



# Beyond the Flames: Advanced Smoke, Soot, and Odor Restoration

ATIrestoration.com | (800) 400-9353



# Table of Contents

**03**

Introduction

**04**

Fire Damage Beyond the Burn Area

**05**

How Impact Zones Determine Restoration Scope

**07**

A Four-Step Wildfire Restoration Framework

**09**

Removing Wildfire Residues

**10**

Making Smart Restoration Decisions

**11**

Defining What “Clean” Really Means

**12**

Conclusion



# Introduction

In recent wildfire events, buildings far from active burn zones have been blanketed with smoke and ash despite never being touched by flame. As wildfire frequency and scale increase, smoke, char, and ash are coming into contact with more commercial and residential structures than ever before, a shift driven by the expansion of communities into fire-prone landscapes known as the wildland–urban interface (WUI).

In the aftermath of these fires, property owners face difficult questions: Is our building damaged? Is it safe to occupy? Do we have to tear everything out and start over?

Fortunately, the presence of wildfire smoke, ash, or odor does not mean a structure is irreversibly damaged. For most wildfire-impacted properties, smoke exposure results in surface-level contamination that is highly correctable through professional restoration.

This whitepaper explores how wildfire smoke behaves, what contamination it leaves behind, and how professional restorers can help you determine what truly needs to be cleaned, restored, and replaced. By understanding how smoke impact is assessed and addressed, property owners can make decisions that protect health, reduce losses, and avoid costly overcorrection once the smoke clears.



# Fire Damage Beyond the Burn Area

The initial combustion is only the first stage in a longer, more complex sequence of damage. In addition to what was burned down completely, or partially burned, significant impacts are driven by how smoke, soot, and airborne residues move, settle, and interact with buildings over time.

This progression explains why even small or contained fires can cause widespread secondary damage. Smoke does not respect room boundaries or fire breaks. It follows airflow paths, moving through open spaces, wall cavities, ductwork, and shared mechanical systems. Differences in air pressure can pull smoke into areas far removed from the original fire, while porous materials such as fabrics, insulation, and unfinished surfaces readily absorb airborne contaminants.

As smoke and soot settle, they form chemical residues that can adhere to finishes, penetrate soft goods, and accumulate in mechanical systems. Over time, these residues may corrode metals, degrade electronics, and bond with porous materials.



## THE PHASES OF FIRE DAMAGE

- Combustion initiates the release of heat, smoke, and by-products into the surrounding environment.
- Smoke and fine particulates then migrate, carried by wind, pressure differentials, and mechanical systems such as HVAC.
- As these airborne contaminants travel, they deposit chemical residues on surfaces, within porous materials, and inside building systems.
- Long after visible smoke has cleared, these residues can continue to affect indoor environments through corrosion, odor re-emission, and ongoing system contamination.



# How Impact Zones Determine Restoration Scope

The level of restoration required depends on how close a property was to a fire and how it was exposed to smoke, soot, and residue over time. Understanding where a property falls along the exposure spectrum ensures restoration decisions reflect actual conditions, preventing undertreatment and overreaction.

## **FAR-FIELD ZONE (> 6.2 miles)**

Primarily fine particulate matter (PM2.5) that can be removed.

## **NEAR FIELD ZONE (0.62 – 6.2 miles)**

Coarse char, ash, and strong odors can penetrate the building.

## **BURN ZONE**

Possible structural damage from direct flame or extreme heat.



## BURN ZONE

Properties in the burn zone are those exposed to direct flame contact or extreme radiant heat. Structural damage may be present, and reconstruction or partial demolition may be required. Restoration efforts in this zone focus on stabilizing damaged structures, addressing compromised materials, and rebuilding where necessary.

## NEAR-FIELD ZONE

The near-field zone includes properties exposed to dense smoke plumes and heavier particulate deposition without direct flame contact. These buildings may experience significant smoke infiltration, residue buildup, and odor issues that extend into contents and building systems.

Restoration in the near-field zone typically requires more intensive cleaning and selective replacement of heavily impacted materials. Even at this level of exposure, most structures and contents are generally restorable. Restoration plans are guided by residue load, material type, and exposure duration.

## FAR-FIELD ZONE

Structures in the far-field zone are often located miles from the fire and are primarily affected by fine particulate infiltration, including microscopic smoke particles carried over long distances.

In far-field properties, impacts are usually surface-level and highly correctable through professional restoration methods. While odors and residue may be present, they usually do not require demolition or large-scale material replacement. Targeted cleaning, deodorization, and system decontamination are often sufficient to restore safe, functional conditions.



# A Four-Step Wildfire Restoration Framework

No two fire events are identical. A flexible, science-based framework allows professional restorers to tailor their response to actual conditions on a property rather than applying one-size-fits-all solutions, ensuring that restoration scope is appropriate, proportionate, and supported by observable conditions.



## STEP 1: EVALUATE THE PROPERTY'S CONDITION

Restoration following smoke exposure should begin with a professional evaluation of the property's condition. This phase includes recording data including the presence and character of damage and odors, the type of building and materials involved, and the ways occupants use the space. In this step, restoration professionals determine how smoke interacted with the structure: where it traveled, where it settled, and whether there are indicators of deeper contamination.

For many properties, especially those in the far-field zone, this initial evaluation provides sufficient information to proceed directly to restoration without further escalation.



## STEP 2: CONDUCT A SCIENTIFIC ASSESSMENT

Not every smoke-impacted property requires third-party testing. Professional restoration companies may engage independent experts to take samples and generate a report when specific risk factors are present, such as elevated occupant sensitivity, conflicting stakeholder opinions, regulatory or insurer requirements, and conditions that cannot be resolved through observation alone.

## STEP 3: REMOVE CONTAMINATION AT ITS SOURCE

Restoration companies select cleaning methods based on residue type, material sensitivity, and exposure level, with the goal of eliminating residues without spreading or embedding them further. This phase may include surface cleaning, contents restoration, deodorization, and system-level decontamination, depending on the scope of impact.

## STEP 4: CONFIRM REMEDIATION

Restoration is complete when visible residues are removed, odors are eliminated, and affected areas are ready for normal use. Confirmation will involve professional judgment and documentation, and possibly third-party testing where confirmation is required by stakeholders or where additional assurance is appropriate.



# Removing Wildfire Residues

A common misconception is that contamination from wildfire smoke is permanent. In reality, most wildfire-related residues can be effectively removed through professional restoration, particularly when exposure is identified and addressed appropriately.

Wildfire smoke contains a range of combustion by-products. While these substances may sound alarming, their behavior follows consistent patterns. Concentrations generally decrease rapidly with distance from the fire, and in many properties, residues are deposited primarily on surfaces rather than embedded deep within structural components.

This distinction is critical. Surface-level contamination is typically highly correctable using professional cleaning methods designed specifically for smoke and fire residues. When restoration is performed using material-appropriate techniques, residues can be removed from structural surfaces and contents without spreading contamination or causing secondary damage.

Importantly, regulatory agencies and industry guidance do not support mass disposal of contents or wholesale rebuilding of homes solely due to smoke exposure. What matters most is the degree of exposure, the type of residue, and how it interacts with materials over time.

## COMMON BY-PRODUCTS OF FIRE AND SMOKE

Fires generate a range of by-products depending on what burns and how combustion occurs.

- **SOOT:** Fine carbon-based particles created during incomplete combustion
- **ASH:** Heavier particulate matter resulting from burned materials
- **CHAR:** Partially burned material that may remain on surfaces or contents exposed to heat and smoke
- **VOLATILE ORGANIC COMPOUNDS (VOCs):** Gaseous compounds released during combustion that contribute to odor and indoor air quality concerns
- **SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs):** Heavier compounds that can settle onto surfaces and re-emit over time, particularly with changes in temperature or humidity
- **TRACE METALS AND OTHER RESIDUES:** Residues released in small quantities, commonly when structures or vehicles burn



# Making Smart Restoration Decisions

A difficult challenge that property owners face in the aftermath of wildfire smoke exposure is deciding what to replace and what to save. The instinct to discard and rebuild is understandable: smoke is invisible, odors are unsettling, and uncertainty can make restoration feel risky. However, experience and science consistently show that cleaning and salvaging materials should be the starting point whenever feasible. Smoke-related contamination is often removable, particularly in properties outside the immediate burn zone. With proper assessment and material-specific methods, professionals can safely restore many surfaces, furnishings, and personal belongings that appear compromised.

That said, restoration does not mean preserving everything at all costs. Replacement is appropriate when conditions clearly warrant it. Items like food or medicine that present health risks if ingested require replacement to ensure occupant safety. In

other cases, replacement becomes the practical choice when the cost of cleaning exceeds the item's replacement value. For example, some highly porous soot covered materials may be more expensive to clean than to replace.

The goal is to balance safety, effectiveness, and practicality while avoiding unnecessary loss. When restoration professionals evaluate contents and materials through this lens, outcomes are more consistent, defensible, and aligned with actual risk.

Prioritizing cleaning before replacement also has broader benefits. It reduces environmental waste, limits disruption to occupants, and preserves items that may be difficult or impossible to replace. In wildfire events, where entire communities may be affected at once, this approach helps prevent overwhelming disposal streams and unnecessary rebuilding.



# Defining What “Clean” Really Means

Establishing a clear definition of completion is essential for avoiding lingering uncertainty about safety and performance. “Clean” means that contamination has been addressed in a way that is appropriate, effective, and supported by professional judgment.

A restoration project is considered complete when three conditions are met.

#1

Visible residues have been removed. Surfaces, contents, and systems that were impacted by smoke, soot, or ash no longer show signs of contamination. This includes not only obvious deposits but also residues that may have accumulated in less visible areas where smoke commonly settles.

#2

Odors have been eliminated. Persistent smoke odors indicate that contamination remains. Effective restoration addresses odor at its source, ensuring that smells do not return with changes in temperature, humidity, or normal building use.

#3

The defined restoration scope has been met. Cleaning and remediation have been completed in accordance with industry standards and the conditions identified during evaluation and assessment.



# Conclusion

As communities continue to expand in the wildland–urban interface, smoke, soot, and ash are increasingly affecting buildings that never encounter flame. These conditions can create uncertainty, anxiety, and pressure on property owners to act before they understand the true scope of impact.

Advanced restoration applies science, experience, and judgment to determine what needs to be addressed, what can be restored, and how to return buildings and contents to safe, functional use without unnecessary loss. This is where expertise matters. Proper smoke and

odor restoration requires an understanding of combustion by-products, material behavior, and how contamination moves through buildings and contents over time. When handled correctly, most smoke-impacted properties and their contents can be restored rather than replaced.

ATI supports property owners, insurers, and communities by applying this science-driven approach across wildfire and fire-related losses nationwide. From initial evaluation through contents restoration and final confirmation, we focus on restoring what matters while minimizing disruption, waste, and long-term risk.

# With 70+ Locations Nationwide

ATI responds to major events and day-to-day  
emergencies across the U.S.



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 National Response Trailers



**Contact Us**

(800) 400-9353

[info@ATRestoration.com](mailto:info@ATRestoration.com)

[ATRestoration.com](http://ATRestoration.com)