coarse char, ash) but also gaseous combustion byproducts (Volatile Organic Compounds, or VOCs) into the building envelope. Remediation in this zone should address settled particulates, VOCs, and complex odors they produce.
- **The Far-Field Zone:** This zone includes all areas beyond the near-field, which can extend for hundreds of miles. By the time the smoke plume reaches this area, it has cooled, and heavier particles have fallen out. The primary impact is the infiltration of fine chemically aged particulate matter ($PM_{2.5}$). These particles are often non-damaging to most building materials and can be effectively removed.

This framework demonstrates that for the vast majority of affected properties, which lie in the far-field, the impact is a surface-level issue that is highly correctable. Properties within the near-field zone will require more significant restoration efforts and may require some replacement of impacted materials but are generally restorable.

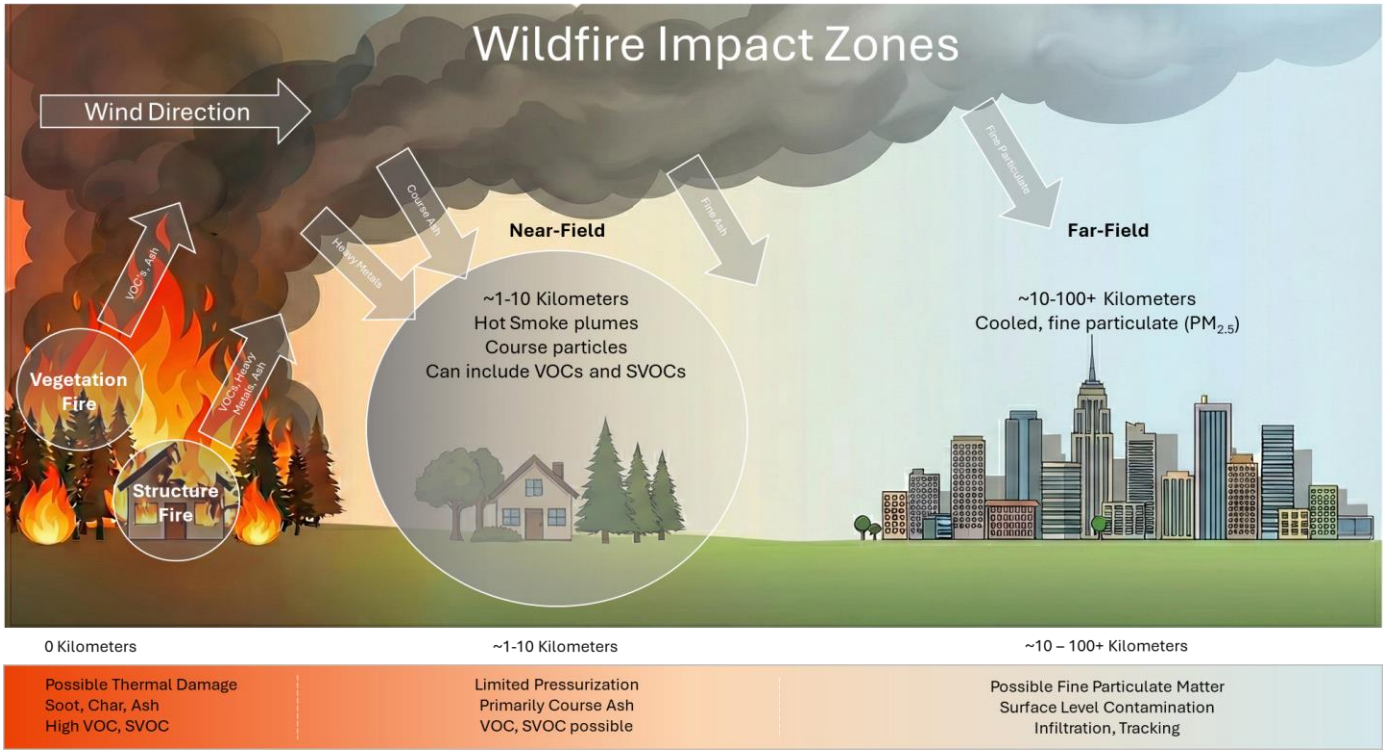

Figure 2: Wildfire Impact Zones

4. Pre-Restoration Evaluation and Assessment

The scope of the restoration process following impact from wildfire and related Combustion By-Products (CBP) begins with information gathering. The initial step is a restorer-performed Pre-Restoration Evaluation. Based on the information gathered, an independent Pre-Restoration Assessment may be necessary. For more information on the process of Assessment (Pre-Restoration Assessment, Post Restoration Verification), refer to the AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2nd edition (2025).

4.1 Pre-Restoration Evaluation (PRE)

The Pre-Restoration Evaluation (PRE) is the critical first step performed by the restorer to establish the degree of impact from a wildfire event. The goal of the PRE is to identify the presence of CBP through visual and sensory inspection and to assess key risk factors. This initial evaluation determines whether restoration can begin immediately or if a more detailed, scientific assessment by a qualified third-party professional is necessary.

4.1.1 Pre-Entry Safety Considerations

Before entering any wildfire-impacted structure, a thorough safety evaluation should be conducted. Potential hazards include:[1]

- **Compromised Structural Integrity:** Wildfire heat can weaken roofs, floors, walls, and foundations. A structural evaluation by a qualified engineer may be warranted before entry.
- **Utility and Environmental Hazards:** Assess risks from active electrical hazards, gas leaks, and the potential for falling trees or other debris, even at a distance from the main fire perimeter.
- **Personal Protection Equipment (PPE):** At a minimum, N-95 masks and gloves are recommended. If VOCs or SVOCs are suspected, PPE should be upgraded to tight-fitting air-purifying respirators equipped with organic vapor cartridges.

4.1.2 Evaluation Procedures

The PRE is a systematic process that combines information gathering with a methodical inspection of the property. The information gathered is used to establish the scope of the restoration process, to include whether elevated risk factors are present and therefore necessitate the inclusion of a Pre-Restoration Assessment.

- **Information Gathering:** The initial step in the evaluation is to collect information regarding the circumstances of the impact specific to the property, to include information regarding the nature of the fire, the proximity of the structure to the fire, and conduct a diagnostic interview with occupants or property managers to reconstruct the building's exposure conditions. Key information that should be collected, if available, during the information gathering phase includes:
    - **The proximity of the fire**: to determine if the property is in the Near-Field Zone or Far-Field Zone.
    - **The duration of smoke exposure**: longer duration of exposure can impact the degree of infiltration from combustion related byproducts.
    - **Whether windows or doors were open**: to establish the degree to which infiltration could have been elevated during the time of exposure.

- **If the structure was occupied during or after the event**: high traffic can increase resuspension of combustion byproducts and significantly impact sorption into fibrous, porous materials.
- **If cleaning has been previously attempted**: cleaning processes that are not performed properly can cause further spread and sorption of combustion byproducts.
- **If the HVAC system was operating**: when in operation, the HVAC system can contribute significantly to the distribution of combustion byproducts. When the HVAC system incorporates a fresh air return, the HVAC system can also significantly contribute to the infiltration rate.

- **Visual Inspection:** the restorer should inspect for key visual indicators of smoke and soot impact, which often follow airflow patterns within the structure. Indicators of the degree and type of Combustion By-Product (CBP) impact include:
  - **Filtration Marks / Threshold Streaks:** dark lines or streaks found where air has been forced through small openings, such as under doors or around trim. The surface acts as a filter, trapping airborne particles. The presence of filtration and threshold streaks indicate pressure differentials were present.
  - **Smoke Webs and Smoke Chains / Smoke Tags:** Soot particles can become attached to and completely coat spider webs, which are surprisingly heat-resistant. These often appear as dark, floating chains or webs, typically in corners near the ceiling. The presence of smoke webs indicates the space has been impacted.
  - **Electrophoresis (Ghosting):** Darkened areas on walls or ceilings, often outlining framing members. This occurs when charged soot particles are attracted to surfaces with an opposite electrical charge, which can be influenced by temperature differences over studs and joists.
- **Odor Perception:** Odor is a key indicator of wildfire impact from VOCs and SVOCs. The presence and character of any smoke-related odors should be carefully noted throughout the inspection.

Table 2: Odorous Combustion Byproducts

Type	Source of Odor	Odor Persistence/Decay Rate
Volatile Organic Compounds (VOCs)	Gaseous/Vapors: generally produced during combustion. Examples include benzene and formaldehyde.	Quick Dissipation: Most VOCs have short gas-phase to particle half-lives of seconds to hours. They tend to dissipate quickly through mechanical and natural ventilation, especially in the far field, where the plume has cooled.
Semi-Volatile Organic Compounds (SVOCs)	Adsorbed/Partitioned Residues: heavy organic molecules that adsorb or condense onto particulates (soot, char, ash) and solid surfaces. Examples include Polycyclic Aromatic Hydrocarbons (PAHs), and creosol.	Longer-term Persistence (Reservoirs): SVOCs cause odors that linger for extended periods. They partition onto building components and contents (carpets, wallboard) and can slowly desorb (off-gas) for time periods ranging from hours to weeks or months.

- **Evaluation of Interstitial Spaces:** when pressure differentials were possible or likely during the event, the restorer should evaluate interstitial spaces as needed. Pressure differentials during a fire can drive smoke and residues deep into these non-occupied areas, which can later serve as a source of re-suspension of combustion related byproducts or off gassing of VOCs and SVOCs. Interstitial spaces that should be evaluated when there are visual indicators of penetration include but are not limited to:
    - Attics
    - Crawlspaces
    - wall cavities
    - HVAC systems

4.1.3 Determining the Need for a Pre-Restoration Assessment (PRA)

A formal Pre-Restoration Assessment (PRA) by a third-party expert should be recommended to the property owner when one or more of the following conditions are identified during the PRE:

- When elevated risk factors are discovered during the PRE (e.g., heavy visible residue, strong persistent odors, proximity to the burn zone, high traffic from occupancy during or after the event).
- When there is a conflict or disagreement among materially interested parties regarding the presence or extent of wildfire related combustion byproducts and related chemicals of concern.
- When a materially interested party explicitly requests a formal assessment.

A third-party PRA shall be performed when it is required by authorities having jurisdiction.

If the PRE does not identify any of these triggers, the restoration process may commence without a PRA.

The findings of the PRE serve as a critical decision point, dictating whether the project can proceed directly to restoration or if the conditions warrant the in-depth scientific analysis of a PRA.

4.2 Pre-Restoration Assessment (PRA)

The Pre-Restoration Assessment (PRA) is a formal, third-party process, typically performed by an Industrial Hygienist (IH) or other qualified Occupational and Environmental Health and Safety (OEHS) professional. It is triggered by specific findings in the PRE, stakeholder request or when required by AHJ. The strategic purpose of the PRA is to use scientific sampling and laboratory analysis to definitively characterize the type and extent of Combustion By-Products (CBPs) present and to establish a data-driven, defensible scope of work for the restoration contractor.

The sections below outline the core principles of the PRA. However, the assessor should refer to AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2nd edition (2025) for more information and the full context of the PRA process.

4.2.1 Designing the Sampling Strategy

A well-designed sampling strategy is essential for generating reliable data to answer key questions about the property.

- **Defining Assessment Goals:** A PRA can have two complementary goals. A forensic investigation aims to confirm the presence of wildfire residue and attribute it to a specific source. An exposure

assessment aims to evaluate potential health hazards to occupants. A comprehensive PRA often combines elements of both.[1]

- **Historical Perspective:** To understand the full extent of the impact, it is important to sample surfaces *before* any cleaning has occurred. Uncleaned areas provide a "historical perspective" of particle accumulation and are most representative of the building's condition immediately following the fire event.[1]
- **Sampling Design:** While probability-based sampling (e.g., random sampling) can be used, a judgmental sampling design is more common for initial site assessments. In this approach, the IH uses professional judgment to select sampling locations most likely to reveal CBCs, such as areas with visible particulate, near airflow pathways, or on horizontal surfaces where particles would settle.[4]

Sampling and testing methodology should consider the proximity of the project to the burn zone, and the fuel sources likely contributing to the CBPs. The following are recommended:

Burn Zone

- Combustion by-products (CBP) on deposited surfaces
- pH bulk or micro vacuum samples of settled particles
- Heavy metals, including lead, especially for structures built before 1978
- PAH (polycyclic aromatic hydrocarbon) organic compounds via wipe sampling
- Asbestos for structures built before approximately 1970 that were fully or partially burned and show structural damage

Near Field

- Combustion by-products
- Heavy metals
- pH of deposited fire particles

Far Field

- Testing, if any, is typically limited to CBP particulate

4.2.2 Sampling Methods and Media

Several methods are used to collect samples for laboratory analysis. The choice of method depends on the surface being tested and the target analytes.

Table 3: Sampling Methods and Media[1]

Method	Description and Use
Tape Lifts	A method where clear adhesive tape is pressed onto a surface to collect settled particles. It is ideal for preserving the spatial distribution of particles for direct microscopical analysis to identify char, ash, and soot.
Wipes	A sterile gauze or other medium, often wetted with a solvent, is used to wipe a pre-measured surface area. This is a highly effective method for collecting samples for quantitative analysis of metals and Semi-Volatile Organic Compounds (SVOCs).
Micro-Vacuuming	A specialized vacuum with a collection cassette is used to collect dust samples from porous or textured surfaces like carpets, upholstery, and inside wall cavities.

Bulk Sampling	A physical piece of a material (e.g., a piece of drywall, carpet, or insulation) is collected for analysis. This is used when a CBP is suspected to have penetrated deep into a material.
Air Sampling for Organic Compounds	Methods such as air sampling canisters or thermal desorption tubes are used to collect airborne samples. The samples are then analyzed using techniques like thermal desorption-gas chromatography/mass spectrometry (TD-GC-MS) to identify specific VOCs and SVOCs associated with wildfire smoke and odor.

4.2.3 Analysis and Scope of Work Development

The data generated from laboratory analysis provides the scientific basis for the restoration plan.

- **Identifying Wildfire Indicators:** Analysis can identify specific markers that differentiate wildfire residue from common household dust or other combustion sources. These include the physical morphology of char, ash, and soot particles; the presence of organic compounds unique to biomass combustion; and specific ratios of metals.[1]
- **Developing the Scope of Work:** The results of the PRA should be used to establish the formal scope of work for the restorer. The data will define which areas of the structure are impacted, what materials require cleaning versus replacement, and which specific cleaning protocols are necessary.
- **Informing Repair vs. Replace Decisions:** If laboratory analysis identifies significant levels of organic compounds, corrosive chemicals, or certain heavy metals above background, the findings may heavily influence the decision to repair versus replace specific affected systems or materials.

The data-driven scope of work developed in the PRA is not merely a suggestion; it serves as the definitive, non-negotiable blueprint for the restoration and cleanup activities detailed in the following section.

4.2.4 Professional Judgement

All decisions regarding sampling types, sampling locations, and the need for testing should be made in consultation with the assessment professional, as defined in the AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2025 2nd Edition.

5. The Restoration Phase

The restoration phase is the physical process of removing the wildfire-related combustion byproducts that were identified in either the Pre-Restoration Evaluation or the Pre-Restoration Assessment. The overarching goal is to return the structure, its systems, and contents to a clean, safe condition. This requires a systematic approach that includes detailed source-removal cleaning, indoor air quality management, and the proper documentation and disposal of non-salvageable items.

5.1 Health and Safety During Cleanup

Restoration work involves direct contact with potentially hazardous materials, and worker safety is paramount.

- Individuals conducting restoration should be fully aware of the potential chemical and physical hazards associated with cleaning up Combustion By-Products (CBPs) from a WUI fire. Exposure can occur through both inhalation and skin contact.[1]
- For properties that have been deemed a total loss and require demolition, OSHA's Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (1910.120) should be consulted to ensure proper health and safety plans and exposure control procedures are implemented.[1,4]

5.2 Restoration Procedures and Methods

The standard of care for cleaning wildfire-impacted structures focuses on source removal. The following procedures outline the general approach for various materials and surfaces.

- **General Surfaces (Walls, Ceilings):** A two-step process is generally used. First, all surfaces should be thoroughly vacuumed with a High-Efficiency Particulate Air (HEPA) filtered vacuum to remove loose particulates. Second, surfaces should be cleaned using damp methods, such as wiping with a mild detergent and water solution, to remove any remaining adhered residue.
- **Flooring:** Hard surfaces should be HEPA vacuumed and damp cleaned. Carpets that are deemed restorable require a more intensive approach, starting with HEPA vacuuming and followed by hot water extraction. Extensive fire- and smoke-impacted carpet in Near-Zone areas may need to be fully replaced, along with the pad, followed by cleaning of the subfloor.
- **HVAC Systems:** As a major conduit for combustion byproduct spread, HVAC systems should be professionally cleaned by a qualified contractor adhering to National Air Duct Cleaners Association (NADCA) Standards.
- **Contents and Personal Property:** The cleaning method depends on the material type. Nonporous hard surfaces (e.g., furniture, ceramics) should be HEPA vacuumed and damp wiped. Porous items (e.g., clothing, bedding) should be professionally laundered or dry-cleaned. Items that cannot be effectively cleaned should be disposed of.

5.2.1 Restoration Methods by Zone

The scope of restoration methods varies depending upon the type of materials impacted, the proximity of the property to the burn zone, the fuel consumed by the fire, and other factors outlined in the Pre-Restoration Evaluation (PRE). Below are restoration methods that are recommended based on the impact zone the

project is located in. The professional judgement of the restorer should be used to determine which of these methods are applicable to a given project.

Table 4: Restoration Methods by Zone

Zone	Restoration Goals	Key Restoration Methods
Burn Zone	**Exposure Assessment, Demolition, Cleaning**	**Structural Safety:** Structural integrity must be evaluated. Charred wood framing must be scraped or abraded down to clear wood or replaced. **Hazardous Materials:** The appropriate expert shall determine if regulated materials are present in accordance with AHJ. Nonregulated hazardous materials should be evaluated when the PRE identifies the presence of risk factors associated with CBCs. Refer to Section *4.1.3 Determining the Need for a Pre-Restoration Assessment (PRA)*. **Containment**: The restorer should isolate work areas with polyethylene sheeting and use HEPA-filtered negative air machines to maintain pressure differentials when impacted and clean areas are both present to prevent spread of CBPs. **Demolition:** directly burned and thermally impacted building materials should be replaced if damage is irreversible. Impacted fiberglass, blown-in, or rolled insulation should be replaced. Flexible ductwork and interior insulated ducting should be replaced. **Odor Management:** active carbon or similar odor absorbent media should be used with air filtration devices to remove VOCs. **HEPA Vacuum:** All impacted surfaces should be vacuumed using a HEPA filter equipped vacuum system to prevent particle re-suspension. **HVAC Remediation:** The system should be thoroughly cleaned in accordance with NADCA Standards. Smooth ductwork should be cleaned under negative pressure. Filters should be replaced with MERV 11 higher. **Cleaning:** Systematic (ceiling to floor, least to most aggressive). Hard surfaces should be cleaned using appropriate detergents that will neutralize CBCs. Sealing and repainting may be used on ceilings, walls, and exposed framing after cleaning to address visual impact. **Contents Decisions:** Replacement may be necessary when cleaning costs exceed the item's value, especially for heavily impacted porous materials like apparel, bedding, or toys. **Exterior:** Washing or spray rinsing can mitigate the need for more intensive work on decks and siding.

Near Field	**Systematic Cleaning**	**Containment**: The restorer should isolate work areas with polyethylene sheeting and use HEPA-filtered negative air machines to maintain pressure differentials when impacted and clean areas are both present to prevent spread of CBPs. **Odor Management:** active carbon or similar odor absorbent media should be used with air filtration devices to remove VOCs. **HEPA Vacuum:** All impacted surfaces should be vacuumed using a HEPA filter equipped vacuum system to prevent particle re-suspension. **HVAC Remediation:** The system should be thoroughly cleaned in accordance with NADCA Standards. Smooth ductwork should be cleaned under negative pressure. Filters should be replaced with MERV 11 higher. **Cleaning:** Systematic (ceiling to floor, least to most aggressive). Hard surfaces should be cleaned using appropriate detergents that will neutralize CBCs. Sealing and repainting may be used on ceilings, walls, and exposed framing after cleaning to address visual impact. **Contents Decisions:** Replacement may be necessary when cleaning costs exceed the item's value, especially for heavily impacted porous materials like apparel, bedding, or toys. **Exterior:** Washing or spray rinsing can mitigate the need for more intensive work on decks and siding.
Far Field	**Particulate Removal & Cleaning**	**Containment**: The restorer should isolate work areas with polyethylene sheeting and use HEPA-filtered negative air machines to maintain pressure differentials when impacted and clean areas are both present to prevent spread of CBPs. **Odor Management:** active carbon or similar odor absorbent media should be used with air filtration devices to remove VOCs when present. **HEPA Vacuum:** All impacted surfaces should be vacuumed using a HEPA filter equipped vacuum system to prevent particle re-suspension. **HVAC Remediation:** The system should be cleaned in accordance with NADCA Standards. Smooth ductwork should be cleaned under negative pressure. Filters should be replaced with MERV 11 higher. **Cleaning:** Hard surfaces may be cleaned as needed using appropriate detergents. **Contents Decisions:** Replacement may be necessary when cleaning costs exceed the item's value, especially for heavily impacted porous materials like apparel, bedding, or toys. **Exterior:** Spray rinsing may be used to remove particulate from decks and siding.

5.3 Removal of Unrestorable Goods

A critical decision point in any restoration project is determining whether an item or an entire structure can be successfully cleaned or should be removed and replaced. This decision is driven by the levels of CBCs present, the porosity of the affected materials, and the cost-effectiveness of restoration versus replacement, and compliance with the handling of regulated hazardous materials as required by AHJ.

5.3.1 Criteria for Determining "Unrestorable"

Restoration may not be a viable option in all cases. The primary factor for determining restorability is the presence of high levels of CBCs, combined with the type of material, opportunities for human exposure, and the other risk factors that are components of the PRE. When these risk factors indicate high levels of CBCs are reasonably likely to be present, a detailed Pre-restoration Assessment should be performed.

The Pre-restoration Assessment should then be used to determine the feasibility of restoration for the materials present in the impacted property.

6. Project Completion

A critical point of confusion in wildfire claims is how to define "clean." The restoration industry, in alignment with guidance from the American Industrial Hygiene Association (AIHA), observes a clear distinction between the *evaluation* performed by the restorer and the *assessment* that may be requested by a third party.[1]

6.1 Restoration Completion Evaluation (RCE)

The Restoration Completion Evaluation is the standard process for completing a restoration project. It is performed by the restoration contractor to ensure the scope of work has been successfully met.[1]

The RCE is based primarily on visual and olfactory inspection.[1] As noted by industry experts, "the removal of visible combustion particles is often considered sufficient evidence of restoration."[2] The restorer conducts a thorough walkthrough, wipe-testing, and odor assessment to confirm that all impacted surfaces have been addressed and the property is free of visible residue and smoke odors. The RCE typically does not involve laboratory sampling.[1]

6.2 Post-Restoration Verification (PRV)

The Post-Restoration Verification (PRV) is a process that is separate from the restorer's standard evaluation.[1] This section outlines the core principles of the PRV, however the PRV should be conducted in accordance with the AIHA *Technical Guide for Wildfire Impact Assessments for the OEHS Professional*, 2nd edition (2025).

A PRV is a formal, scientific assessment that involves sampling and laboratory analysis[1,5] performed by an independent third-party, such as a Certified Industrial Hygienist (CIH) or other Occupational and Environmental Health and Safety (OEHS) professional.[1] It is *not* the restorer's standard procedure but is a specialized tool reserved for specific circumstances, including:

1. **Dispute Resolution:** When there is a disagreement between the materially interested parties (e.g., the owner and insurer) about the efficacy of the restoration.[1]
2. **Occupant Health Concerns:** When a building occupant belongs to an "at-risk" or "susceptible" population (e.g., individuals with pre-existing asthma, COPD, or compromised immune systems).[1,6]
3. **Third-Party Requirement:** When a Post-Restoration Assessment is required by an insurer, lender, or other stakeholder as a condition of the claim.
4. **Suspicion of Hidden Combustion Byproduct Reservoirs:** In rare cases, restoration may remove all visible and olfactory evidence, but occupants may still report symptoms or suspect remaining hidden or residual CBCs. In these cases, a PRV should be performed.

When these triggers are not present, the PRV process in not necessary, and the restoration should be deemed complete following the restorer performed RCE.

Technical Guide Secretariat Organizations

Institute of Inspection, Cleaning and Restoration Certification (IICRC)

- **Summary:** The IICRC is a global non-profit organization that develops and publishes internationally recognized standards and certifications.
- **Industries Represented:** It is the primary standards-setting body for the inspection, cleaning, and restoration industries.
- **Membership:** The IICRC has more than 8,000 Certified Firms and approximately 50,000 active Certified Technicians in 40+ countries.
- **Website:** iicrc.org

Restoration Industry Association (RIA)

- **Summary:** The Restoration Industry Association is the oldest and largest non-profit trade association dedicated to providing leadership, advocacy, and professional qualifications for the restoration and reconstruction industry.
- **Industries Represented:** The association represents professionals in water and fire damage restoration, environmental remediation (mold, asbestos, lead), reconstruction, contents restoration, and cleaning, as well as the vendors and manufacturers that serve these sectors.
- **Membership:** The RIA has more than 1900 member companies representing thousands of restoration professionals, vendors, and service providers.
- **Website: www.**restorationindustry.org

Cleaning Industry Research Institute (CIRI)

- **Summary:** CIRI is a not-for-profit institute focused on promoting the science of cleaning through unbiased scientific research and data.
- **Industries Represented:** The institute serves the cleaning industry and its affiliations, including disaster restoration.
- **Membership:** A specific membership number for CIRI is not publicly specified.
- **Website:** ciriscience.org

Wildfire Joint Task Force Members

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Brandon Burton, MWR, WLS Brandon Burton has over 30 years of experience in the restoration industry. He serves as the **Standards Chair for the Institute of Inspection, Cleaning and Restoration Certification (IICRC)** and has served in various industry technical committees, to include the RIA/IICRC/AIHA Crisis Response Joint Task Force. As a long-time IICRC instructor for Water Damage Restoration (WRT) and Applied Structural Drying (ASD), he has trained over 10,000 professionals. He is a co-author of *The Complete Guide to Cleaning and Restoration* and currently serves as Senior Principal, Industry Relations at Cotality.

Glossary of Terms

Action Levels The regulatory level set by agencies, below which chemicals of concern are considered non-actionable.

AIHA (American Industrial Hygiene Association) A non-profit organization dedicated to "creating knowledge to protect worker health" that serves as a primary resource for industrial hygienists and occupational health professionals.

Bulk Sampling A sampling method where a physical piece of a material (e.g., drywall, carpet, or insulation) is collected for analysis, typically used when a CBP is suspected to have penetrated deep into a material.

Burn Zone (The) A wildfire impact zone where properties have experienced direct flame impingement or significant radiant heat. Structural integrity is the primary concern, and restoration involves structural repair and remediation of heavy combustion byproducts.

Building Envelope The term used to describe the components of a structure that separate it from the outdoor environment.

Char A solid combustion byproduct, along with ash and smoke, brought into contact with residential and commercial structures during wildfire events. Analysis of collected particles can identify the physical morphology of char.

CIH (Certified Industrial Hygienist) An independent third-party professional, akin to a forensic investigator, who may perform a Post-Restoration Verification (PRV).

CIRI (Cleaning Industry Research Institute International) A not-for-profit institute focused on promoting the science of cleaning through unbiased scientific research and data. It serves the cleaning industry and its affiliations, including disaster restoration.

Combustion Byproducts The resulting substances (e.g., char, ash, smoke) created from a fire event. The goal of a Pre-Restoration Evaluation (PRE) is to identify the presence of these byproducts.

Damage Defined subjectively as an alteration resulting in a loss of appearance, utility, or value. A core goal of restoration is to remove the *impact* and thereby prevent or reverse the *damage*.

Electrophoresis (Ghosting) Darkened areas often found on walls or ceilings that outline framing members. This occurs when charged soot particles are attracted to surfaces with an opposite electrical charge, often influenced by temperature differences over studs and joists.

Exposure Assessment A goal of a Pre-Restoration Assessment (PRA) that aims to evaluate potential health hazards to occupants.

Far-Field Zone (The) A wildfire impact zone that extends beyond the Near-Field Zone, potentially for hundreds of miles. In this area, the primary impact is the infiltration of fine particulate matter (PM2.5) after the smoke plume has cooled and heavier particles have fallen out. The impact is often surface-level and highly correctable.

Filtration Marks / Threshold Streaks Dark lines or streaks found where air has been forced through small openings, such as under doors or around trim. The surface acts as a filter, trapping airborne particles.

Forensic Investigation A goal of a Pre-Restoration Assessment (PRA) that aims to confirm the presence of wildfire residue and attribute it to a specific source. A Post-Restoration Verification (PRV) is also akin to a forensic investigation.

HAZWOPER (Hazardous Waste Operations and Emergency Response) The OSHA standard (1910.120) that should be consulted for proper health and safety plans when conducting demolition work on properties deemed a total loss.

HEPA (High-Efficiency Particulate Air) Filtered Vacuum A type of vacuum required for the first step of cleaning general surfaces to remove loose particulates.

Hot Water Extraction An intensive cleaning approach recommended for carpets that have been HEPA vacuumed following wildfire impact.

IICRC (Institute of Inspection, Cleaning and Restoration Certification) A global non-profit organization that develops and publishes internationally recognized standards and certifications. It is the primary standards-setting body for the inspection, cleaning, and restoration industries.

IH (Industrial Hygienist) A professional who typically performs the formal, third-party Pre-Restoration Assessment (PRA).

Impact The simple presence of combustion byproducts.

Judgmental Sampling A sampling design common for initial site assessments where the Industrial Hygienist (IH) uses professional judgment to select sampling locations most likely to reveal CBPs, such as areas with visible particulate, near airflow pathways, or on horizontal surfaces where particles would settle.

Levoglucosan An organic compound unique to biomass combustion that analysis can identify as a specific marker differentiating wildfire residue from common household dust.

Micro-Vacuuming A specialized vacuum method using a collection cassette to collect dust samples from porous or textured surfaces like upholstery, carpets, and inside wall cavities.

NADCA (National Air Duct Cleaners Association) The association whose standards qualified contractors should adhere to when professionally cleaning and sanitizing HVAC systems.

Near-Field Zone (The) A wildfire impact zone extending from the fire perimeter to approximately 1–10 kilometers (0.6 to 6.2 miles). Structures here can be affected by the hot, turbulent smoke plume, forcing particulates and gaseous combustion byproducts (VOCs) into the building envelope.

OEHS (Occupational and Environmental Health and Safety) Professional A qualified professional, such as an Industrial Hygienist (IH), who may perform a formal, third-party Pre-Restoration Assessment (PRA).

Olfactory Inspection An inspection method based on the sense of smell. The Post-Restoration Evaluation (PRE) relies primarily on visual and olfactory inspection to confirm that all smoke odors have been addressed.

Organic Compound Sampling Methods such as air sampling canisters or thermal desorption tubes used to collect airborne samples for analysis, typically using TD-GC-MS, to identify specific VOCs and SVOCs associated with wildfire smoke and odor.

OSHA (Occupational Safety and Health Administration) The federal agency responsible for worker safety, whose HAZWOPER standard should be consulted for demolition work.

PM2.5 (Fine Particulate Matter 2.5) Fine particulate matter, which is the primary form of impact found in the Far-Field Zone.

PPE (Personal Protection Equipment) Equipment such as N-95 masks and gloves recommended as a minimum for safety when entering a wildfire-impacted structure. If VOCs or SVOCs are suspected, this should be upgraded to tight-fitting air-purifying respirators equipped with organic vapor cartridges.

PRA (Pre-Restoration Assessment) A formal, third-party process, typically performed by an Industrial Hygienist (IH), that uses scientific sampling and laboratory analysis to definitively characterize combustion byproducts and establish a data-driven, defensible scope of work for the restoration contractor.

PRE (Pre-Restoration Evaluation) The critical first step performed by the restorer to establish the degree of impact from a wildfire event. The goal is to identify the presence of combustion byproducts through visual and sensory inspection and to assess key risk factors.

PRV (Post-Restoration Verification) An optional, specialized process that is separate from the restorer's standard evaluation. It is a formal, scientific assessment that involves sampling and laboratory analysis performed by an independent third party, such as a Certified Industrial Hygienist (CIH). It is reserved for specific circumstances like dispute resolution or occupant health concerns.

RCE (Restoration Completion Evaluation) The Restoration Completion Evaluation is the standard process for completing a restoration project. It is performed by the restoration contractor to ensure the scope of work has been successfully met.

Restoration Phase (The) The physical process of removing the wildfire-related combustion byproducts to return the structure, its systems, and contents to a clean, safe, and odor-free condition.

RIA (Restoration Industry Association) An association of property restoration professionals, representing thousands of restoration companies and restorers who are responsible for prudent wildfire restoration practices.

Risk Factors Key elements assessed during the PRE, such as proximity to the burn zone, heavy visible residue, or strong persistent odors, that may trigger the need for a formal PRA.

Scope of Work The detailed, data-driven plan for restoration and cleanup activities established using scientific sampling and laboratory analysis from the PRA.

Smoke Webs and Smoke Chains / Smoke Tags Soot particles that become attached to and completely coat spider webs, which appear as dark, floating chains or webs, typically in corners near the ceiling.

Source Removal The fundamental approach for cleaning wildfire-impacted structures, focusing on removing combustion byproducts identified in the PRE or PRA.

SVOCs (Semi-Volatile Organic Compounds) Compounds that, along with volatile compounds and metals, adsorb or condense on surfaces of particles that infiltrate structures. They can be collected using wipes for quantitative analysis.

Tape Lifts A sampling method where clear adhesive tape is pressed onto a surface to collect settled particles. It is ideal for preserving the spatial distribution of particles for direct microscopical analysis to identify char, ash, and soot.

TD-GC-MS (Thermal Desorption-Gas Chromatography/Mass Spectrometry) A technique used to analyze samples collected via organic compound sampling (such as thermal desorption tubes) to identify specific VOCs and SVOCs associated with wildfire smoke and odor.

Time and Distance Effect The concept that the type and concentration of Combustion By-Products (CBPs) present vary based on the property's distance from the fire.

Unrestorable A determination that an item or structure cannot be successfully cleaned and should be removed and replaced. This determination is often driven by the extent of impact from Combustion By-Products (CBCs), the porosity of affected materials, and cost-effectiveness.

VOCs (Volatile Organic Compounds) Gaseous combustion byproducts that, along with particulates, can be forced into the building envelope in the Near-Field Zone. Odor is a key indicator of their presence.

Wipes A sterile gauze or other medium, often wetted with a solvent, used to wipe a pre-measured surface area. This method is highly effective for collecting samples for quantitative analysis of metals and Semi-Volatile Organic Compounds (SVOCs).

Wipe-testing A procedure conducted by the restorer during the Post-Restoration Evaluation (PRE) to confirm that all impacted surfaces have been addressed.

WUI (Wildland-Urban Interface) The area where the growing frequency and scale of wildfires have expanded, bringing smoke, char, and ash into contact with more residential and commercial structures.

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