

# **BRUSH, GRASS, AND FOREST FIRES**

**Marty Ahrens**

**August 2010**



**National Fire Protection Association  
Fire Analysis and Research Division**

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## **Abstract**

Based on data from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey, NFPA estimates that during 2004-2008, local fire departments responded to an average of 356,800 natural vegetation fires per year. In most, less than one acre burned. These incidents accounted for 23% of all fires reported to local fire departments. This study examines the circumstances and causal factors of: a) brush or brush and grass mixture fires; b) grass fires; c) forest, woods, or wildland fires; and d) total brush, grass, and forest fires, including unclassified natural vegetation fires. One in five was intentionally set. The most common heat source was a hot ember or ashes. Smoking materials, open burning and high winds were also frequent factors. Lightning was a more common factor in forest, woods, or wildland fires than the other types of fires.

Keywords: fire statistics, natural vegetation fires; brush fires, grass fires, wildland fires; forest fires; mulch fires, railroad.

## **Acknowledgements**

The National Fire Protection Association thanks all the fire departments and state fire authorities who participate in the National Fire Incident Reporting System (NFIRS) and the annual NFPA fire experience survey. These firefighters are the original sources of the detailed data that make this analysis possible. Their contributions allow us to estimate the size of the fire problem.

We are grateful to the U.S. Fire Administration for its work in developing, coordinating, and maintaining NFIRS. We would also like to thank the National Interagency Fire Center for providing so much information about wildland fires handled by state and federal agencies.

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## Executive Summary

Fires in the wildland/urban interface have often been in the news in recent years. Nine of the 25 costliest fires in the U.S. were described as either wildland or wildland/urban interface fires. The eight costliest fires were in the last two decades. Federal or state agencies are typically involved in these massive fires. The term wildland/urban interface (WUI) is typically used to describe areas where extensive vegetation mixes with numerous structures and their inhabitants. WUI fires of note often begin and grow large in the vegetated areas before spreading to structures.

What many people don't realize is how often local fire departments around the country are called to much smaller brush, grass and forest fires.

During 2004-2008, local fire departments responded to an estimated average of 356,800 brush, grass, and forest fires per year. This translates to 976 such fires every day.

- Only 10% of these fires were coded as forest, woods, or wildland fires.
- Two of every five (41%) were brush or brush and grass mixtures;
- more than one-third (37%) were grass fires; and
- 12% were unclassified forest, brush or grass fires.

In three-quarters (74%) of the brush, grass, and forest fires handled by local fire departments, less than an acre burned. Only 4% burned more than ten acres. Fires in forests tended to be larger than other vegetation fires. Only three-fifths (57%) of the forest fires were less than an acre while 9% consumed more than ten acres.

*These statistics are derived from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual fire department experience survey. Fires handled by federal and state wildland fire agencies are generally not included in these statistics unless they were also reported to a local fire department.*

Regional differences are seen in the overall frequency of these fires and in rates per 1,000 square miles. The rate is based on total area without regard for ownership.

- More than half (54%) of total brush, grass, and forest fires handled by local fire departments were in the South, as were 51-63% of the specific types of vegetation fires. The South also had the highest rate of total brush, grass, and forest fires per 1,000 square miles overall as well as the highest rate for grass and forest fires specifically. It ranked second in brush or brush and grass mixture fires.
- One of every five brush, grass or forest fire responses handled by local fire departments occurred in the Midwest. The Midwest ranked second in all four of the specific types of vegetation and third on all measures of brush, grass or forest fires per 1,000 square miles.
- The Northeast had the smallest percentages of all types of reported brush, grass, or forest fires. However, the Northeast also covers the smallest area of the four census regions. It led the country in the rate of fires involving brush or brush and grass mixtures per 1,000

square miles. The Northeast had the second highest rate for total brush, grass, and forest fires and forest woods or wildland fires specifically. It ranked third in the rate for grass fires.

- Local fire departments in the West ranked third in the percentage of U.S. brush, grass, and forest fires handled, but they had the lowest rate of fires per 1,000 square miles for all the fire categories studied. Although most of the largest wildland fires were in the West, many of these were on lands owned by the federal government and are not protected by local fire departments.

Brush, grass and forest fires endanger much more than other brush, grass and forest land. One indication can be seen in the property use codes recorded for these fires. In many cases, the property use codes describe places where people, buildings, and vehicles would be expected to be nearby. Roughly one-third of (36%) these fires occurred in open lands or fields. One in six occurred on highways, streets or parking areas. Nine percent, or an average of 31,700 fires per year, occurred at one- or two-family homes.

The important point is that these fires often occur on properties where people live, work, or travel. A brush, grass, or forest fire can spread to buildings or vehicles on the property. A fire that starts outside a building can get into the concealed spaces between the exterior and interior. A fire inside the wall or attic space may not activate smoke alarms or sprinklers until it gets into the living space.

### **Prevention and Mitigation Strategies**

Many of the same wildfire safety strategies employed by property owners and residents in the wildland/urban interface can reduce the likelihood of structural ignition or fire spread from brush, grass or forest fires throughout the country. Vegetation, landscaping, and garden materials can be fuel sources for fires in a wide variety of settings. NFPA's Firewise program helps people who live in wildland-urban interfaces protect their homes from wildfire. Much of the Firewise advice makes sense for anyone who has a yard even if they do not live or work in a wildland-urban interface. There are two important goals in fire prevention and fire protection. The first is to prevent unwanted fires from starting in the first place. The second goal is to minimize the probability that a fire, once started, will cause serious harm.

To prevent fires, it is necessary to know how they typically start. The leading causes of brush, grass and forest fires were intentional (20%), hot embers or ashes (17%), outside fires for debris or waste disposal (15%), high wind (13%), smoking materials (12%), playing with heat source (6%), fireworks (5%), electrical power or utility lines (4%), and lightning (4%). The cause profile varies by type of fire and type of material first ignited. Lightning caused 15% of the forest fires but only 4% of these fires overall. Because the causes are pulled from different NFIRS fields, they are not mutually exclusive.

Prevention strategies are relatively easy to identify for some of the causes. Be sure that smoking materials are disposed of properly in fire-resistant containers. Provide metal containers for cigarette disposal to prevent them from being tossed on the ground. If you have a campfire or bonfire, be sure it is completely out. Avoid outside fires on windy days. Leave fireworks to the professionals. Keep matches and lighters away from children. Preventing deliberate, malicious



fires is far more challenging. When dealing with human beings, it is easier to say what should be done than to ensure that the procedures are always followed.

To protect your home or property from potential fire spread from a brush, grass or forest fire, reduce the available fuel on and around the home. In particular, keep plants that burn fast and hot away from the structure. Get rid of dead branches, leaves, brush and tree limbs that hang over your home. Use gravel or some other non-combustible material next to the building instead of an organic mulch. Ensure the home itself is as ignition-resistant as possible by choosing non-flammable roofing, fire-resistant siding, screened or ember-resistant vents, and attachments (fences, decks, porches) that are fire-resistant or modified to keep from carrying fire to the main structure.

Most people have a long list of things to do around home and yard and not enough time to do them in. It may help to know that landscaping to reduce the threat of fire can pay off in additional ways. Some of these techniques also increase the security of your home. In their information on crime prevention through environmental design, the Seattle Police Department recommends a maximum height of three feet for hedges and a minimum height of eight feet for tree canopies, particularly in areas close to doors and windows. This approach provides fewer hiding places. Higher tree canopies make it less likely that a fire that starts on the ground will reach the branches. Keeping tree branches, vegetation, and mulch away from siding or roof can not only limit fire spread, it can help keep carpenter ants out of the home.

Many of us would like to have a more natural yard to make our lands more attractive to birds and pollinators. It is important to remember fire safety in the process.

## **Safety Tips to Prevent Brush, Grass, and Forest Fires**

- Place cigarette butts in metal containers. Do *not* throw them on the ground or into vegetation.
- Keep at least 18 inches between mulch beds and building materials that can burn.
- Follow the instructions at [www.firewise.org](http://www.firewise.org) to make your home and landscaping more resistant to fire.
- Call the local fire department or municipality before outdoor or open air burning. This includes campfires, brush fires, fire pits, chimineas, and outdoor fireplaces. You may not be permitted to do outdoor burning in some municipalities and during some seasons. Closely attend all outdoor fires. Be sure to put out the fire completely before leaving.
- Avoid burning on windy, dry days. When conditions are windy or dry, it is too easy for open burning to spread out of control.
- Do not use gasoline or other flammable or combustible liquids to burn brush, trash, or other waste.

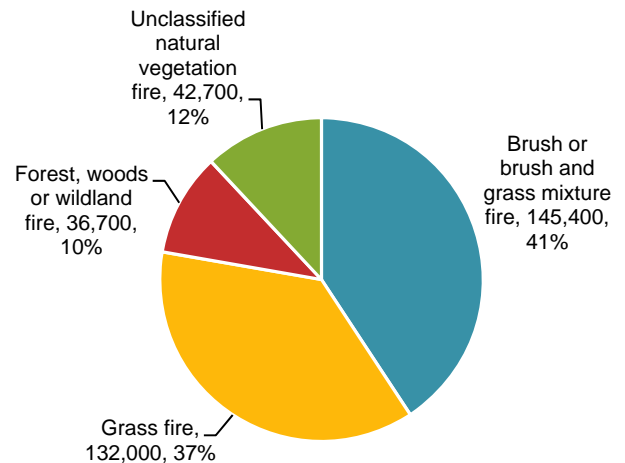


## Local Fire Department Responses to Brush, Grass or Forest Fires in 2004-2008

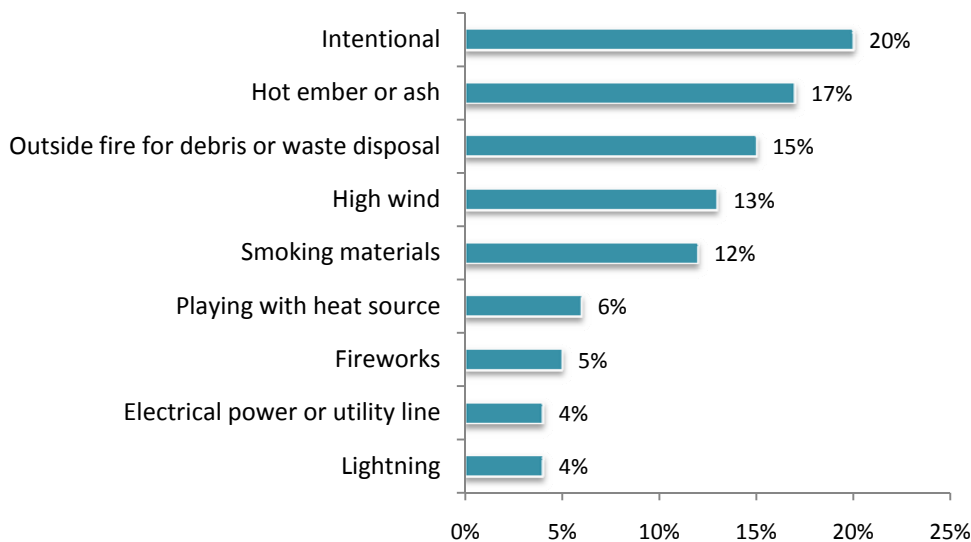
During the five-year period of 2004-2008, local U.S. fire departments responded to an estimated average of 356,800 brush, grass, and forest fires per year.<sup>1</sup>

- 41% were brush or brush and grass mixtures. More than one-third were grass fires. Only 10% were forest, woods, or wildland fires.
- On average, 976 brush, grass, or forest fires were reported per day.
- These incidents accounted for 23% of all fires reported to local fire departments.
- 4,800 buildings were involved in these brush, grass, and forest fires per year.
- Less than an acre burned in three-quarters (74%) of these fires. Only 4% burned more than ten acres.
- Nine percent, or an average of 31,700 fires per year, occurred at one- or two-family homes.

**Brush, Grass and Forest Fires by Incident Type**



## Brush, Grass and Forest Fires by Major Causal Factors and Type of Fire



Overall, one in five of these fires were intentionally set.

Other leading factors include hot embers or ashes, open burning of debris, high winds, and smoking materials.

Lightning caused 15% of the forest, woods or wildland fires, but only 4% of overall brush, grass or forest fires.

<sup>1</sup> Fires handled by the federal and state wildland fire agencies are not included in these statistics unless they were also reported to a local fire department.



# Brush, Grass, and Forest Fires

While fire is a natural phenomenon and a necessary part of many natural habitats,<sup>1</sup> it becomes a problem when it impinges on inhabited areas. Fires in the wildland/urban interface have often been in the news in recent years. Nine of the 25 costliest fires in the U.S. were either wildland or wildland/urban interface fires. The eight costliest fires were in the last two decades.<sup>2</sup> Federal or state agencies were typically involved in these massive fires. The term wildland/urban interface (WUI) is typically used to describe areas where extensive vegetation mixes with numerous structures and their inhabitants. WUI fires of note often begin and grow large in the vegetated areas before spreading to structures.

What many people don't realize is how often local fire departments around the country are called to much smaller brush, grass and forest fires. Most of the analysis that follows focuses on fires handled by local fire departments. Information obtained from the National Interagency Fire Center's website about wildland fires handled by state and federal wildland agencies is also included toward the end of the report.

## Fires Reported to Local Fire Departments

**356,800 brush, grass, and forest fires, on average, were reported to local fire departments annually.**

During the five-year period of 2004-2008, local U.S. fire departments responded to an estimated average of 356,800 brush, grass, and forest fires per year. Crop and cultivated vegetation fires are excluded from these statistics, as are plant fires occurring in or on structures. On average, 976 brush, grass, or forest fires were reported per day. These incidents accounted for 23% of all fires reported to local fire departments and 46% of the outside and unclassified fires. During this period, 4,800 buildings, on average, were involved annually in brush, grass, and forest fires handled by local departments.

Figure 1 shows that the 356,800 natural vegetation fires reported per year include an average of:

- 145,400 (41%) brush or brush and grass mixture fires;
- 132,000 (37%) grass fires;
- 36,700 (10%) forest, woods or wildland fires; and
- 42,700 (12%) natural vegetation fires that were not classified further.

*“Natural vegetation fires” is a term used to describe brush, grass, or forest fires regardless of their causes.*

<sup>1</sup> K. Jeffrey Danter. "Fire Dependent Ecosystems of the United States" in *Communicator's Guide: Wildland Fire*, accessed at [http://www.nifc.gov/preved/comm\\_guide/wildfire/fire\\_6.html](http://www.nifc.gov/preved/comm_guide/wildfire/fire_6.html) on August 20, 2010.

<sup>2</sup> National Fire Protection Association. "The 25 Largest-Loss Fires in U.S. History" September 2009. See Appendix A.

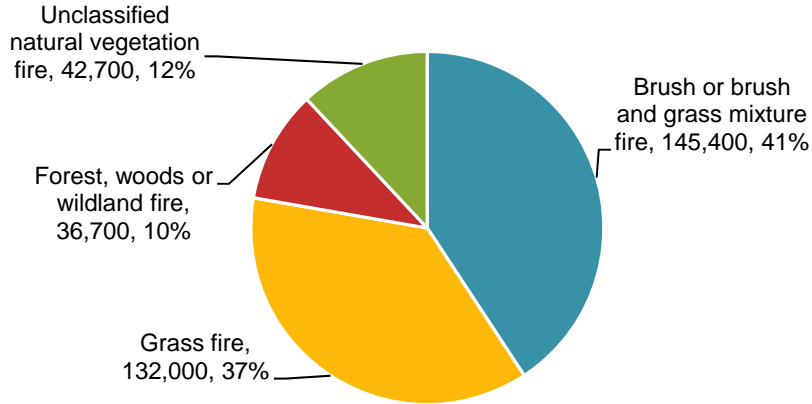
## Data Sources, Definitions and Conventions Used in this Report

Unless otherwise specified, the statistics in this analysis are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. These estimates are projections based on the detailed information collected in Version 5.0 of the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS 5.0) and the National Fire Protection Association's (NFPA's) annual fire department experience survey. Except for property use and incident type, fires with unknown or unreported data were allocated proportionally in calculations of national estimates.

NFIRS incident type codes 140-143 capture natural vegetation fires, including forest, grass, and brush or brush and grass mixture fires. "Natural vegetation fires" is a term to describe brush, grass, or forest fires regardless of their causes. Unclassified natural vegetation fires are included in the totals, but no further analysis was done of these incidents. Percentages calculated from the details in NFIRS 5.0 were applied to projections derived from NFPA's survey. In most of the national estimates (except property use and incident type), fires with missing or unknown data were allocated proportionally among fires with known data. Appendix C describes the methodology used. Tables supporting the text are provided at the end of this analysis.

Although one NFIRS incident type in this study captures forest, woods, or wildland fires, it does not capture all the losses associated with wildland fires in the same way that the media, land management organizations and the National Interagency Fire Center (NIFC) do. If a vegetation fire spreads to structures or vehicles, these structures and vehicle fires would be captured in NFIRS *as* structure and vehicle fires, *not as* wildland fires. NFPA collects reports from local fire departments on firefighter fatalities, large-loss fires, and multiple death fires. In these studies, the term "wildland fire" is consistent with the use by the other agencies. NFPA's national estimates use the NFIRS data and definitions.

**Figure 1. Brush, Grass and Forest Fires by Incident Type  
2004-2008 Annual Averages**



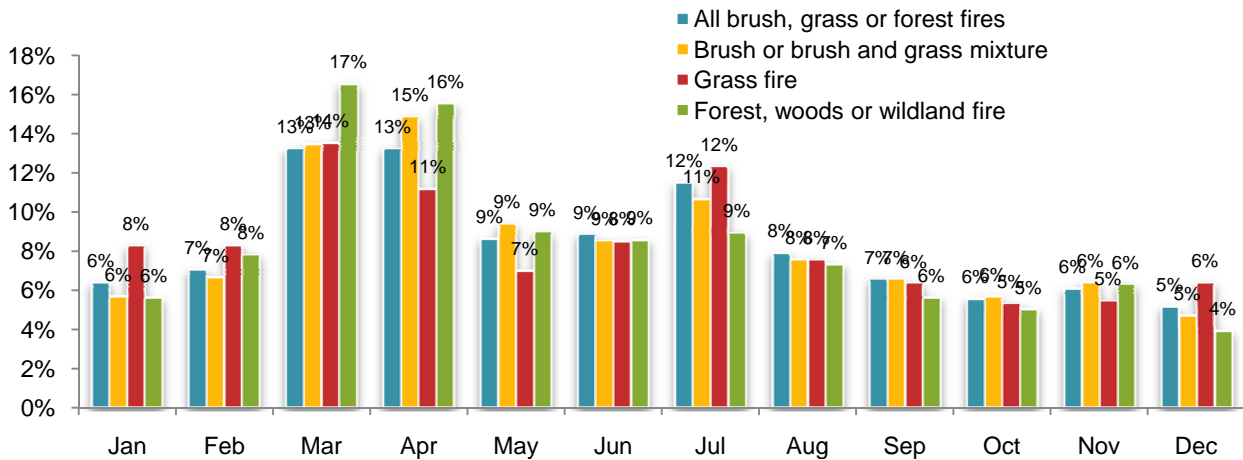
Source: NFIRS 5.0 and NFPA survey.

**Local fire department responses to natural vegetation fires peak in March and April.**

Figure 2 and Table 1 show that local responses to total forest, brush and grass fires, fires in forests, woods or wildlands; and brush or brush and grass mixture fires peaked in March and April. Grass fires peaked in March. July ranked second and April was third.

An early spring peak is also seen for reported incidents of non-hostile outdoor fires that may involve vegetation. The first graph in Appendix B shows that April was the peak month for incidents of controlled burning with a permit and of unauthorized burning.

**Figure 2.  
Local Fire Department Responses to Brush, Grass, and Forest Fires  
by Month of Alarm and Type of Fire  
2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

**Fourth of July was peak day for these fires.**

Although April was the peak month for these fires, Table A shows that July 4<sup>th</sup> had almost five times the daily average of 976 forest, brush or grass fires. July 5<sup>th</sup> ranked second and July 3<sup>rd</sup> was fourth. July 4<sup>th</sup>, 5<sup>th</sup> and 3<sup>rd</sup> are the peak days for fireworks-related fires of all types.<sup>3</sup>

Two clusters of days in March and April rounded out the top ten peak days for brush, grass and forest fires.

**Table A.**  
**Peak Days for Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**2004-2008 Annual Averages**

	<b>Date</b>	<b>Fires</b>	
1.	July 4	4,700	(1.3%)
2.	July 5	2,600	(0.7%)
3.	March 12	2,400	(0.7%)
4.	July 3	2,300	(0.7%)
5.	April 16	2,300	(0.7%)
6.	April 19	2,200	(0.6%)
7.	April 18	2,200	(0.6%)
8.	April 17	2,200	(0.6%)
9.	March 13	2,100	(0.6%)
10.	April 15	2,100	(0.6%)

Source: NFIRS 5.0 and NFPA survey.

**Saturday was peak day for natural vegetation fires.**

Table 2 shows that Saturday was the peak day for these fires. Sunday ranked second. It is likely that these are peak days to be engaging in outside activities.

Figure 3 and Table 3 show that these fires peak between noon and 6:00 p.m. The second graph in Appendix B shows that fire department responses to incidents of controlled burning with a permit and of unauthorized burning both peak between 6:00 and 9:00 p.m.

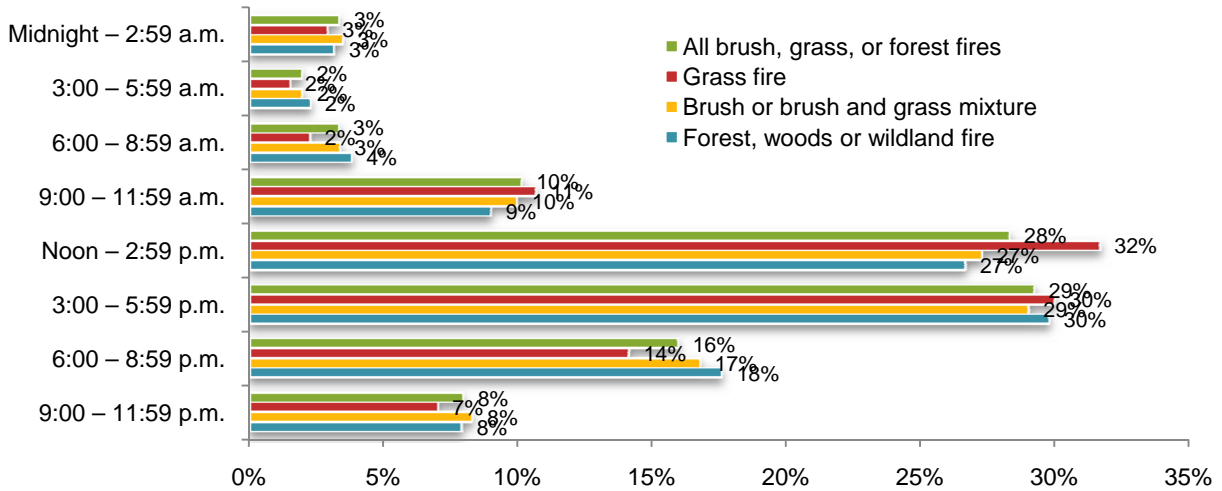
**Nine percent of these fires occurred at one-or two-family homes.**

Figure 4 and Table 4 show that roughly four of every ten natural vegetation fires occurred on properties described as open land or fields. For brush or brush and grass mixture fires and grass fires, the second most common property use mentioned was highway, street, or parking area; one-or two-family homes ranked third. Forests, timberland, or woodland ranked second among the forest, woods, or wildland fires. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself. Many of the property uses are not completely distinct. A home may be on open or cared-for land. Also, some property types are more common than others.

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<sup>3</sup> John R. Hall, Jr. *Fireworks*, Quincy, MA: National Fire Protection Association, 2010, p.19.

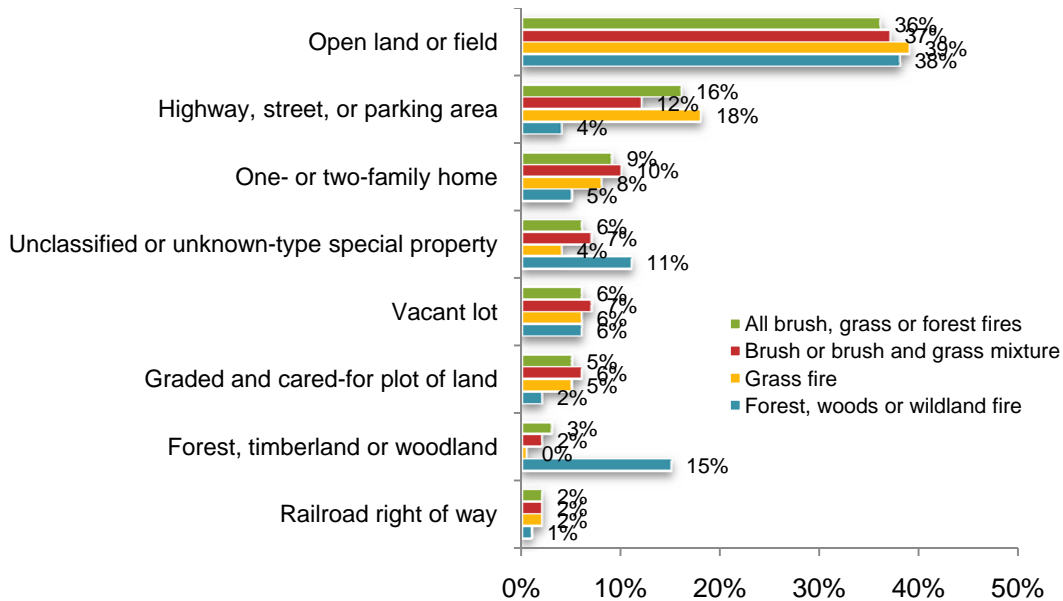
**Figure 3.**  
**Local Fire Department Responses to Brush, Grass and Forest Fires**  
**by Alarm Time and Type of Fire**  
**2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

During this period, heavy or light vegetation was the item first ignited in an average of 4,800 reported home *structure* fires per year.

**Figure 4.**  
**Local Fire Department Responses to Brush, Grass and Forest Fires**  
**by Property Use and Type of Fire**  
**2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

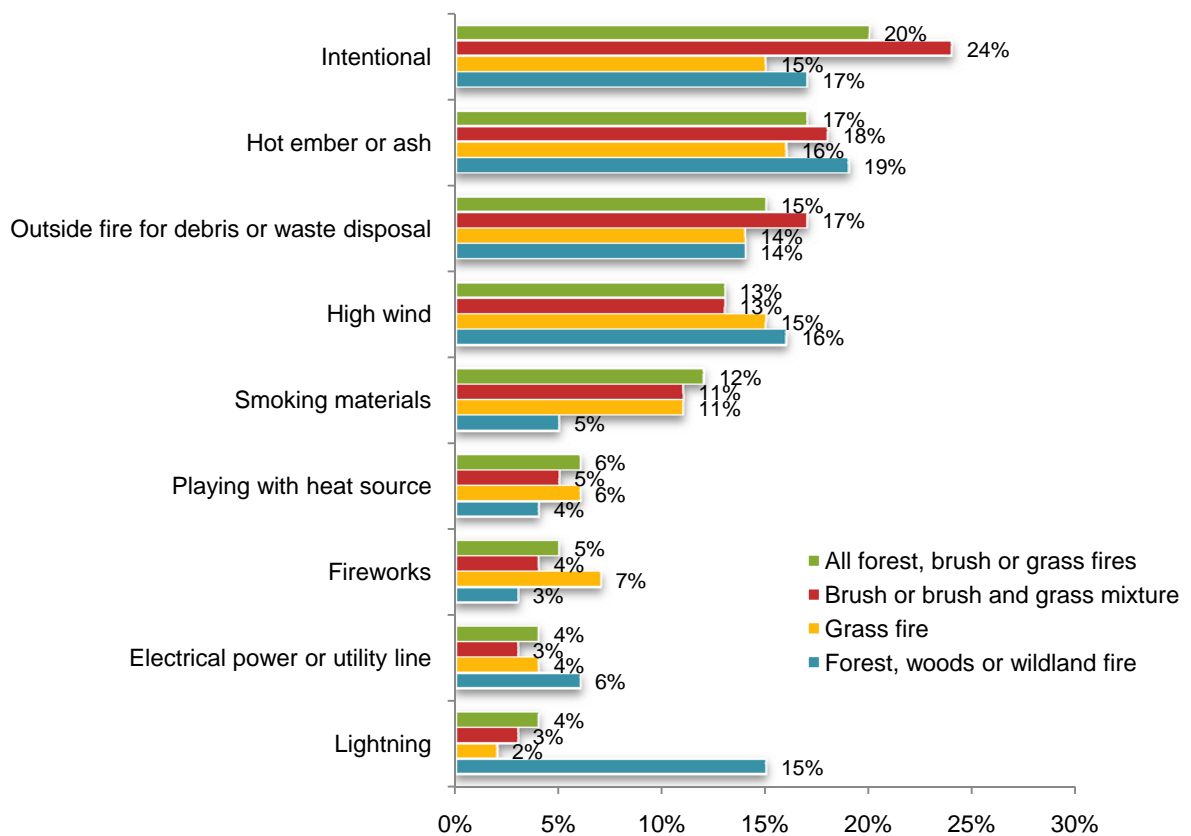


Only 1% of the forest timberland or woodland fires and 2% of the fires in other categories occurred in railroad rights of way. On average, 5,500 forest, brush, or grass fires were reported on railroad rights of way per year. During 2004-2007, U.S. railroads owned an average of 209,250 miles of track.<sup>4</sup> On average, 26 forest, brush, or grass fires at railroad rights of way were reported per 1,000 miles of track.

**One in every five reported brush, grass, or forest fires was intentionally set.**

Figure 5 shows the leading causes of brush, grass and forest fires with data summarized from several NFIRS fields. For some information, the equipment involved in ignition is most relevant; heat source, the field “cause of ignition,” and factor contributing to ignition also provide relevant information. Because the causes are pulled from different NFIRS fields, they are not mutually exclusive.

**Figure 5.**  
**Local Fire Department Responses to Brush, Grass, or Forest Fires**  
**by Major Cause and Type of Fire**  
**2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

<sup>4</sup> U.S. Census Bureau. Table 1085, "Railroads, Class I -- Summary: 1990 to 2005," *Statistical Abstract of the United States: 2010* (129th Edition), Washington, DC. 2009. Includes estimate for Class II and III railroads.

The leading causes of all reported brush, grass and forest fires were: intentional (20%), hot embers or ashes (17%), outside fires for debris or waste disposal (15%), high wind (13%), smoking materials (12%), playing with heat source (6%), fireworks (5%), electrical power or utility lines (4%), and lightning (4%). The cause profile varies by type of fire and type of material first ignited. Lightning caused 15% of the forest fires but only 4% of these fires overall. While high wind is not a heat source, wind can cause non-hostile fires such as campfires or fires for open burning, to spread out of control.

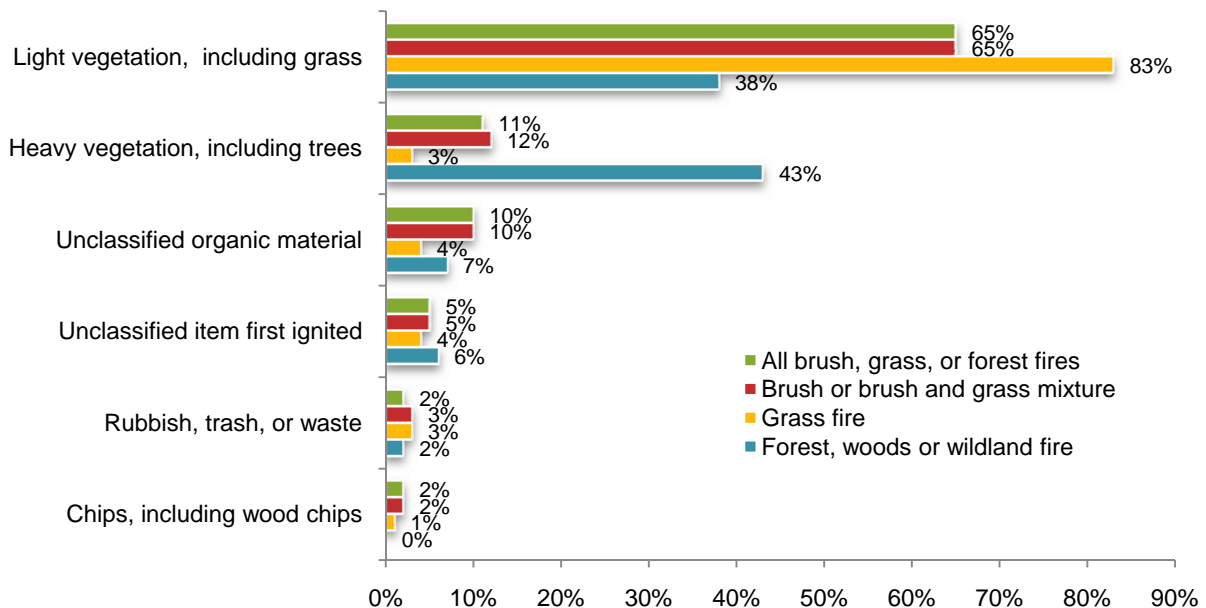
*Place cigarette butts in metal containers. Do not throw them on the ground or into vegetation.*

The broad categories of cause of ignition, a field in NFIRS 5.0, are shown in Table 5. Factors contributing to ignition are shown in Table 6. Table 7 shows more information on heat sources. More detailed information on equipment involved in ignition may be found in Table 8.

**Almost two-thirds of these fires began with light vegetation.**

Figure 6 and Table 9 show that 83% of grass fires, 65% of brush or brush and grass mixture fires, and 38% of forest, woods or wildland fires begin with light vegetation, including grass, leaves, needles, chaff, mulch and compost. Not surprisingly, 43% of forest, woods, or wildland fires start with heavy vegetation, including trees.

**Figure 6.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Item First Ignited and Type of Fire**  
**2004-2008**



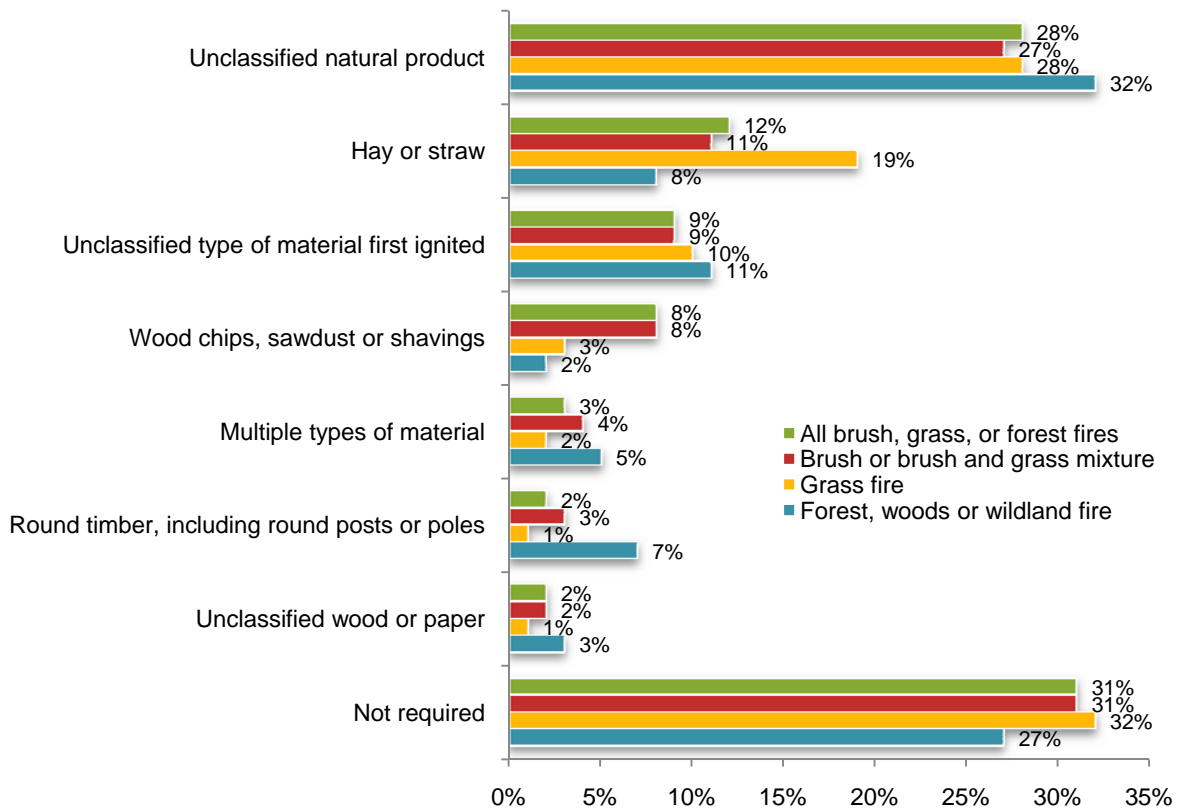
Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

**Hay or straw, and wood chips, sawdust, or shavings were the leading specific types of material first ignited.**

In NFIRS 5.0, the type of material ignited, or what the item first ignited is made from, is not required for certain items, including vegetation. However, it is sometimes completed even when not required. In 27-32% of the brush, grass, and forest fires, it was not required and not completed.

Table 10 and Figure 7 show that an unclassified natural product was first ignited in one-quarter to one-third of these fires. Hay or straw was first ignited in 19% of the grass fires and 8-12% of the remaining categories. Wood chips, sawdust, or shavings were first ignited in 8% of the brush or brush and grass mixture and of total forest, brush, or grass fires.<sup>5</sup>

**Figure 7.**  
**Local Fire Department Responses to Forest, Brush, and Grass Fires**  
**by Type of Material First Ignited and Type of Fire**  
**2004-2008 Annual Averages**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

<sup>5</sup> Because NFIRS 5.0 does not require that the type of material first ignited be completed in fires in which item first ignited is some type of vegetation, the estimates shown in Tables 11 A and B should be considered underestimates.

### **Mulch fires are attracting increased attention.**

As more homes and businesses ban indoor smoking, a larger share of smoking is done outside. Too often, the discarded cigarettes end up in the landscaping mulch, leaves, or vegetation. In a 2008 article, Mark Finucane wrote that the Johnston City, Tennessee Fire Department responds to an average of 100 mulch fires per year. He noted that the burning mulch was sometimes right next to a commercial or residential building. The burning mulch can ignite the underside of the structure's siding and spread into the structure. Large piles of mulch can spontaneously ignite.<sup>6</sup>

On May 26, 2010, the Massachusetts Department of Fire Services issued a press release encouraging people to keep smoking materials out of bark mulch. They noted that in the past five years, Massachusetts had 184 fires that began with mulch but spread to buildings. A 2008 Massachusetts fire caused \$5 million in damage to a sprinklered apartment building. Thirty-six residents were permanently displaced.<sup>7</sup>

In a 2003 article, Steward, Sydnor, and Bishop reported on their findings about how easily 13 landscape mulches were ignited by cigarettes, matches, and a propane torch.<sup>8</sup> Ground recycled pallets, composted yard waste, and shredded pine bark were most easily ignited by cigarettes. Decorative ground rubber, pine straw, and oat straw were the most easily ignited by the propane torch. They did not find statistically significant differences in tests with matches. The authors also noted that weathering increased the ignitability of some mulches and decreased others.

In their 2007 paper on mulch flammability, Wayne Zipperer and his colleagues noted that other factors, such as how long the item burns, how much heat is produced, and how much of the fuel is consumed, are also important.<sup>9</sup> They studied four different mulches: pine straw, shredded cypress wood and bark, small pine bark chunks, and large pine bark chunks under laboratory and field conditions. They found the pine straw was easiest to ignite. The large pine bark and pine straw had produced large amounts of heat and had high rates of consumption. However, the pine straw burned for the shortest length of time. The authors note:

“Each one of the tested mulches burned and none are 100% safe. Mulch should not be used next to flammable material or vinyl surfaces on buildings...Only decorative gravel or stones or some other non-flammable material should be used immediately adjacent to the home...”

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<sup>6</sup> Mark J. Finucane. “Combating and Preventing Mulch Fires,” *Fire Engineering*, 161 (3) 139-140+, March 2008.

<sup>7</sup> Jennifer Mieth, contact for Commonwealth of Massachusetts Department of Fire Services, “Keep Smoking Material Out of Bark Mulch,” May 26, 2010, accessed at [http://www.mass.gov/Eeops/docs/dfs/news/press/20100526\\_mulch\\_fires.pdf](http://www.mass.gov/Eeops/docs/dfs/news/press/20100526_mulch_fires.pdf) on July 28, 2010.

<sup>8</sup> Larry G. Steward, T.Davis Sydnor, and Bert Bishop. “The Ease of Ignition of 13 Landscape Mulches,” *Journal of Arboriculture* 26 (6): 317-320, November 2003.

<sup>9</sup> Wayne Zipperer, Alan Long, Brian Hinton, Alexander Maranghides, and William Mell. “Mulch Flammability,” *Proceedings of Emerging Issues along Urban-Rural Interfaces II: Linking Land-Use Science and Society*: 192-195, 2007.

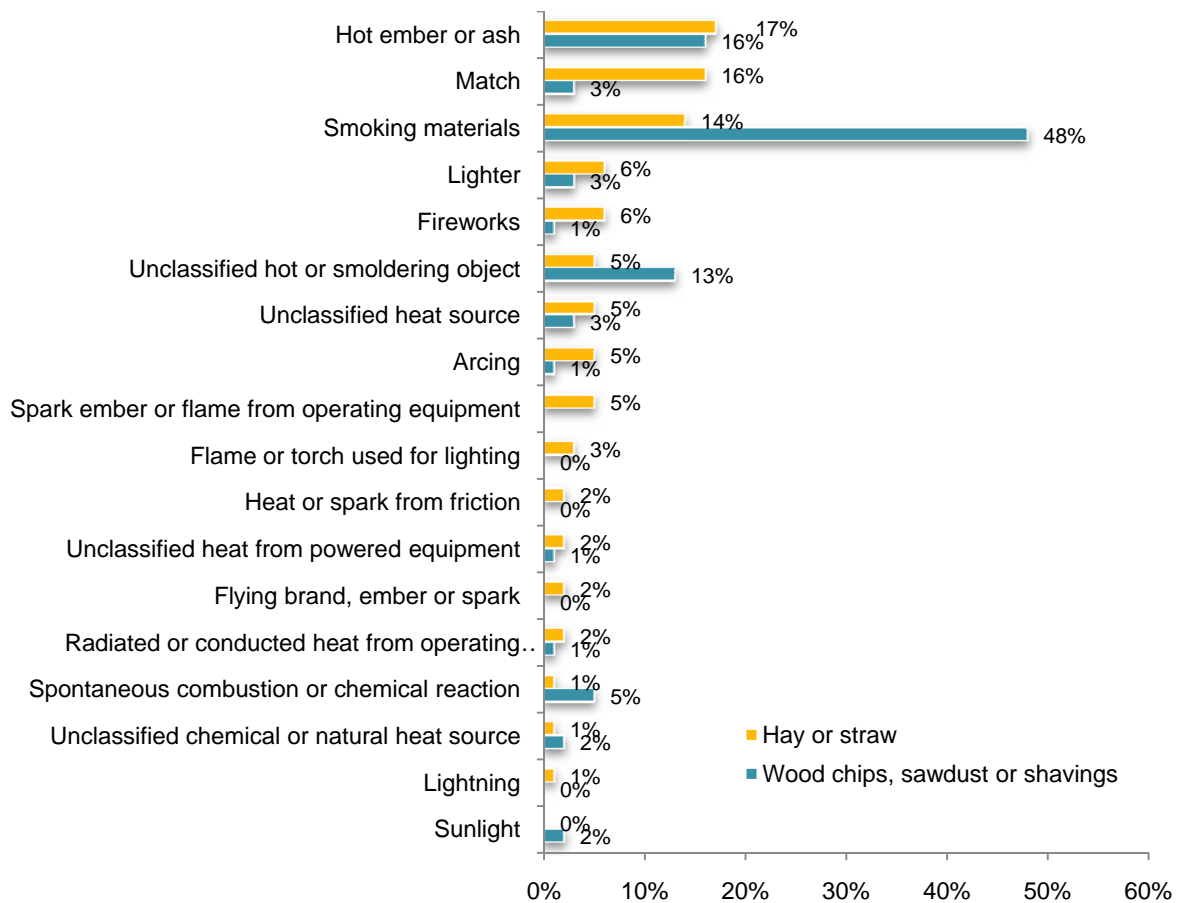
**Smoking materials started roughly half of all forest, brush or grass fires beginning with wood chips, sawdust, or shavings.**

Unfortunately, NFIRS does not specifically identify mulch. Some are probably captured as unclassified natural products, the leading type of material first ignited in these fires.

Unfortunately, that category is not specific enough to provide much useful information. An analysis of heat sources in brush, grass and forest fires beginning with two types of material that could be mulch - a) wood chips, sawdust, and shavings; and b) hay or straw - found that the first group was more likely to have been ignited by smoking materials.

Figure 8 and Table 11A show that smoking materials were the heat source in 48% of the brush or brush and grass mixture fires that began with wood chips, sawdust, or shavings. Table 7A shows that this is four times the 12% of all forest, brush, or grass fires started by smoking materials. Hot embers or ashes were common sources for both hay or straw and wood chips. Matches were more common sources of fires beginning with hay or straw.

**Figure 8.  
Local Fire Department Responses to Brush, Grass, or Forest Fires  
That Began with Wood Chips, Sawdust, or Shavings  
Compared to Fires that Began with Hay or Straw  
2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass, or forest fires” but not shown separately.

*Keep at least 18 inches between mulch beds and building materials that can burn.*

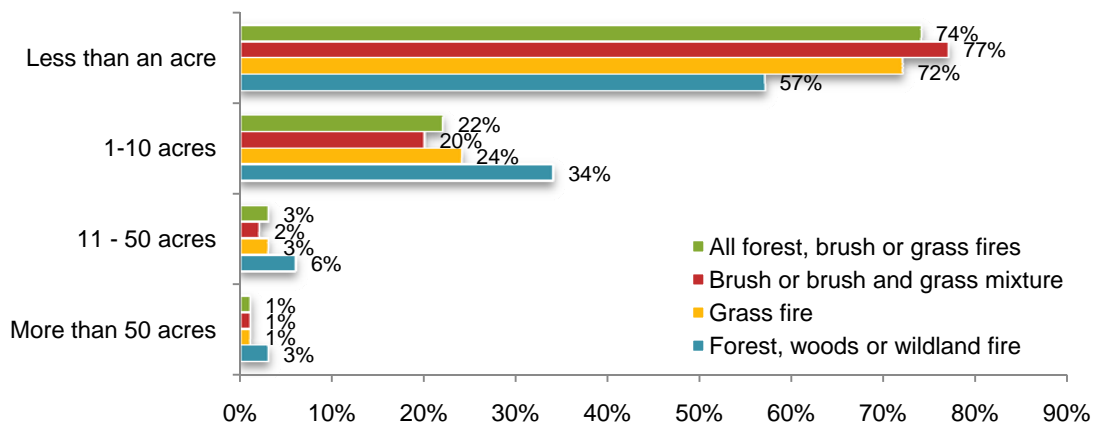
In general, fires starting with hay or straw were more likely than wood chips, sawdust or shavings to have had a flaming ignition source such as matches (16% vs. 3%), lighters, (6% vs. 3%), and fireworks (6% vs. 1%). Arcing was also a more frequent heat source in hay or straw fires (5% vs. 1%). Smoking materials were already discussed. An unclassified hot or smoldering object was the heat source in only 5% of the hay or straw fires compared to 13% of the wood chips, sawdust or shavings fires.

The Virginia Department of Forestry published a pamphlet<sup>10</sup> that addresses mulch fires. They advise keeping at least 18 inches between mulch beds and combustible building materials. Receptacles for smoking materials should be provided and used. The mulch should be kept moist, if possible.

**Unlike the wildland fires that make the news, three-quarters of brush, grass, and forest fires handled by local fire departments burned less than an acre.**

Figure 9 and Table 12 show that 57% of forest, woods, or wildland fires and 72-77% of the remaining types of fires consumed less than one acre. Nine percent of the forest, wildland, or wood fires consumed more than ten acres compared to 3-4% of the remaining types of fires.

**Figure 9.**  
**Local Fire Department Responses to Natural Vegetation Fires**  
**by Acres Burned and Type of Fire**  
**2004-2008 Annual Averages**



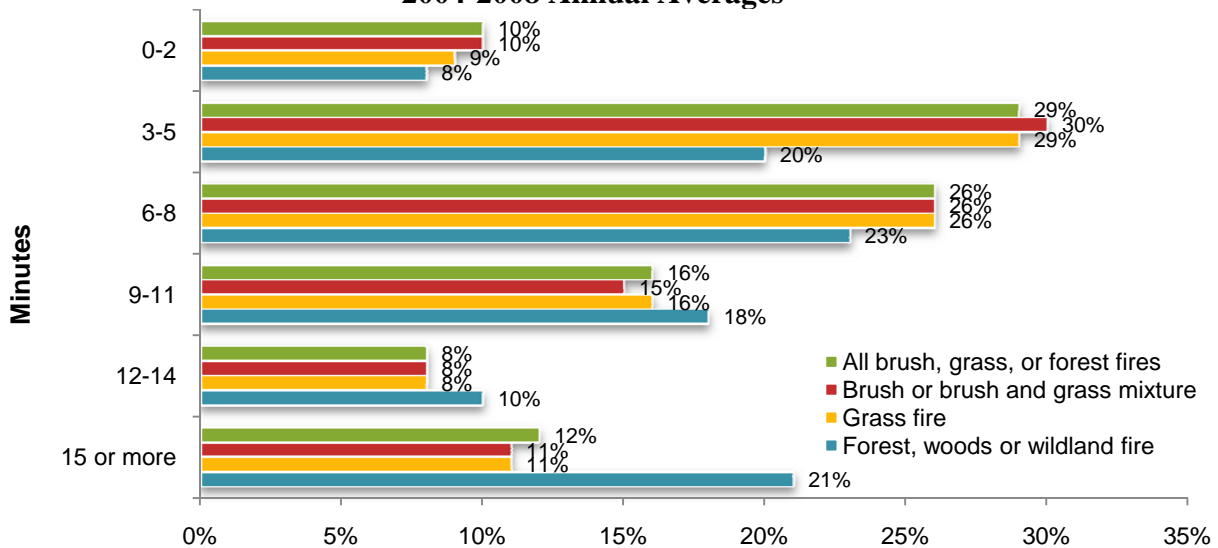
Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

<sup>10</sup> Virginia Department of Forestry. "Mulch Fires: A Serious Threat to your Home, Property and Family," available at <http://www.dof.virginia.gov/fire/resources/pub-Mulch-Fires.pdf>.

**Response time was often greater for forest fires than for brush or grass fires.**

One reason that forest, woods, or wildland fires were likely to grow larger than other vegetation fires is that the response time tended to be longer. Figure 10 shows that it took local fire departments 15 minutes or more to reach 21% of the forest, woods or wildland fires. For the other categories of natural vegetation fires, only 11-12% of the responses took that long. Also, only 28% of forest, woods, or wildland fires were reached within five minutes, compared to 38-40% of other categories of natural vegetation fires.

**Figure 10.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Response Time and Type of Fire**  
**2004-2008 Annual Averages**



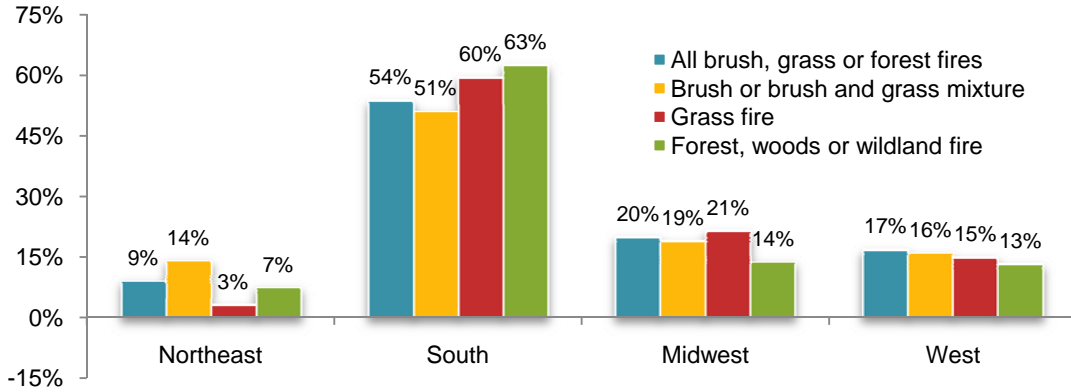
Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

**Southern fire departments responded to the majority of U.S. brush, grass, and forest fires.**

While most of the wildland fires in the news occur in the West, Figure 11 and Table 13 show that fire departments in the South made 54% of all local fire department responses to brush, grass and forest fires were to fires. The Midwest ranked second.

Local fire departments in the Northeast had the smallest percentages of all types of reported brush, grass, or forest fires. The distribution of fires in the Northeast was also different. Fires involving brush or brush and grass mixtures accounted for almost two-thirds (64%) of the brush, grass or forest fire responses in the region, compared to 38% in the South, Midwest, and West. Fires involving grass only accounted for only 12% of these fires in the Northeast compared to 33% to 41% in the other three regions. These percentages were calculated from the data in Table 13 but are not shown. Figure 12 shows the states that are in each census region. The Northeast is the smallest in area.

**Figure 11.**  
**Local Fire Department Responses to Natural Vegetation Fires**  
**by Census Region and Type of Fire**  
**2004-2008**



Source: NFIRS 5.0 and NFPA survey. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

**Figure 12. Census Regions**

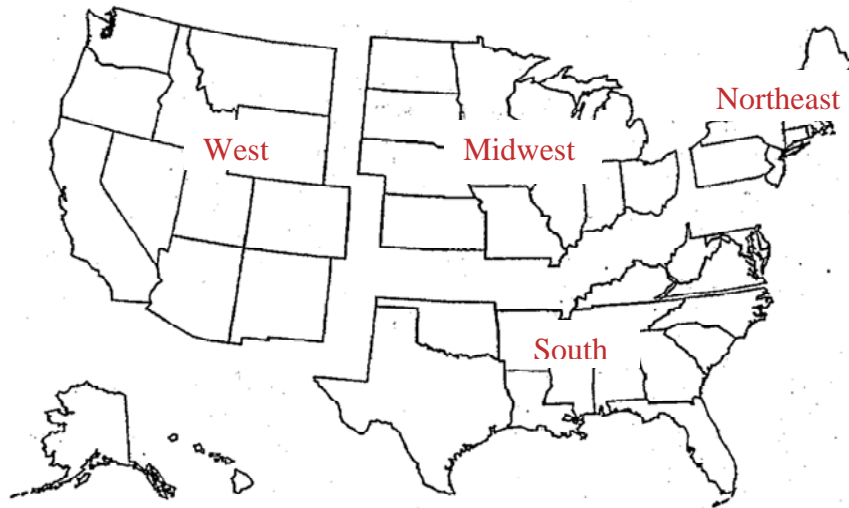


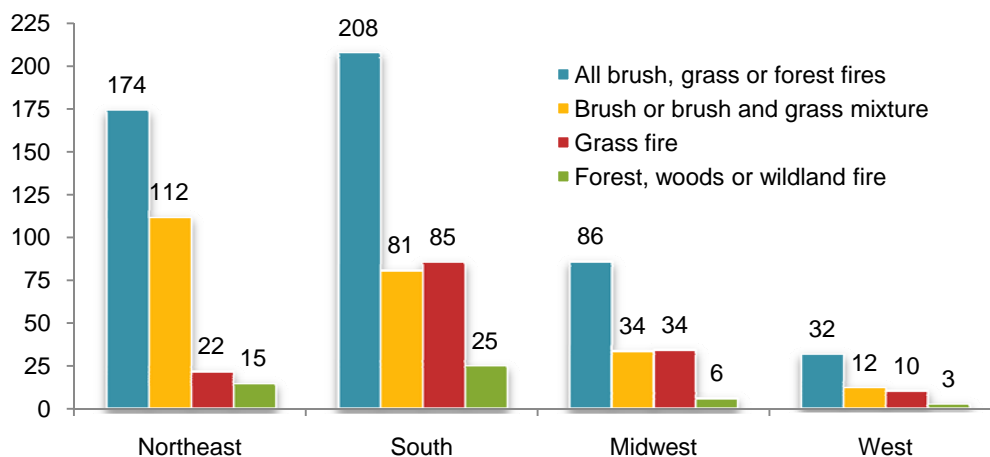
Figure 13 and Table 14 show that the South also had the highest rate of total brush, grass, and forest fires per 1,000 square miles overall as well as the highest rate for grass and forest fires specifically. The Northeast ranked second overall but led the country in the rate of brush or brush and grass mixtures. Local fire departments in the West had the lowest rate for all the fire categories studied. This may seem counterintuitive. However, large parts of the West are not protected by local fire departments.



**Almost half of the privately owned U.S. forested land is in the South.**

The National Atlas reports that the U.S. federal government owns almost 30% of the land area in the country. Their map of Federal Lands and Indian Reservations shows that most federally owned lands are in the Western region.<sup>11</sup> Table B shows that 80% of the forested land owned by federal or state government is located in the West.<sup>12</sup> Federal agencies such as the U.S. Bureau of Land Management, the Bureau of Indian Affairs, the Fish and Wildlife Service, the National Park Service, and the Forest Service handle fires on their own properties. State Forest Services also maintain firefighting crews. In many cases, homes or communities abut these lands. Fire in one jurisdiction can spread to others. Federal and state agencies may also provide assistance when local fire departments need help fighting larger brush, grass or forest fires in their jurisdictions.

**Figure 13.**  
**Local Fire Department Responses to Natural Vegetation Fires**  
**Per 1,000 Square Miles by Census Region and Type of Fire**  
**2004-2008**



Sources: NFIRS 5.0 and NFPA survey and “Land and Water Area of States, 2000, (in square miles), accessed at <http://www.infoplease.com/ipa/A0108355.html> on July 29, 2010. Unclassified natural vegetation fires are included in “all brush, grass or forest fires” but not shown separately.

Local fire departments are less likely to be involved in firefighting on federal properties and state parks and more likely to be fighting fires on private property or land owned by the municipality or county. Forty-six percent of the forested land owned privately or by county or municipal

<sup>11</sup> National Atlas.gov. “Federal Lands and Indian Reservations” accessed at <http://www.nationalatlas.gov/printable/fedlands.html#us> on July 28, 2010.

<sup>12</sup> W. Brad Smith, Patrick D. Miles, Charles H. Perry, Scott A. Pugh. Table 2. “Forest Land Area in the United States by Ownership, Region, Subregion, and State, 2007” in *Forest Resources of the United States, 2007*, Gen. Tech. Rep. WO-78, Washington, DC: U.S. Department of Agriculture, Forest Service, 2009. State data were summed to obtain totals for each census region as the report uses a different regional grouping. Properties owned by Indian tribes are considered private property.

governments were in the South. The Northeast had the smallest amount of forested land in all categories of ownership.

**Table B.**  
**Forest Land Area in the US in 2007 by Census Region and Ownership**  
**Expressed in Million Acres**

<b>Region</b>	<b>Federal and State</b>	<b>County and Municipal</b>	<b>Private</b>	<b>Total Forested Acres</b>	<b>Private plus County and Municipal</b>
Northeast	12.5 (4%)	1.9 (17%)	55.4 (13%)	69.8 (9%)	57.3 (13%)
South	28.6 (9%)	2.3 (21%)	198.7 (47%)	229.6 (31%)	201.0 (46%)
Midwest	23.4 (7%)	5.6 (51%)	64.0 (15%)	93.0 (12%)	69.6 (16%)
West	252.7 (80%)	1.1 (10%)	104.9 (25%)	358.8 (48%)	106.0 (24%)
Total	317.2 (100%)	11.0 (100%)	423.0 (100%)	751.2 (100%)	434.0 (100%)

Source: Smith, Miles, Perry and Pugh, U.S. Forest Service, 2009.

## Wildland Fire Statistics from the National Interagency Fire Center

### State and federal agencies handle some vegetation or wildland fires independently and assist local departments with others.

Information on federal and state wildland firefighting activities may be found at the National Interagency Fire Center's (NIFC's) web site, <http://www.nifc.gov/>. An unknown portion of the fires included in their statistics were also handled by local fire departments and are also counted in NFPA's estimates. At present, the different data collections systems are independent and it is not possible to confidently connect them. Statistics for Figures 14-17<sup>13</sup> are independent of statistics presented elsewhere in this analysis.

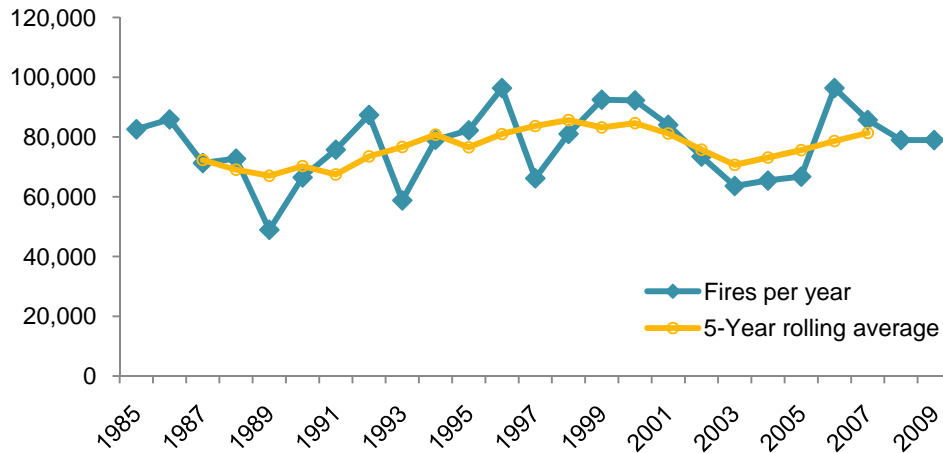
### Wildland fire agencies handled roughly 79,000 fires in 2009.

Figure 14 shows the number of wildland fires handled by federal or state wildland fire agencies since 1985. The total varied from a low of 48,900 in 1989 to highs of 96,400 in 1996 and 2006. In 2009, these agencies responded to 78,972 wildland fires that burned 5.9 million acres. In 2009, an average of 75 acres burned per wildland fire handled by these agencies.

The frequency and severity of these fires fluctuates from year to year. To identify trends, it is helpful to look at five year rolling averages, shown by the gold lines in Figures 14-16. The first point, shown at 1987, is the average for 1985-1989. The next, shown at 1988, is the average for 1986-1990. The last point shown, at 2007, is the average for 2005-2009.

<sup>13</sup> National Interagency Fire Center. "Fire Information -- Wildland Fire Statistics," sourced to National Interagency Coordination Center. Accessed at [http://www.nifc.gov/fire\\_info/fire\\_stats.htm](http://www.nifc.gov/fire_info/fire_stats.htm) on July 28, 2010.

**Figure 14.**  
**Wildland Fires Handled by Wildland Fire Agencies, by Year**  
**1985-2009**

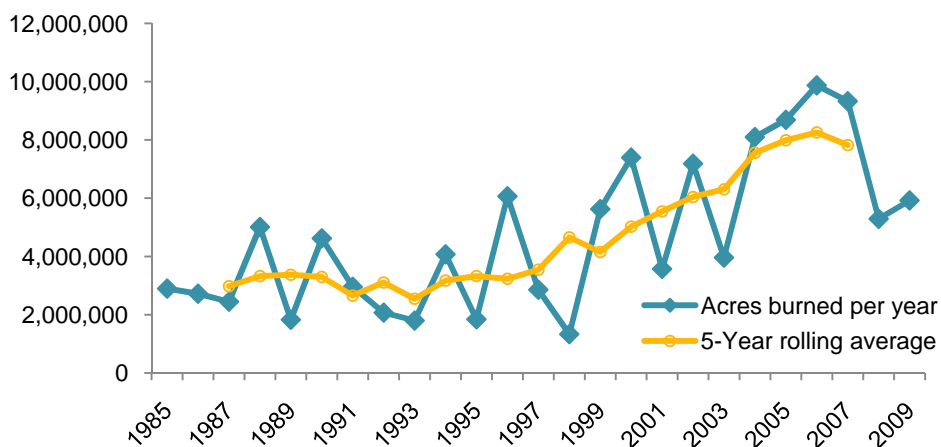


Source: National Interagency Coordination Center  
 2004 data does not include state lands for North Carolina.

**Acreage burned in these wildland fires peaked in 2004-2007.**

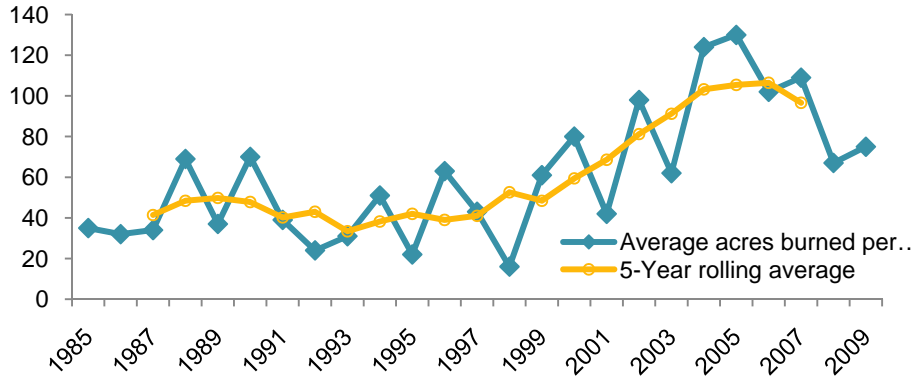
Figure 15 shows that the acreage burned in wildland fires handled by wildland fire agencies was higher in 2004-2007 than at any point since 1985. The rolling averages show a fairly steady increase from the late 1990s on, despite the smaller number of incidents in 2008 and 2009. Although the average number of acres burned per wildland fire handled by these agencies fluctuates greatly from year to year, Figure 16 shows that the five-year rolling average acres burned per wildland fire has generally been increasing in the past decade along with the total acreage burned.

**Figure 15.**  
**Acres Burned in Wildland Fires Handled by Wildland Fire Agencies, by Year**  
**1985-2009**



Source: National Interagency Coordination Center  
 2004 data does not include state lands for North Carolina.

**Figure 16.**  
**Average Number of Acres Burned in Wildland Fires**  
**Handled by Wildland Fire Agencies, by Year**  
**1985-2009**



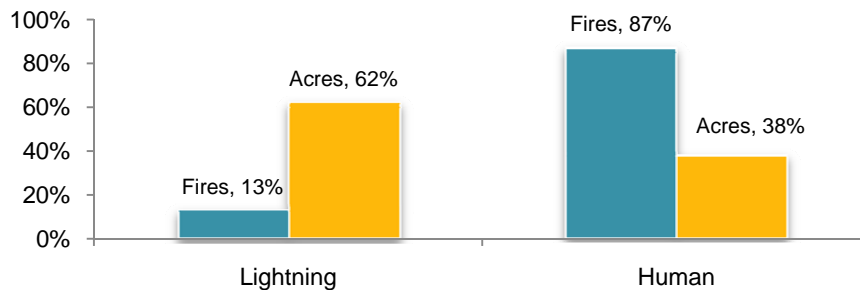
Source: National Interagency Coordination Center.  
 2004 data does not include state lands for North Carolina.

Taken together, the data suggests that it is the severity, rather than the frequency, of these fires, that is the major change.

**Fires started by lightning accounted for two-thirds of acres burned in 2005-2009 fires handled by wildland fire agencies.**

Thirteen percent of wildland fires handled by wildland fire agencies were started by lightning.<sup>14</sup> but Figure 17 shows that almost two-thirds (62%) of the burned wildland acres were consumed in these fires. The percentage of fires started by lightning is fairly consistent with the 2004-2008 percentage of local fire department responses to forest, woods, or wildland fires started by lightning discussed earlier.

**Figure 17.**  
**Human Caused vs. Lightning-Caused Wildland Fires**  
**Handled by Wildland Fire Agencies**  
**2005-2009**



Source: National Interagency Coordination Center.

<sup>14</sup> National Interagency Fire Center. "Fire Information -- Wildland Fire Statistics," sourced to National Interagency Coordination Center. Accessed at [http://www.nifc.gov/fire\\_info/lightning\\_human\\_fires.html](http://www.nifc.gov/fire_info/lightning_human_fires.html) on July 28, 2010.

## **Firefighter Fatalities at Forest, Brush, or Grass Fires**

**On average, 18 firefighters per year were fatally injured by wildland or prescribed fires.**

NFPA maintains a census of firefighter fatalities. From 1999 through 2008, 180, or 18% of the 1,007 firefighter fatalities (excluding the firefighters killed at the World Trade Center on September 11, 2001) died as a result of wildland fires, defined here as forest, brush or grass fires, and prescribed fires.<sup>15</sup> Eleven of the 180 deaths resulted from nine prescribed fires while 169 were related to 124 wildfires. More than half (57%) of the fatal firefighter injuries associated with wildland or prescribed fires occurred on the fire ground. Fifty-four percent of these victims were associated with federal or state land management agencies. Almost half were associated with local fire departments, including 40% who were volunteers and 6% who had been career firefighters.

More than one-quarter (28%) of all fire ground firefighter fatalities resulted from wildland or prescribed fires.

## **Prevention of and Protection from Brush, Grass, and Forest Fires**

Prevention strategies are relatively easy to identify for some of the fire causes. Be sure that smoking materials are disposed of properly in fire-resistant containers. Provide metal containers for cigarette disposal to prevent them from being tossed on the ground. If you have a campfire, fire for waste disposal, or bonfire, be sure it is completely out. Avoid outside fires on windy days. Leave fireworks to the professionals. Keep matches and lighters away from children. Preventing deliberate, malicious fires is far more challenging. When dealing with human beings, it is easier to say what should be done than to ensure that the procedures are always followed.

Sometimes, a fire will start in spite of efforts to prevent ignition. To prevent a fire from damaging your home or spreading, reduce the available fuel on and around the home. In particular, keep plants that burn fast and hot away from the structure. Get rid of dead branches, leaves, brush and tree limbs that hang over your home. Use gravel or some other non-combustible material next to the building instead of an organic mulch. Ensure the home itself is as ignition-resistant as possible by choosing non-flammable roofing, fire-resistant siding, screened or ember-resistant vents, and attachments (fences, decks, porches) that are fire-resistant or modified to keep from carrying fire to the main structure.

### **Protecting your home from a landscape fire can also help protect against carpenter ants and crime.**

Entomologist Mike Potter of University of Kentucky College of Agriculture offers a number of tips to prevent carpenter ant problems. Several sound similar to strategies to protect against fire spread. Among them are:

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<sup>15</sup> Rita F. Fahy. *Wildland Firefighter Fatalities, 1999-2008*: Quincy, MA: National Fire Protection Association, July 2009.

- “Eliminate wood-to-ground contact such as where landscaping has moved soil or mulch up against the wood siding of a home.
- Clip back tree limbs and vegetation touching the roof or siding of the house. Limbs and branches serve as "bridges" between carpenter ants nesting in a dead tree limb and the structure.
- Stack firewood away from the foundation...”<sup>16</sup>

It is also possible to reduce the fire threat while increasing the security of your home. In their information on crime prevention through environmental design, the Seattle Police Department recommends a maximum height of three feet for hedges and a minimum height of eight feet for tree canopies, particularly in areas close to doors and windows. This approach provides fewer hiding places.<sup>17</sup> Eliminating lower branches makes it less likely that fire that starts on the ground will spread into the tree canopy.

These techniques reduce the fuel and the path for fire to spread into your home.

Many of us would like to have a more natural yard to make our lands more attractive to birds and pollinators. It is important to remember fire safety in the process.

## Safety Tips

- Place cigarette butts in metal containers. Do *not* throw them on the ground or into vegetation.
- Keep at least 18 inches between mulch beds and building materials that can burn.
- Follow the instructions at [www.firewise.org](http://www.firewise.org) to make your home and landscaping more resistant to fire.
- Call the local fire department or municipality before outdoor or open air burning. This includes campfires, brush fires, fire pits, chimineas, and outdoor fireplaces. You may not be permitted to do outdoor burning in some municipalities and during some seasons. Closely attend all outdoor fires. Be sure to put out the fire completely before leaving.
- Avoid burning on windy, dry days. When conditions are windy or dry, it is too easy for open burning to spread out of control.
- Do not use gasoline or other flammable or combustible liquids to burn brush, trash, or other waste.

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<sup>16</sup> Mike Potter. "Carpenter Ants" University of Kentucky College of Agriculture, ENTFACT-603, accessed at <http://www.ca.uky.edu/entomology/entfacts/ef603.asp> on July 22, 2010.

<sup>17</sup> Seattle Police Department. "Crime Prevention through Environmental Design," accessed at <http://www.seattle.gov/police/prevention/Neighborhood/CPTED.htm> on July 22, 2010.

**Table 1.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Month and Type of Fire**  
**2004-2008 Annual Averages**

Month	Brush or Brush/ Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
January	8,200	(6%)	10,900	(8%)	2,100	(6%)	22,800	(6%)
February	9,700	(7%)	10,900	(8%)	2,900	(8%)	25,100	(7%)
March	19,500	(13%)	17,900	(14%)	6,100	(17%)	47,200	(13%)
April	21,600	(15%)	14,700	(11%)	5,700	(16%)	47,200	(13%)
May	13,600	(9%)	9,200	(7%)	3,300	(9%)	30,800	(9%)
June	12,400	(9%)	11,200	(8%)	3,100	(9%)	31,500	(9%)
July	15,500	(11%)	16,200	(12%)	3,300	(9%)	41,000	(12%)
August	11,000	(8%)	10,000	(8%)	2,700	(7%)	28,100	(8%)
September	9,500	(7%)	8,400	(6%)	2,100	(6%)	23,400	(7%)
October	8,200	(6%)	7,000	(5%)	1,800	(5%)	19,800	(6%)
November	9,300	(6%)	7,200	(5%)	2,300	(6%)	21,600	(6%)
December	6,800	(5%)	8,400	(6%)	1,400	(4%)	18,300	(5%)
Total	145,400	(100%)	132,000	(100%)	36,700	(100%)	356,800	(100%)
Average	12,100	(8%)	11,000	(8%)	3,100	(8%)	29,700	(8%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 2.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Day of Week and Type of Fire**  
**2004-2008 Annual Averages**

Day of Week	Brush or Brush/ Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Sunday	22,600	(16%)	19,900	(15%)	5,900	(16%)	55,000	(15%)
Monday	21,000	(14%)	19,200	(15%)	5,300	(14%)	51,600	(14%)
Tuesday	19,700	(14%)	18,300	(14%)	4,900	(13%)	48,700	(14%)
Wednesday	19,400	(13%)	17,800	(14%)	4,900	(13%)	48,000	(13%)
Thursday	18,900	(13%)	17,300	(13%)	4,800	(13%)	46,600	(13%)
Friday	19,600	(13%)	18,100	(14%)	4,900	(13%)	48,500	(14%)
Saturday	24,200	(17%)	21,400	(16%)	6,100	(17%)	58,300	(16%)
Total	145,400	(100%)	132,000	(100%)	36,700	(100%)	356,800	(100%)
Average	20,800	(14%)	18,900	(14%)	5,200	(14%)	51,000	(14%)

**Table 3.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Alarm Time and Type of Fire**  
**2004-2008 Annual Averages**

Alarm Time	Brush or Brush/ Grass Mixture		Grass		Forest, Woods or Wildland		Total, including Unclassified	
Midnight – 2:59 a.m.	5,000	(3%)	3,800	(3%)	1,100	(3%)	11,900	(3%)
3:00 – 5:59 a.m.	2,800	(2%)	2,000	(2%)	800	(2%)	6,900	(2%)
6:00 – 8:59 a.m.	4,900	(3%)	3,000	(2%)	1,400	(4%)	11,800	(3%)
9:00 – 11:59 a.m.	14,500	(10%)	14,100	(11%)	3,300	(9%)	36,100	(10%)
Noon – 2:59 p.m.	39,600	(27%)	41,800	(32%)	9,800	(27%)	100,900	(28%)
3:00 – 5:59 p.m.	42,200	(29%)	39,600	(30%)	10,900	(30%)	104,200	(29%)
6:00 – 8:59 p.m.	24,400	(17%)	18,600	(14%)	6,400	(18%)	56,900	(16%)
9:00 – 11:59 p.m.	12,000	(8%)	9,200	(7%)	2,900	(8%)	28,300	(8%)
Total	145,400	(100%)	132,000	(100%)	36,700	(100%)	356,800	(100%)
Average	18,200	(13%)	16,500	(13%)	4,600	(13%)	44,600	(13%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Unclassified vegetation fires are not shown separately.

Source: NFIRS 5.0 and NFPA survey.



**Table 4A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires, by Property Use**  
**2004-2008 Annual Averages**

<b>Property Use</b>	<b>Fires</b>	
<b>Outside or special property</b>	<b>254,600</b>	<b>(71%)</b>
<i>Open land, beach, or campsite</i>	<i>168,800</i>	<i>(47%)</i>
Open land or field	127,300	(36%)
Vacant lot	21,000	(6%)
Graded and cared-for plot of land	19,300	(5%)
<i>Highway, street, or parking area</i>	<i>51,600</i>	<i>(14%)</i>
Highway or divided highway	22,000	(6%)
Residential street, road or residential driveway	12,400	(3%)
Vehicle parking area	6,800	(2%)
Street or road in commercial area	3,900	(1%)
Unclassified street	6,600	(2%)
<i>Railroad area</i>	<i>6,600</i>	<i>(2%)</i>
Railroad right of way	5,500	(2%)
<i>Construction site, outdoor plant yard, pipeline, or oil or gas field</i>	<i>2,500</i>	<i>(1%)</i>
<i>Water area</i>	<i>2,000</i>	<i>(1%)</i>
<i>Unclassified special property</i>	<i>22,700</i>	<i>(6%)</i>
<b>Residential</b>	<b>39,300</b>	<b>(11%)</b>
<i>One- or two-family home</i>	<i>31,700</i>	<i>(9%)</i>
<i>Apartment or multi-family dwelling</i>	<i>3,200</i>	<i>(1%)</i>
<i>Unclassified residential</i>	<i>3,900</i>	<i>(1%)</i>
<b>Mercantile or business</b>	<b>6,700</b>	<b>(2%)</b>
<i>Office, bank or mail facility</i>	<i>2,000</i>	<i>(1%)</i>
<b>Industrial, utility, defense, agriculture or mining</b>	<b>17,700</b>	<b>(5%)</b>
<i>Forest, timberland or woodland</i>	<i>10,000</i>	<i>(3%)</i>
<i>Agriculture</i>	<i>5,300</i>	<i>(1%)</i>
Crop or orchard	2,800	(1%)
Livestock production	2,500	(1%)
<b>Public assembly</b>	<b>4,900</b>	<b>(1%)</b>
<b>Educational</b>	<b>1,800</b>	<b>(1%)</b>
<b>Other known property use</b>	<b>2,800</b>	<b>(1%)</b>
<b>Unclassified or unknown property use</b>	<b>29,000</b>	<b>(8%)</b>
<b>Total</b>	<b>356,800</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

**Table 4B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Property Use**  
**2004-2008 Annual Averages**

<b>Property Use</b>	<b>Fires</b>	
<b>Outside or special property</b>	<b>103,700</b>	<b>(71%)</b>
<i>Open land, beach, or campsite</i>	71,600	(49%)
Open land or field	53,100	(37%)
Vacant lot	9,700	(7%)
Graded and cared-for plots of land	8,300	(6%)
<i>Highway, street, or parking area</i>	17,500	(12%)
Highway or divided highway	5,600	(4%)
Residential street, road or residential driveway	5,000	(3%)
Vehicle parking area	3,200	(2%)
Unclassified street	2,200	(2%)
Street or road in commercial area	1,500	(1%)
<i>Unclassified special property</i>	9,500	(7%)
<i>Railroad area</i>	2,600	(2%)
Railroad right of way	2,500	(2%)
<i>Construction site, outdoor plant yard, pipeline, or oil or gas field</i>	1,100	(1%)
<i>Water area</i>	900	(1%)
<b>Residential</b>	<b>17,400</b>	<b>(12%)</b>
<i>One-or-two-family home</i>	14,100	(10%)
<i>Unclassified residential property</i>	1,600	(1%)
<i>Apartment or multi-family dwelling</i>	1,400	(1%)
<b>Industrial, utility, defense, agriculture, or mining</b>	<b>6,100</b>	<b>(4%)</b>
<i>Forest, timberland or woodland</i>	3,500	(2%)
<i>Agriculture</i>	1,800	(1%)
Crop or orchard	1,000	(1%)
Livestock production	800	(1%)
<b>Mercantile or business</b>	<b>3,000</b>	<b>(2%)</b>
<i>Office, bank or mail facility</i>	900	(1%)
<b>Public assembly</b>	<b>2,100</b>	<b>(1%)</b>
<b>Educational</b>	<b>800</b>	<b>(1%)</b>
<b>Other known property use</b>	<b>1,200</b>	<b>(1%)</b>
<b>Unclassified or unknown property use</b>	<b>11,100</b>	<b>(8%)</b>
<b>Total</b>	<b>145,400</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

**Table 4C.**  
**Local Fire Department Responses to Grass Fires**  
**by Property Use**  
**2004-2008 Annual Averages**

<b>Property Use</b>	<b>Fires</b>	
<b>Outside or special property</b>	<b>100,200</b>	<b>(76%)</b>
<i>Open land, beach, or campsite</i>	66,300	(50%)
Open land or field	52,100	(39%)
Vacant lot	7,600	(6%)
Graded and cared-for plot of land	6,300	(5%)
<i>Highway, street, or parking area</i>	24,300	(18%)
Highway or divided highway	14,300	(11%)
Residential street, road or residential driveway	4,600	(3%)
Unclassified street	2,900	(2%)
Street or road in commercial area	1,400	(1%)
Vehicle parking area	1,100	(1%)
<i>Unclassified special property</i>	5,500	(4%)
<i>Railroad area</i>	2,500	(2%)
Railroad right of way	2,400	(2%)
<i>Construction site, outdoor plant yard, pipeline, or oil or gas field</i>	900	(1%)
<b>Residential</b>	<b>12,500</b>	<b>(9%)</b>
<i>One- or two-family home</i>	10,300	(8%)
<i>Unclassified residential</i>	1,300	(1%)
<i>Apartment or multi-family dwelling</i>	700	(1%)
<b>Industrial, utility, defense, agriculture or mining</b>	<b>4,100</b>	<b>(3%)</b>
<i>Agriculture</i>	2,600	(2%)
Livestock production	1,400	(1%)
Crop or orchard	1,200	(1%)
<b>Mercantile or business</b>	<b>1,300</b>	<b>(1%)</b>
<b>Public assembly</b>	<b>1,200</b>	<b>(1%)</b>
<b>Other known property use</b>	<b>1,300</b>	<b>(1%)</b>
<b>Unclassified or unknown property use</b>	<b>11,400</b>	<b>(9%)</b>
<b>Total</b>	<b>132,000</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

**Table 4D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Property Use**  
**2004-2008 Annual Averages**

<b>Property Use</b>	<b>Fires</b>	
<b>Outside or special property</b>	<b>23,500</b>	<b>(64%)</b>
<i>Open land, beach, or campsite</i>	17,200	(47%)
Open land or field	14,100	(38%)
Vacant lot	2,100	(6%)
Graded and cared-for plots of land	900	(2%)
<i>Unclassified special property</i>	3,900	(11%)
<i>Highway, street, or parking area</i>	1,500	(4%)
Residential street, road or residential driveway	600	(2%)
Highway or divided highway	500	(1%)
Unclassified street	200	(1%)
<i>Construction site, outdoor plant yard, pipeline, or oil or gas field</i>	300	(1%)
Pipeline, power line or other utility right of way	200	(1%)
<i>Railroad area</i>	300	(1%)
Railroad right of way	300	(1%)
<i>Water area</i>	200	(1%)
<b>Industrial, utility, defense, agriculture, or mining</b>	<b>6,000</b>	<b>(16%)</b>
<i>Forest, timberland or woodland</i>	5,500	(15%)
<i>Agriculture</i>	300	(1%)
<b>Residential</b>	<b>2,400</b>	<b>(7%)</b>
<i>One- or two-family home</i>	1,900	(5%)
<i>Unclassified residential</i>	400	(1%)
<b>Public assembly</b>	<b>300</b>	<b>(1%)</b>
<b>Other known property use</b>	<b>400</b>	<b>(1%)</b>
<b>Unclassified or unknown property use</b>	<b>4,100</b>	<b>(11%)</b>
<b>Total</b>	<b>36,700</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Although these incidents were outside fires, in many cases, the property use was recorded for the structure on the property rather than the land itself.

Source: NFIRS 5.0 and NFPA survey.

**Table 5A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Cause of Ignition**  
**2004-2008 Annual Averages**

<b>Cause of Ignition</b>	<b>Fires</b>
Unintentional	174,300 (49%)
Intentional	70,600 (20%)
Unclassified	61,800 (17%)
Act of nature	28,200 (8%)
Failure of equipment or heat source	21,900 (6%)
Total	356,800 (100%)

**Table 5B.**  
**Local Fire Department Responses to Brush or Grass and Grass Mixture Fires**  
**by Cause of Ignition**  
**2004-2008 Annual Averages**

<b>Cause of Ignition</b>	<b>Fires</b>
Unintentional	68,100 (47%)
Intentional	35,000 (24%)
Unclassified	26,400 (18%)
Act of nature	9,200 (6%)
Failure of equipment or heat source	6,600 (5%)
Total	145,400 (100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the cause of ignition was unknown or not reported were allocated proportionally among fires of known cause of ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 5C.**  
**Local Fire Department Responses to Grass Fires**  
**by Cause of Ignition**  
**2004-2008 Annual Averages**

<b>Cause of Ignition</b>	<b>Fires</b>
Unintentional	70,600 (54%)
Unclassified	21,900 (17%)
Intentional	20,500 (15%)
Failure of equipment or heat source	12,100 (9%)
Act of nature	6,900 (5%)
Total	132,000 (100%)

**Table 5D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Cause of Ignition**  
**2004-2008 Annual Averages**

<b>Cause of Ignition</b>	<b>Fires</b>
Unintentional	15,000 (41%)
Act of nature	7,400 (20%)
Unclassified	6,600 (18%)
Intentional	6,200 (17%)
Failure of equipment or heat source	1,500 (4%)
Total	36,700 (100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the cause of ignition was unknown or not reported were allocated proportionally among fires of known cause of ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 6A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Factor Contributing to Ignition**  
**2004-2008 Annual Averages**

<b>Factor Contributing to Ignition</b>	<b>Fires</b>	
Abandoned or discarded material	56,900	(16%)
Outside or open fire for debris or waste disposal	51,800	(15%)
High wind	45,300	(13%)
Unclassified factor contributed to ignition	30,800	(9%)
Unclassified natural condition	28,000	(8%)
Unclassified misuse of material or product	22,700	(6%)
Electrical failure or malfunction	20,300	(6%)
Playing with heat source	19,900	(6%)
Unclassified fire spread or control	16,900	(5%)
Storm	13,200	(4%)
Agriculture or land management burn	12,900	(4%)
Heat source too close to combustible	12,700	(4%)
Rekindle	12,400	(3%)
Mechanical failure or malfunction	11,200	(3%)
Outside or open fire for warming or cooking	4,600	(1%)
Cutting or welding too close to combustible	4,300	(1%)
Exposure fire	4,300	(1%)
Other known factors	9,300	(3%)
<b>Total fires</b>	<b>356,800</b>	<b>(100%)</b>
<b>Total entries*</b>	<b>377,400</b>	<b>(106%)</b>

\*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 6B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Factor Contributing to Ignition**  
**2004-2008 Annual Averages**

<b>Factor Contributing to Ignition</b>	<b>Fires</b>	
Outside or open fire for debris or waste disposal	25,400	(17%)
Abandoned or discarded material	22,500	(16%)
High wind	18,400	(13%)
Unclassified factor contributed to ignition	12,500	(9%)
Unclassified natural condition	11,300	(8%)
Unclassified misuse of material or product	10,000	(7%)
Playing with heat source	7,900	(5%)
Unclassified fire spread or control	7,700	(5%)
Electrical failure or malfunction	7,100	(5%)
Rekindle	5,600	(4%)
Agriculture or land management burn	5,500	(4%)
Heat source too close to combustible	5,100	(3%)
Mechanical failure or malfunction	3,400	(2%)
Storm	3,400	(2%)
Outside or open fire for warming or cooking	2,300	(2%)
Exposure fire	1,600	(1%)
Cutting or welding too close to combustible	1,300	(1%)
Other known factors	3,500	(2%)
<b>Total fires</b>	<b>145,400</b>	<b>(100%)</b>
<b>Total entries*</b>	<b>154,600</b>	<b>(106%)</b>

\*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.



**Table 6C.**  
**Local Fire Department Responses to Grass Fires**  
**by Factor Contributing to Ignition**  
**2004-2008 Annual Averages**

<b>Factor Contributing to Ignition</b>	<b>Fires</b>	
High wind	19,400	(15%)
Outside or open fire for debris or waste disposal	18,800	(14%)
Abandoned or discarded material	16,500	(13%)
Unclassified factor contributed to ignition	10,400	(8%)
Electrical failure or malfunction	10,100	(8%)
Unclassified natural condition	9,000	(7%)
Playing with heat source	8,500	(6%)
Unclassified misuse of material or product	7,600	(6%)
Mechanical failure or malfunction	6,600	(5%)
Unclassified fire spread or control	6,000	(5%)
Agriculture or land management burn	5,400	(4%)
Heat source too close to combustibles	5,200	(4%)
Rekindle	3,300	(2%)
Cutting or welding too close to combustible	2,700	(2%)
Storm	2,700	(2%)
Exposure fire	1,800	(1%)
Outside or open fire for warming or cooking	1,100	(1%)
Other known factors	4,300	(3%)
<b>Total fires</b>	<b>132,000</b>	<b>(100%)</b>
<b>Total entries*</b>	<b>139,400</b>	<b>(106%)</b>

\*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 6D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Factor Contributing to Ignition**  
**2004-2008 Annual Averages**

<b>Factor Contributing to Ignition</b>	<b>Fires</b>	
High wind	5,800	(16%)
Outside or open fire for debris or waste disposal	5,000	(14%)
Abandoned or discarded material	4,700	(13%)
Storm	4,600	(13%)
Unclassified natural condition	3,200	(9%)
Unclassified factor contributed to ignition	2,400	(6%)
Rekindle	2,400	(6%)
Unclassified fire spread or control	2,000	(6%)
Electrical failure or malfunction	1,700	(5%)
Playing with heat source	1,600	(4%)
Agriculture or land management burn	1,300	(4%)
Unclassified misuse of material or product	1,300	(3%)
Heat source too close to combustible	1,000	(3%)
Outside or open fire for warming or cooking	700	(2%)
Mechanical failure or malfunction	600	(2%)
Exposure fire	400	(1%)
Other known factors	700	(2%)
Total fires	36,700	(100%)
Total entries*	39,400	(107%)

\*Multiple entries are allowed, resulting in more factor entries than fires.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the factor contributing to ignition was undetermined, coded as “none,” or not reported were allocated proportionally among fires with known factor contributing to ignition. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 7A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Heat Source**  
**2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Hot ember or ash	60,000	(17%)
Match	44,300	(12%)
Smoking materials	44,000	(12%)
Unclassified heat source	36,500	(10%)
Unclassified hot or smoldering object	25,500	(7%)
Lighter	19,200	(5%)
Fireworks	18,300	(5%)
Arcing	17,800	(5%)
Spark, ember, or flame from operating equipment	14,300	(4%)
Lightning	14,000	(4%)
Flame or torch used for lighting	11,300	(3%)
Flying brand, ember or spark	9,500	(3%)
Unclassified heat spread from another fire	5,900	(2%)
Heat or spark from friction	5,700	(2%)
Unclassified heat from powered equipment	4,900	(1%)
Heat from direct flame or convection current	3,400	(1%)
Radiated or conducted heat from operating equipment	3,300	(1%)
Unclassified fireworks or explosives	3,200	(1%)
Multiple heat sources, including multiple ignitions	2,800	(1%)
Chemical reaction or spontaneous combustion	2,700	(1%)
Molten or hot material	2,600	(1%)
Other known heat source	7,600	(2%)
Total	356,800	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 7B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Heat Source**  
**2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Hot ember or ash	26,300	(18%)
Match	21,900	(15%)
Smoking materials	16,700	(11%)
Unclassified heat source	15,500	(11%)
Unclassified hot or smoldering object	10,500	(7%)
Lighter	9,300	(6%)
Fireworks	6,200	(4%)
Arcing	5,800	(4%)
Flame or torch used for lighting	5,400	(4%)
Spark, ember or flame from operating equipment	4,500	(3%)
Flying brand, ember or spark	3,900	(3%)
Lightning	3,700	(3%)
Unclassified heat spread from another fire	2,500	(2%)
Heat or spark from friction	1,900	(1%)
Unclassified heat from powered equipment	1,500	(1%)
Heat from direct flame or convection current	1,400	(1%)
Multiple heat sources, including multiple ignitions	1,200	(1%)
Chemical reaction or spontaneous combustion	1,100	(1%)
Unclassified fireworks or explosive	1,100	(1%)
Radiated or conducted heat from operating equipment	1,000	(1%)
Molten or hot material	800	(1%)
Other known heat source	3,100	(2%)
<b>Total</b>	<b>145,400</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting, and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 7C.  
Local Fire Department Responses to Grass Fires  
by Heat Source  
2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Hot ember or ash	21,700	(16%)
Smoking materials	14,800	(11%)
Match	14,800	(11%)
Unclassified heat source	11,700	(9%)
Fireworks	9,900	(7%)
Spark, ember or flame from operating equipment	8,300	(6%)
Unclassified hot or smoldering object	8,100	(6%)
Arcing	7,900	(6%)
Lighter	6,000	(5%)
Flying brand, ember or spark	4,100	(3%)
Flame or torch used for lighting	4,000	(3%)
Heat or spark from friction	3,100	(2%)
Lightning	2,900	(2%)
Unclassified heat from powered equipment	2,500	(2%)
Unclassified heat spread from another fire	2,300	(2%)
Unclassified fireworks or explosive	1,600	(1%)
Radiated or conducted heat from operating equipment	1,600	(1%)
Molten or hot material	1,600	(1%)
Heat from direct flame or convection current	1,400	(1%)
Multiple heat sources, including multiple ignitions	900	(1%)
Other known heat sources	2,900	(2%)
<b>Total</b>	<b>132,000</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 7D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Heat Source**  
**2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Hot ember or ash	7,100	(19%)
Lightning	5,600	(15%)
Match	4,000	(11%)
Unclassified heat source	4,000	(11%)
Unclassified hot or smoldering object	2,200	(6%)
Arcing	2,200	(6%)
Lighter	1,900	(5%)
Smoking materials	1,700	(5%)
Flying brand, ember or spark	1,400	(4%)
Flame or torch used for lighting	1,000	(3%)
Unclassified heat spread from another fire	900	(3%)
Fireworks	900	(3%)
Spark, ember or flame from operating equipment	800	(2%)
Heat from direct flame or convection currents	500	(1%)
Multiple heat sources, including multiple ignitions	400	(1%)
Heat or spark from friction	300	(1%)
Unclassified heat from powered equipment	300	(1%)
Other known heat source	1,200	(3%)
Total	36,700	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the heat source undetermined or not reported were allocated proportionally among fires with known heat source. The estimates of matches, lighters, smoking materials, flames or torches used for lighting and candles include a proportional share of fires in which the heat source was heat from an unclassified open flame or smoking material. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 8A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Equipment Involved in Ignition**  
**2004-2008 Annual Averages**

<b>Equipment Involved in Ignition</b>	<b>Fires</b>	
No equipment involved	308,000	(86%)
Electrical power or utility line	13,500	(4%)
Unclassified equipment involved in ignition	6,800	(2%)
Electrical distribution or lighting equipment except power or utility line or transformer	5,500	(2%)
Lawn mower	4,700	(1%)
Cutting or welding torch, burner or soldering iron	4,200	(1%)
Shop tools and industrial equipment, except torches	2,700	(1%)
Hay processing equipment	2,600	(1%)
Garden tool or agricultural equipment except lawn mower or hay processing equipment	2,300	(1%)
Transformer	2,300	(1%)
Other known equipment	4,200	(1%)
Total	356,800	(100%)

**Table 8B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Equipment Involved in Ignition**  
**2004-2008 Annual Averages**

<b>Equipment Involved in Ignition</b>	<b>Fires</b>	
No equipment involved	129,400	(89%)
Electrical power or utility line	4,600	(3%)
Electrical distribution or lighting equipment except power or utility line	2,700	(2%)
Unclassified equipment involved in ignition	2,400	(2%)
Garden tool or agricultural equipment except lawn mower	1,400	(1%)
Cutting or welding torch, burner or soldering iron	1,300	(1%)
Lawn mower	1,100	(1%)
Shop tool or industrial equipment except torch	900	(1%)
Other known equipment	1,600	(1%)
Total	145,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the equipment involved in ignition was undetermined or not reported were allocated proportionally among fires with known equipment involved in ignition. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Sums may not equal due to rounding errors.  
Source: NFIRS 5.0 and NFPA survey.

**Table 8C.**  
**Local Fire Department Responses to Grass Fires**  
**by Equipment Involved in Ignition**  
**2004-2008 Annual Averages**

<b>Equipment Involved in Ignition</b>	<b>Fires</b>	
No equipment involved in ignition	109,100	(83%)
Electrical power or utility line	5,400	(4%)
Unclassified equipment involved in ignition	3,000	(2%)
Lawn mower	2,900	(2%)
Cutting or welding torch or soldering iron	2,500	(2%)
Electrical distribution or lighting equipment except power or utility line or transformer	2,000	(2%)
Hay processing equipment	1,800	(1%)
Shop tool or industrial equipment other than torch	1,500	(1%)
Transformer	1,400	(1%)
Garden tool or agricultural equipment, other than lawn mower or hay processing equipment	900	(1%)
Other known equipment	1,600	(1%)
Total	132,000	(100%)

**Table 8D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Equipment Involved in Ignition**  
**2004-2008 Annual Averages**

<b>Equipment Involved in Ignition</b>	<b>Fires</b>	
No equipment involved	31,900	(87%)
Electrical power or utility line	2,200	(6%)
Unclassified equipment involved in ignition	700	(2%)
Garden tool or agricultural equipment	600	(2%)
Electrical distribution or lighting equipment except power or utility line	400	(1%)
Shop tool or industrial equipment, including torch	400	(1%)
Lighter*	200	(1%)
Other known equipment	200	(1%)
Total	36,700	(100%)

\* Most fires with lighter as heat source do not show a lighter as equipment involved in ignition.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the equipment involved in ignition was undetermined or not reported were allocated proportionally among fires with known equipment involved in ignition. Fires in which the equipment involved in ignition was entered as none but the heat source indicated equipment involvement or the heat source was unknown were also treated as unknown and allocated proportionally among fires with known equipment involved. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.



**Table 9A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Item First Ignited**  
**2004-2008 Annual Averages**

<b>Item First Ignited</b>	<b>Fires</b>	
Light vegetation, including grass	231,200	(65%)
Heavy vegetation, including trees	41,000	(11%)
Unclassified organic material	37,100	(10%)
Unclassified item first ignited	17,100	(5%)
Rubbish, trash, or waste	8,500	(2%)
Chips, including wood chips	6,600	(2%)
Agricultural crop, including fruits and vegetables	5,100	(1%)
Other known item	10,200	(3%)
Total	356,800	(100%)

**Table 9B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Item First Ignited**  
**2004-2008 Annual Averages**

<b>Item First Ignited</b>	<b>Fires</b>	
Light vegetation, including grass	93,900	(65%)
Heavy vegetation, including trees	17,300	(12%)
Unclassified organic materials	14,900	(10%)
Unclassified item first ignited	6,700	(5%)
Rubbish, trash, or waste	4,100	(3%)
Chips, including wood chips	2,600	(2%)
Agricultural crop, including fruits and vegetables	1,600	(1%)
Other known item	4,400	(3%)
Total	145,400	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the item first ignited was undetermined or not reported were allocated proportionally among fires with known item first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 9C.**  
**Local Fire Department Responses to Grass Fires**  
**by Item First Ignited**  
**2004-2008 Annual Averages**

<b>Item First Ignited</b>	<b>Fires</b>	
Light vegetation, including grass	109,100	(83%)
Unclassified item first ignited	5,300	(4%)
Unclassified organic material	5,000	(4%)
Heavy vegetation, including trees	3,600	(3%)
Rubbish, trash, or waste	3,200	(2%)
Agricultural crop, including fruits and vegetables	1,700	(1%)
Chips, including wood chips	700	(1%)
Other known item	3,500	(3%)
<b>Total</b>	<b>132,000</b>	<b>(100%)</b>

**Table 9D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Item First Ignited**  
**2004-2008 Annual Averages**

<b>Item First Ignited</b>	<b>Fires</b>	
Heavy vegetation, including trees	15,900	(43%)
Light vegetation, including grass	13,800	(38%)
Unclassified organic material	2,600	(7%)
Unclassified item first ignited	2,100	(6%)
Rubbish, trash, or waste	900	(2%)
Agricultural crop, including fruits and vegetables	300	(1%)
Other known item	1,100	(3%)
<b>Total</b>	<b>36,700</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the item first ignited was undetermined or not reported were allocated proportionally among fires with known item first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 10A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Type of Material First Ignited**  
**2004-2008 Annual Averages**

<b>Type of Material First Ignited</b>	<b>Fires</b>	
Unclassified natural product	99,100	(28%)
Hay or straw	43,700	(12%)
Unclassified type of material first ignited	32,200	(9%)
Wood chips, sawdust or shavings	29,200	(8%)
Multiple types of material	10,100	(3%)
Round timber, including round posts or poles	8,100	(2%)
Unclassified wood or paper	5,600	(2%)
Wood pulp or wood fiber	3,400	(1%)
Grain or natural fiber	2,800	(1%)
Sawn wood, including all finished lumber	2,300	(1%)
Paper, including cellulose and waxed paper	1,800	(1%)
Other known item	8,100	(2%)
Not required*	110,300	(31%)
<b>Total</b>	<b>356,800</b>	<b>(100%)</b>

\* Type of material first ignited is required only in incidents in which the item first ignited was in one of the following categories: structural component or finish; furniture or utensil; soft goods or wearing apparel; adornment, recreational material or sign; storage supplies; liquids, piping or filters; or unclassified (item first ignited <70). This field is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; although it *may* be completed in these cases.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 10B.**  
**Local Fire Department Responses to Brush or Brush and Grass Mixture Fires**  
**by Type of Material First Ignited**  
**2004-2008 Annual Averages**

<b>Type of Material First Ignited</b>	<b>Fires</b>	
Unclassified natural product	40,000	(27%)
Hay or straw	16,100	(11%)
Unclassified type of material first ignited	13,100	(9%)
Wood chips, sawdust or shavings	11,800	(8%)
Multiple types of material	5,400	(4%)
Round timber, including round posts and poles	3,800	(3%)
Unclassified wood or paper	2,700	(2%)
Wood pulp	1,500	(1%)
Sawn wood, including all finished lumber	1,300	(1%)
Grain or natural fiber	1,000	(1%)
Paper, including cellulose and waxed paper	700	(1%)
Other known item	3,200	(2%)
Not required*	44,700	(31%)
<b>Total</b>	<b>145,400</b>	<b>(100%)</b>

\* Type of material first ignited is required only in incidents in which the item first ignited was in one of the following categories: structural component or finish; furniture or utensil; soft goods or wearing apparel; adornment, recreational material or sign; storage supplies; liquids, piping or filters; or unclassified (item first ignited <70). This field is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; although it *may* be completed in these cases.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 10C.**  
**Local Fire Department Responses to Grass Fires**  
**by Type of Material First Ignited**  
**2004-2008 Annual Averages**

<b>Type of Material First Ignited</b>	<b>Fires</b>	
Unclassified natural product	36,800	(28%)
Hay or straw	24,600	(19%)
Unclassified type of material	13,600	(10%)
Wood chips, sawdust or shavings	3,600	(3%)
Multiple types of material	2,900	(2%)
Grain or natural fiber	1,500	(1%)
Unclassified wood or paper	1,000	(1%)
Round timber, including round posts and poles	800	(1%)
Paper, including cellulose and waxed paper	800	(1%)
Other known item	4,500	(3%)
Not required*	42,000	(32%)
Total	132,000	(100%)

\* Type of material first ignited is required only in incidents in which the item first ignited was in one of the following categories: structural component or finish; furniture or utensil; soft goods or wearing apparel; adornment, recreational material or sign; storage supplies; liquids, piping or filters; or unclassified (item first ignited <70). This field is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; although it *may* be completed in these cases.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 10D.**  
**Local Fire Department Responses to Forest, Woods, or Wildland Fires**  
**by Type of Material First Ignited**  
**2004-2008 Annual Averages**

<b>Type of Material First Ignited</b>	<b>Fires</b>	
Unclassified natural product	11,900	(32%)
Unclassified type of material first ignited	4,000	(11%)
Hay or straw	3,000	(8%)
Round timber, including round posts and poles	2,500	(7%)
Multiple types of material	1,700	(5%)
Unclassified wood or paper	1,000	(3%)
Wood chips, sawdust, or shavings	800	(2%)
Wood pulp	600	(2%)
Sawn wood, including all finished lumber	300	(1%)
Paper, including cellulose and waxed paper	200	(1%)
Other known item	900	(2%)
Not required*	9,800	(27%)
<b>Total</b>	<b>36,700</b>	<b>(100%)</b>

\* Type of material first ignited is required only in incidents in which the item first ignited was in one of the following categories: structural component or finish; furniture or utensil; soft goods or wearing apparel; adornment, recreational material or sign; storage supplies; liquids, piping or filters; or unclassified (item first ignited <70). This field is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; although it *may* be completed in these cases.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors.

Source: NFIRS 5.0 and NFPA survey.

**Table 11A.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**Beginning with Hay or Straw, by Heat Source**  
**2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Hot ember or ash	7,500	(17%)
Match	6,800	(16%)
Smoking materials	6,200	(14%)
Lighter	2,800	(6%)
Fireworks	2,600	(6%)
Unclassified hot or smoldering object	2,400	(5%)
Unclassified heat source	2,400	(5%)
Arcing	2,300	(5%)
Spark, ember or flame from operating equipment	2,200	(5%)
Flame or torch used for lighting	1,200	(3%)
Heat or spark from friction	1,100	(2%)
Unclassified heat from powered equipment	800	(2%)
Flying brand, ember or spark	800	(2%)
Radiated or conducted heat from operating equipment	800	(2%)
Lightning	800	(2%)
Unclassified fireworks or explosives	600	(1%)
Molten or hot material	400	(1%)
Unclassified heat spread from another fire	300	(1%)
Chemical reaction or spontaneous combustion	300	(1%)
Heat from direct flame or convection currents	300	(1%)
Multiple heat sources including multiple ignitions	300	(1%)
Unclassified chemical or natural heat source	200	(1%)
Other known heat source	700	(2%)
<b>Total</b>	<b>43,700</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors. Because type of material first ignited is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; these estimates probably understate the frequency of these fires..

Source: NFIRS 5.0 and NFPA survey.

**Table 11B.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**Beginning with Wood Chips, Sawdust, or Shavings, by Heat Source**  
**2004-2008 Annual Averages**

<b>Heat Source</b>	<b>Fires</b>	
Smoking materials	14,000	(48%)
Hot ember or ash	4,700	(16%)
Unclassified hot or smoldering object	3,700	(13%)
Chemical reaction or spontaneous combustion	1,300	(5%)
Unclassified heat source	900	(3%)
Match	900	(3%)
Lighter	800	(3%)
Unclassified chemical or natural heat source	600	(2%)
Sunlight	500	(2%)
Radiated or conducted heat from operating equipment	300	(1%)
Arcing	300	(1%)
Fireworks	200	(1%)
Unclassified heat from powered equipment	200	(1%)
Other known heat source	800	(3%)
<b>Total</b>	<b>29,200</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Fires in which the type of material first ignited was required but undetermined or not reported were allocated proportionally among fires with known type of material first ignited. Sums may not equal due to rounding errors. Because type of material first ignited is not required when the item first ignited is organic material, such as vegetation; or a general material, such as rubbish or dust; these estimates probably understate the frequency of these fires..

Source: NFIRS 5.0 and NFPA survey.



**Table 12.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by Acres Burned and Type of Fire**  
**2004-2008 Annual Averages**

<b>Acres Burned</b>	<b>Brush or Brush/ Grass Mixture</b>		<b>Grass</b>		<b>Forest, Woods or Wildland</b>		<b>Total, including Unclassified</b>	
Less than an acre	111,400	(77%)	94,700	(72%)	20,800	(57%)	264,800	(74%)
1-10 acres	28,800	(20%)	31,600	(24%)	12,500	(34%)	77,200	(22%)
11-25 acres	2,200	(2%)	2,600	(2%)	1,400	(4%)	6,400	(2%)
26-50 acres	1,200	(1%)	1,400	(1%)	800	(2%)	3,600	(1%)
51-100 acres	700	(0%)	800	(1%)	500	(1%)	2,100	(1%)
101-500 acres	600	(0%)	700	(1%)	400	(1%)	1,800	(1%)
More than 500 acres	300	(0%)	200	(0%)	300	(1%)	800	(0%)
<b>Total</b>	<b>145,400</b>	<b>(100%)</b>	<b>132,000</b>	<b>(100%)</b>	<b>36,700</b>	<b>(100%)</b>	<b>356,800</b>	<b>(100%)</b>

**Table 13.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**by U.S. Census Region and Type of Fire**  
**2004-2008 Annual Averages**

<b>Region</b>	<b>Brush or Brush/ Grass Mixture</b>		<b>Grass</b>		<b>Forest, Woods or Wildland</b>		<b>Total, including Unclassified</b>	
Northeast	20,300	(14%)	4,000	(3%)	2,700	(7%)	31,600	(9%)
South	74,300	(51%)	78,600	(60%)	23,000	(63%)	191,500	(54%)
Midwest	27,600	(19%)	28,200	(21%)	5,000	(14%)	70,700	(20%)
West	23,000	(16%)	19,600	(15%)	4,800	(13%)	59,700	(17%)
Other US territories or areas	200	(0%)	1,600	(1%)	1,200	(3%)	3,300	(1%)
<b>Total</b>	<b>145,400</b>	<b>(100%)</b>	<b>132,000</b>	<b>(100%)</b>	<b>36,700</b>	<b>(100%)</b>	<b>356,800</b>	<b>(100%)</b>

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Fires are rounded to the nearest hundred. Sums may not equal due to rounding errors. Unclassified vegetation fires are not shown separately. For Table 12, fires in which the number of acres burned were unknown were allocated proportionally.

Source: NFIRS 5.0 and NFPA survey.

**Table 14.**  
**Local Fire Department Responses to Brush, Grass, and Forest Fires**  
**Per 1,000 Square Miles by Census Region and Type of Fire**  
**2004-2008 Annual Averages**

<b>Region</b>	<b>Brush or Brush/ Grass Mixture</b>	<b>Grass</b>	<b>Forest, Woods or Wildland</b>	<b>Total, including Unclassified</b>	<b>Square Miles</b>
Northeast	112	22	15	174	181,000
South	81	85	25	208	920,000
Midwest	34	34	6	86	822,000
West	12	10	3	32	1,871,000
Total for 50 States and Washington DC	38	34	9	93	3,794,000

Note: These rates were calculated from the data in Table 13 and the country's total square miles. Unclassified vegetation fires are not shown separately.

Source: NFIRS 5.0 and NFPA survey and "Land and Water Area of States, 2000, (in square miles), accessed at <http://www.infoplease.com/ipa/A0108355.html> on July 29, 2010.

## Appendix A. The 25 Largest Fire Losses in U.S. History

	Loss in Year Fire Occurred	Adjusted Loss in 2008 Dollars
1. The World Trade Center New York City, New York September 11, 2001	\$33.4 billion	\$40.6 billion
2. San Francisco Earthquake and Fire San Francisco, California April 18, 1906	\$350 million	\$8.3 billion
3. Great Chicago Fire * Chicago, Illinois October 8-9, 1871	\$168 million	\$3.0 billion
4. <b>Oakland Fire Storm (wildland/urban interface) Oakland, California October 20, 1991</b>	\$1.5 billion	\$2.4 billion
5. <b>The Southern California Firestorm San Diego County, California October 20, 2007</b>	\$1.8 billion	\$1.9 billion
6. Great Boston Fire Boston, Massachusetts November 9, 1872	\$75 million	\$1.3 billion
7. Polyolefin Plant Pasadena, Texas October 23, 1989	\$750 million	\$1.3 billion
8. <b>“Cedar” Wildland Fire Julian, California October 25, 2003</b>	\$1.1 billion	\$1.2 billion
9. <b>“Cerro Grande” Wildland Fire (wildland/urban interface) Los Alamos, New Mexico May 4, 2000</b>	\$1.0 billion	\$1.2 billion
10. Baltimore Conflagration Baltimore, Maryland February 7, 1904	\$50 million	\$1.2 billion

## The 25 Largest Fire Losses in U.S. History (continued)

	Loss in Year Fire Occurred	Adjusted Loss in 2008 dollars
11. <b>“Old” Wildland Fire San Bernardino, California October 25, 2003</b>	\$975 million	\$1.1 billion
12. Los Angeles Civil Disturbance Los Angeles, California April 29 - May 1, 1992	\$567 million	\$870 million
13. Power Plant (auto manufacturing complex) Dearborn, Michigan February 1, 1999	\$650 million	\$839 million
14. <b>Southern California November Wildfire** Sacramento, California November 13, 2008</b>	\$800 million	\$800 million
15. <b>“Laguna Beach Fire” (wildland/urban interface) Orange County, California October 27, 1993</b>	\$528 million	\$786 million
16. Textile Mill Methuen, Massachusetts December 11, 1995	\$500 million	\$705 million
17. U.S.S. Lafayette (formerly S.S. Normandie ocean liner) New York, New York February 9, 1942	\$53 million	\$699 million
18. S.S. Grandcamp and Chemical Co. Plant Texas City, Texas April 16, 1947	\$67 million	\$646 million
19. Petroleum Refinery Norco, Louisiana May 5, 1988	\$330 million	\$600 million
20. Cargo plane in-flight fire Near Newburgh, New York September 5, 1996	\$395 million	\$542 million

## The 25 Largest Fire Losses in U.S. History (continued)

	Loss in Year Fire Occurred	Adjusted Loss in 2008 Dollars
21. Great Fire of New York New York, New York December 16, 1835	\$26 million	\$540 million
<b>22. Wildland Fire** Florida May – June, 1998</b>	\$395 million	\$520 million
23. One Meridian Plaza (high-rise office building) Philadelphia, Pennsylvania February 23, 1991	\$325 million	\$513 million
<b>24. Forest Fire Cloquet, Minnesota October 12, 1918</b>	\$35 million	\$498 million
25. Apollo Spacecraft Cabin Cape Kennedy, Florida January 27, 1967	\$75 million	\$483 million

Loss estimates are from NFPA records. Adjustment to 2008 dollars done using the Consumer Price Index, including Census Bureau estimates for historical times. The list is limited to fires with some reliable dollar-loss estimate that occur in or over the U.S.A.

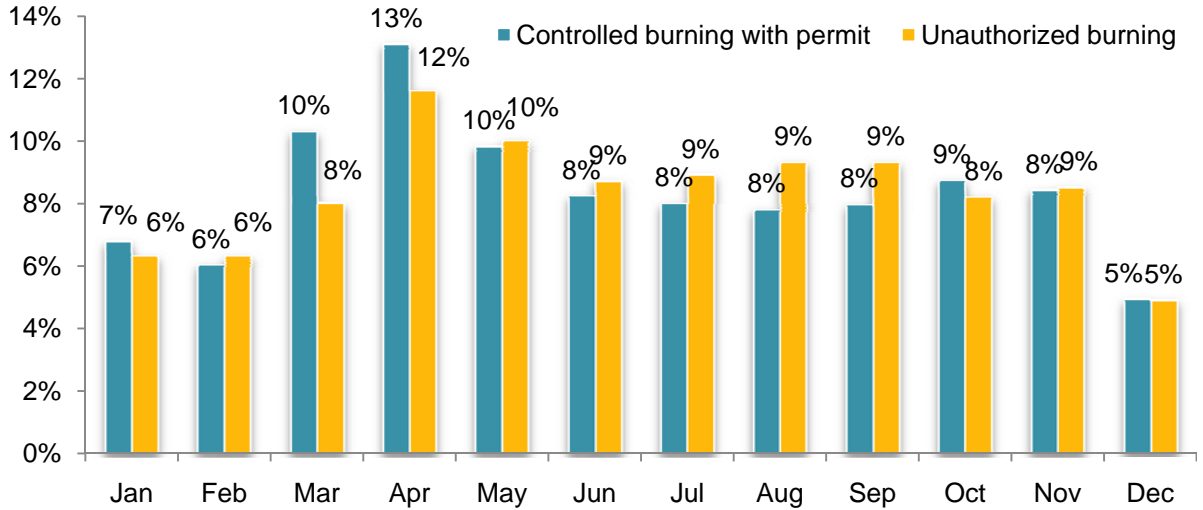
\*Each year Fire Prevention Week falls in the week of October 9th, and thus the anniversary of the Great Chicago Fire of 1871 is dedicated to encouraging fire safety. The National Fire Protection Association has been the proud sponsor of Fire Prevention Week ever since it was first proclaimed in 1922 by President Warren G. Harding.

\*\*Includes multiple fires.

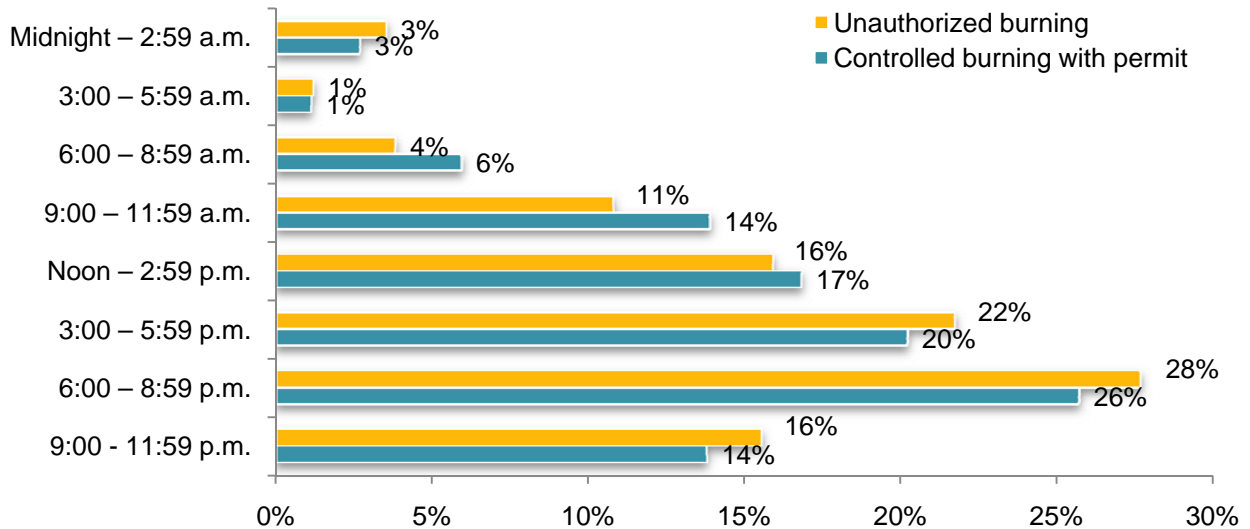
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## Appendix B. Local Fire Department Responses to Incidents of Controlled Burning with Permit and Unauthorized Burning in 2008

### By Month



### by Alarm Time



Source: NFIRS 5.0

## **Appendix C.**

### **How National Estimates Statistics Are Calculated**

The statistics in this analysis are estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association's (NFPA's) annual survey of U.S. fire departments. NFIRS is a voluntary system by which participating fire departments report detailed factors about the fires to which they respond. Roughly two-thirds of U.S. fire departments participate, although not all of these departments provide data every year. Fires reported to federal or state fire departments or industrial fire brigades are not included in these estimates.

NFIRS provides the most detailed incident information of any national database not limited to large fires. NFIRS is the only database capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. NFIRS also captures information on the extent of flame spread, and automatic detection and suppression equipment. For more information about NFIRS visit <http://www.nfirs.fema.gov/>. Copies of the paper forms may be downloaded from [http://www.nfirs.fema.gov/documentation/design/NFIRS\\_Paper\\_Forms\\_2008.pdf](http://www.nfirs.fema.gov/documentation/design/NFIRS_Paper_Forms_2008.pdf).

NFIRS has a wide variety of data elements and code choices. The NFIRS database contains coded information. Many code choices describe several conditions. These cannot be broken down further. For example, area of origin code 83 captures fires starting in vehicle engine areas, running gear areas or wheel areas. It is impossible to tell the portion of each from the coded data.

#### **Methodology may change slightly from year to year.**

NFPA is continually examining its methodology to provide the best possible answers to specific questions, methodological and definitional changes can occur. *Earlier editions of the same report may have used different methodologies to produce the same analysis, meaning that the estimates are not directly comparable from year to year.*

#### **NFPA's fire department experience survey provides estimates of the big picture.**

Each year, NFPA conducts an annual survey of fire departments which enables us to capture a summary of fire department experience on a larger scale. Surveys are sent to all municipal departments protecting populations of 50,000 or more and a random sample, stratified by community size, of the smaller departments. Typically, a total of roughly 3,000 surveys are returned, representing about one of every ten U.S. municipal fire departments and about one third of the U.S. population.

The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities have fewer people protected per department and are less likely to respond to the survey. A larger number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and

protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined in NFIRS; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; (3) the number and nature of non-fire incidents; and (4) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results. The results of the survey are published in the annual report *Fire Loss in the United States*. To download a free copy of the report, visit <http://www.nfpa.org/assets/files/PDF/OS.fireloss.pdf>.

### **Projecting NFIRS to National Estimates**

As noted, NFIRS is a voluntary system. Different states and jurisdictions have different reporting requirements and practices. Participation rates in NFIRS are not necessarily uniform across regions and community sizes, both factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second database -- the NFPA survey -- is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

Scaling ratios are obtained by comparing NFPA's projected totals of residential structure fires, non-residential structure fires, vehicle fires, and outside and other fires, and associated civilian deaths, civilian injuries, and direct property damage with comparable totals in NFIRS. Estimates of specific fire problems and circumstances are obtained by multiplying the NFIRS data by the scaling ratios. Reports for incidents in which mutual aid was given are excluded from NFPA's analyses.

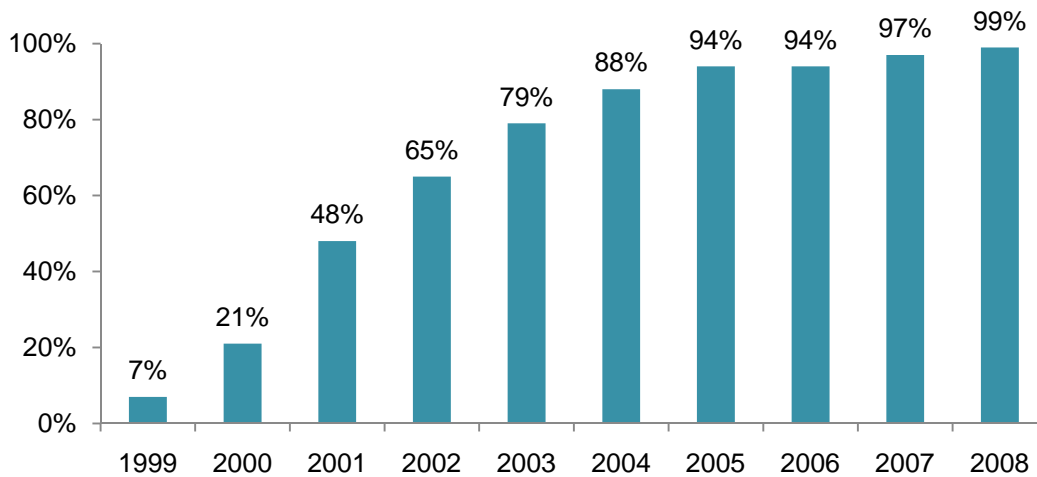
Analysts at the NFPA, the USFA and the Consumer Product Safety Commission developed the specific basic analytical rules used for this procedure. "The National Estimates Approach to U.S. Fire Statistics," by John R. Hall, Jr. and Beatrice Harwood, provides a more detailed explanation of national estimates. A copy of the article is available online at <http://www.nfpa.org/osds> or through NFPA's One-Stop Data Shop.

Version 5.0 of NFIRS, first introduced in 1999, used a different coding structure for many data elements, added some property use codes, and dropped others. The essentials of the approach described by Hall and Harwood are still used, but some modifications have been necessary to accommodate the changes in NFIRS 5.0.

Figure C.1 shows the percentage of fires originally collected in the NFIRS 5.0 system. Each year's release version of NFIRS data also includes data collected in older versions of NFIRS that were converted to NFIRS 5.0 codes.



**Figure C.1. Fires Originally Collected in NFIRS 5.0 by Year**



From 1999 data on, analyses are based on scaling ratios using only data originally collected in NFIRS 5.0:

$$\frac{\text{NFPA survey projections}}{\text{NFIRS totals in Version 5.0}}$$

For 1999 to 2001, the same rules may be applied, but estimates for these years in this form will be less reliable due to the smaller amount of data originally collected in NFIRS 5.0; they should be viewed with extreme caution.

For most fields other than Property Use and Incident Type, NFPA allocates unknown data proportionally among known data. This approach assumes that if the missing data were known, it would be distributed in the same manner as the known data. NFPA makes additional adjustments to several fields. *Casualty and loss projections can be heavily influenced by the inclusion or exclusion of unusually serious fire.*

In the formulas that follow, the term “all fires” refers to all fires in NFIRS on the dimension studied. The percentages of fires with known or unknown data are provided for non-confined fires and associated losses, and for confined fires only.

**Total Brush, Grass and Forest Fires in NFIRS 5.0:** A total of 993,171 fires with incident types in the 140-149 range were reported to NFIRS 5.0 during the five-year period of 2004-2008. With projections from the NFPA survey described above, these fires scaled to an estimated annual average of 356,800 brush, grass or forest fires that were reported to local fire departments.

Analyses were done of the entire 140s series of incident types, and for the three defined categories. Unclassified natural vegetation fires (incident type 140) were not analyzed separately for any of the specific causal factors or circumstances.

**Cause of Ignition:** This field is used chiefly to identify intentional fires. “Unintentional” in this field is a specific entry and does not include other fires that were not intentionally set:

failure of equipment or heat source, act of nature, or “other” (unclassified).” The last should be used for exposures but has been used for other situations as well. Fires that were coded as under investigation and those that were coded as undetermined after investigation were treated as unknown. For total brush, grass or forest fires (incident type 140-149), the cause was known in 62% of the fires.

**Factor Contributing to Ignition:** In this field, the code “none” is treated as an unknown and allocated proportionally. For Human Factor Contributing to Ignition, NFPA enters a code for “not reported” when no factors are recorded. “Not reported” is treated as an unknown, but the code “none” is treated as a known code and not allocated. Multiple entries are allowed in both of these fields. Percentages are calculated on the total number of fires, not entries, resulting in sums greater than 100%. Although Factor Contributing to Ignition is only required when the cause of ignition was coded as: 2) unintentional, 3) failure of equipment or heat source; or 4) act of nature, data is often present when not required. Consequently, any fire in which no factor contributing to ignition was entered was treated as unknown.

In some analyses, all entries in the category of mechanical failure, malfunction (factor contributing to ignition 20-29) are combined and shown as one entry, “mechanical failure or malfunction.” This category includes:

21. Automatic control failure;
22. Manual control failure;
23. Leak or break. Includes leaks or breaks from containers or pipes. Excludes operational deficiencies and spill mishaps;
25. Worn out;
26. Backfire. Excludes fires originating as a result of hot catalytic converters;
27. Improper fuel used; Includes the use of gasoline in a kerosene heater and the like; and
20. Mechanical failure or malfunction, other.

Entries in “electrical failure, malfunction” (factor contributing to ignition 30-39) may also be combined into one entry, “electrical failure or malfunction.” This category includes:

31. Water-caused short circuit arc;
32. Short-circuit arc from mechanical damage;
33. Short-circuit arc from defective or worn insulation;
34. Unspecified short circuit arc;
35. Arc from faulty contact or broken connector, including broken power lines and loose connections;
36. Arc or spark from operating equipment, switch, or electric fence;
37. Fluorescent light ballast; and
30. Electrical failure or malfunction, other.

The factor contributing to ignition was coded as none, undetermined or left blank in 70% of the total brush, grass or forest fires (incident type 140-149).

**Heat Source.** In NFIRS 5.0, one grouping of codes encompasses various types of open flames

and smoking materials. In the past, these had been two separate groupings. A new code was added to NFIRS 5.0, which is code 60: “Heat from open flame or smoking material, other.” NFPA treats this code as a partial unknown and allocates it proportionally across the codes in the 61-69 range, shown below.

61. Cigarette;
62. Pipe or cigar;
63. Heat from undetermined smoking material;
64. Match;
65. Lighter: cigarette lighter, cigar lighter;
66. Candle;
67. Warning or road flare, fuse;
68. Backfire from internal combustion engine. Excludes flames and sparks from an exhaust system, (11); and
69. Flame/torch used for lighting. Includes gas light and gas-/liquid-fueled lantern.

In addition to the conventional allocation of missing and undetermined fires, NFPA multiplies fires with codes in the 61-69 range by

$$\frac{\text{All fires in range 60-69}}{\text{All fires in range 61-69}}$$

The downside of this approach is that heat sources that are truly a different type of open flame or smoking material are erroneously assigned to other categories. The grouping “smoking materials” includes codes 61-63 (cigarettes, pipes or cigars, and heat from undetermined smoking material, with a proportional share of the code 60s and true unknown data.

In total brush, grass or forest fires, code 60: “heat from open flame or smoking material, other” was entered for 3% of the fires. The heat source was undetermined in 58% of total brush, grass or forest fires.

**Equipment Involved in Ignition (EII).** NFIRS 5.0 originally defined EII as the piece of equipment that provided the principal heat source to cause ignition if the equipment malfunctioned or was used improperly. In 2006, the definition was modified to “the piece of equipment that provided the principal heat source to cause ignition.” However, much of the data predates the change. Individuals who have already been trained with the older definition may not change their practices. To compensate, NFPA treats fires in which EII is coded as no equipment involved in ignition (NNN) and heat source is not in the range of 40-99 indicating something other than operating equipment as an additional unknown.

To allocate unknown data for EII, the known data is multiplied by

$$\frac{\text{All fires}}{(\text{All fires} - \text{blank} - \text{undetermined} - [\text{fires in which EII} = \text{NNN and heat source} <> 40-99])}$$

In addition, the partially unclassified codes for broad equipment groupings (i.e., code 100 - heating, ventilation, and air conditioning, other; code 200 - electrical distribution, lighting and power transfer, other; etc.) were allocated proportionally across the individual code choices in their respective broad groupings (heating, ventilation, and air conditioning; electrical

distribution, lighting and power transfer, other; etc.). Equipment that is totally unclassified is not allocated further. This approach has the same downside as the allocation of heat source 60 described above. Equipment that is truly different is erroneously assigned to other categories.

In some analyses, various types of equipment are grouped together.

<b>Code Grouping</b>	<b>EII Code</b>	<b>NFIRS definitions</b>
Central heat	132	Furnace or central heating unit
	133	Boiler (power, process or heating)
Fixed or portable space heater	131	Furnace, local heating unit, built-in
	123	Fireplace with insert or stove
	124	Heating stove
	141	Heater, excluding catalytic and oil-filled
	142	Catalytic heater
	143	Oil-filled heater
Fireplace or chimney	120	Fireplace or chimney
	121	Fireplace, masonry
	122	Fireplace, factory-built
	125	Chimney connector or vent connector
	126	Chimney – brick, stone or masonry
	127	Chimney-metal, including stovepipe or flue
Wiring, switch or outlet	210	Unclassified electrical wiring
	211	Electrical power or utility line
	212	Electrical service supply wires from utility
	214	Wiring from meter box to circuit breaker
	216	Electrical branch circuit
	217	Outlet, receptacle
	218	Wall switch
Power switch gear or overcurrent protection device	215	Panel board, switch board, circuit breaker board
	219	Ground fault interrupter
	222	Overcurrent, disconnect equipment
	227	Surge protector
Lamp, bulb or lighting	230	Unclassified lamp or lighting
	231	Lamp-tabletop, floor or desk
	232	Lantern or flashlight
	233	Incandescent lighting fixture
	234	Fluorescent light fixture or ballast
	235	Halogen light fixture or lamp

	236	Sodium or mercury vapor light fixture or lamp
	237	Work or trouble light
	238	Light bulb
	241	Nightlight
	242	Decorative lights – line voltage
	243	Decorative or landscape lighting – low voltage
	244	Sign
Cord or plug	260	Unclassified cord or plug
	261	Power cord or plug, detachable from appliance
	262	Power cord or plug- permanently attached
	263	Extension cord
Torch, burner or soldering iron	331	Welding torch
	332	Cutting torch
	333	Burner, including Bunsen burners
	334	Soldering equipment
Portable cooking or warming equipment	631	Coffee maker or teapot
	632	Food warmer or hot plate
	633	Kettle
	634	Popcorn popper
	635	Pressure cooker or canner
	636	Slow cooker
	637	Toaster, toaster oven, counter-top broiler
	638	Waffle iron, griddle
	639	Wok, frying pan, skillet
	641	Breadmaking machine

The equipment involved in ignition was undetermined, not reported, or coded as no equipment with a heat source code outside the range of 40-99 (non-equipment related heat sources) in 91% of total brush, grass or forest fires.

**Item First Ignited.** The item first ignited was undetermined or unreported in 51% of total brush, grass, or forest fires

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**Type of Material First Ignited.** NFIRS 5.0 only requires this field to be completed when the item first ignited is in code range 00-69. This field is not required when the item first ignited in an organic material such as vegetation, or crop; or a general material such electrical wire; dust, fiber or lint; rubbish, trash or waste; railroad ties; or multiple items. It is sometimes completed anyway and was analyzed when present. The type of material first ignited was undetermined or

unreported but required in 52% of total brush, grass, or forest fires. The field was not required and left blank in 31% of the fires.

The formula to allocate unknowns for this field is

$$\frac{\text{All fires} - (\text{not required and blank})}{[\text{All fires} - (\text{blank but required}) - \text{undetermined} - (\text{not required and blank})]}$$

**Rounding and percentages.** The data shown are estimates and generally rounded. An entry of zero may be a true zero or it may mean that the value rounds to zero. Percentages are calculated from unrounded values. It is quite possible to have a percentage entry of up to 100% even if the rounded number entry is zero. The same rounded value may account for a slightly different percentage share. Because percentages are expressed in integers and not carried out to several decimal places, percentages that appear identical may be associated with slightly different values.

For estimates derived from NFIRS and the NFPA survey, fires were rounded to the nearest hundred.