This report has been prepared by the National Fire Protection Association (NFPA) in cooperation with the Washington State Department of Natural Resources (DNR).

The report is the third in a series of reports conducted under a project sponsored by the National Wildland/Urban Interface Fire Protection Initiative. This report furthers the goals of the Initiative established in 1986. Those goals are to create general public awareness of the wildland interface problem, to encourage the formation of partnerships among problem-solvers and interest groups, and to focus on the development of local solutions to wildland/urban interface fire problems. The initiative is sponsored by the U.S. Department of Agriculture Forest Service, U.S. Department of Interior, including the Bureau of Land Management, the Bureau of Indian Affairs, the Fish and Wildlife Service, and the National Park Service, U.S. Fire Administration, the National Association of State Foresters, and the National Fire Protection Association.

Contact information for each of these organizations is provided in the Appendix.

As part of achieving the goals of the Initiative, the following analysis was undertaken. Its purpose is to document the fire, determine to the extent possible the variables causing associated structure loss, and make recommendations on how to prevent similar occurrences. Thomas J. Klem, Director of NFPA’s Fire Investigations Department, served as project manager, principal author, and technical advisor. William Baden, Senior Fire Service Specialist, NFPA, served as a technical advisor for the project, Jerry Laughlin, Books on Fire, assembled the raw data, and Spokane District Fire Chief Ed Lewis assisted by providing his assessment of the operational aspects of the incident. The extraordinary work of Maureen Tobin in the preparation of the document, and Chris McCusker for design, layout, and graphics, are acknowledged. Finally, the contribution of James C. Smalley, Director of NFPA’s Communications Technologies and Programs, for his photographs taken for this report (except as noted) is appreciated.

The information from this report is provided to assist planners, local officials, fire service personnel, and homeowners in developing fire safe homes and communities in the wildland/urban interface.

This wildland fire situation is only one of many that occur throughout the world each year. Under the sponsorship of the Initiative, the National Fire Protection Association will review, analyze, and document selected or unusual wildland/urban interface fires that cause major home or structure loss.

The preparation of this report would not have been possible without the assistance of the Washington State Department of Natural Resources, particularly Ken Hoover, Ross Hesseltine, Loy Jones, and Bill Wilburn, and numerous other DNR staff who contributed to this report. Further, Ross Hesseltine coordinated a follow-up data collection effort that resulted in a database, part of which was used for this report. The complete database is available for further analysis by others. We recognize and appreciate this extraordinary effort by Ross and the other members of DNR, and of the fire districts who helped assemble this large database.

National Fire Protection Association
# Abstract

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Winds gusting to 62 miles per hour swept across a four-county area in eastern Washington state on Wednesday, October 16, 1991. These gale-force winds were responsible for 92 separate wildland fires in Spokane, Stevens, Ferry, Okanogan, and Pend Orellie counties. One hundred and fourteen homes and numerous other structures were destroyed. One resident died attempting to escape the flames. Fire fighters continued to extinguish the fires into the weekend when a similar weather pattern was forecast for Monday, October 21. Fire fighters feared that additional high winds from the second wind event would result in the fires of October 16 becoming active again and additional new fires. Therefore, fire managers organized a massive buildup of fire fighters and equipment over the weekend and effectively deployed and dispatched them to new incidents when the high winds began again.

Analysis of the northeast Washington fires indicated that more than 90 percent of the fires started when winds blew down power lines or when trees or limbs fell into power lines. This scenario caused numerous fires in a very short duration of time and all suppression resources were rapidly committed. Personnel experienced difficulty in assessing the magnitude of the fires due to the poor visibility caused by the wind-swept fires and blowing dust.

The predominant fuel type in the region is Ponderosa pine. Its resin and needles are especially susceptible to fire because of their ease of ignition and burning intensity. Once a fire was established, fire brands from these fuels became airborne and ignited other combustibles ahead of the active fire area, increasing the rate and area of fire spread.

In addition, the fuels were extremely dry because of several years of drought and a total lack of precipitation in the previous 41 days. Northeast Washington had experienced 5 years of lower-than-average precipitation. This aided ignition and the rapid growth and fire spread. Heavy spring rains resulted in an abundant crop of grasses, adding further to the available fuels.

Fire scenarios like these have occurred for years, but now the fires are more disastrous because man has moved closer to the forest in “interface” areas. The affected northeast Washington area had been experiencing high population growth and development in its wildland interface areas. Most of the homes losses occurred within the first 4 hours of these fires and before massive assistance from Washington and neighboring states could be mobilized to supplement local forces.

This total commitment of suppression resources resulted in some subsequent fires spreading unchecked since resources were not available to respond.
A few of these fires burned for up to 3 hours before crews committed to other incidents could be reassigned or mutual aid arrived. In wildland fires incident commanders are usually able to assess, plan, and implement a strategy quickly and draw upon resources from neighboring areas to assist with suppression, but because of the number of fires, the first several hours of Fire Storm ‘91 were an incident commander’s nightmare to assess, plan, and direct resources.

The Washington State Department of Natural Resources (DNR) began to organize statewide assistance as the scope of the situation was realized. The DNR used its experience in managing large-scale fires to develop a unified command system that would manage all aspects of the incident.

By the end of the first day, the winds subsided, enabling fire managers to better assess the magnitude of the disaster and coordinate the suppression of all the fires.

Even with reinforcements and better organization, some fires were not contained by Friday. That same day, October 18th, the fire weather forecast predicted that a second wave of high winds would likely sweep across the area on the following Sunday evening or Monday morning. Fire managers worked day and night to assemble personnel and equipment to complete the extinguishment of all remaining fires and prepare to handle any potential fires. The weekend found residents frantically modifying the quantity of fuels adjacent to their homes and creating a defensible space in the event of new fire starts on Monday.

When the second wave of wind arrived as predicted, it was not as strong as October 16 and wind gusts peaked at 52 miles per hour. Resulting new fires were met with rapid and heavy suppression response from strategically placed strike teams that were mobilized from throughout the northwest U.S. over the weekend. The teams were dispatched to fires before homes were threatened. This operation saved the area from potentially devastating incidents.

This eastern Washington fire storm is another example of the hazard of mixing combustible homes with combustible natural vegetation. Homes in the path of intense wildfire flames were usually doomed no matter what heroic protection was attempted. This underscores the need for planning and fire prevention efforts to reduce these hazards.

Two previous NFPA reports provide details on other significant wildland/urban interface fires and specifics on what can be done (and by whom) to reduce fire risks. The Black Tiger Fire case study described the lessons learned from a Colorado interface fire that destroyed 44 homes built on the scenic slopes of the Rocky Mountains near Boulder. The Stephan Bridge Road Fire case study described a wind-driven fire in Michigan that destroyed 76 homes and 125 other structures.

The Spokane-area fires combined the hazards and difficulties identified in both of these previously documented fires, and illustrated the added hazard and difficulty of providing protection when multiple fires occur. The successful implementation of a unified command system and a massive mobilization of resources aided fire managers in avoiding further destructive losses when the second wind storm occurred.

For several years fire protection agencies have attempted to educate affected homeowners nationwide of the risks of wildland fires. Most homeowners, however, are still not fully aware of, or sufficiently concerned about, the problem. Many publications also offer guidance for development in the wildland/urban interface. NFPA 299, Standard for the Protection of Life and Property from Wildland Fire, presents fundamental planning and design criteria for fire agencies, planners, architects, developers, and government for development in wildland/urban interface areas that may be threatened by wildfire.
“Wildland/urban interface” is the term used to describe geographic areas where development and wildland fuels meet at a well-defined boundary. The fuels include forests, brush, and grasslands. National fire officials became especially concerned about this issue after record-breaking national losses to both homes and natural resources occurred in 1985. Leaders from various fire protection agencies formed the National Wildland/Urban Interface Fire Protection Initiative in 1986. Their purpose was to explain the issue and educate those affected by the interface problem, as well as those in positions to reduce the hazards.

Two previous NFPA reports have provided details on other significant wildland/urban interface fires and specifics on what can be done to lower fire risks. The Black Tiger Fire case study detailed the lessons learned from a Colorado interface fire that destroyed 44 homes built on the scenic slopes of the Rocky Mountains near Boulder. The Stephan Bridge Road Fire case study described a wind-driven fire in Michigan that destroyed 76 homes and 125 other structures in an 8-mile path of level forest. Although each of these fire reports illustrates common hazards associated with protecting homes in wildland interface areas, each also portrays unique variables that impacted the outcome of the particular fire.

The Black Tiger Fire case study documented an intense wind-driven fire that moved quickly up steep slopes and destroyed homes. The report attributed the loss of homes to the intensity of the fire, but also corroborated prior conclusions of the hazard associated with wood shake roofs on homes in the interface area.

Next, The Stephan Bridge Road Fire case study demonstrated an even more rapid fire spread than the Black Tiger fire; however, this rapid spread occurred over flat terrain. Dense fuel, undergoing natural processes resulting in a drier, more flammable fuel source, was cited as the cause of the more rapid spread. Few of the destroyed homes contained combustible roofs, but most lacked adequate clearances of combustible vegetation around the structures.

Population Growth of Spokane County

The American dream of owning a home in a beautiful forest environment is alive in northeast Washington. From 1970 to 1990 the population in Spokane County increased slightly more than 25 percent to 360,000, with about 200,000 living in the City of Spokane. Growth in the less urban, unincorporated sections of the county within this time period was 11 times faster than in incorporated sections. During those 20 years, about 24,000 new homes were built in wildland/urban interface areas of the county. Many of the homes are on parcels larger than 2.5 acres, adding to the scenic separation from other homes.
Weather

Northeastern Washington averages around 17.5 inches of precipitation per year (30-year average). The first half of 1991 provided ample rainfall and there were few wildfires.

April recorded above-average rainfall throughout most of the state. May and June followed with more wet periods. Most of the weather stations in eastern Washington reported rainfall well above the norm for June. The town of Republic, 90 miles northwest of Spokane, for example, was 250 percent above normal.

Further, for the third consecutive year in northeast Washington, September was one of the driest months. Normal precipitation for January through October in the Spokane area measures just over 12 inches. In 1991, the total was still under 10 inches in the middle of October. In Spokane County, no measurable precipitation fell for 41 days before the start of the fires on October 16. Meanwhile, unseasonably warm temperatures were accompanied by low humidity, adding to the hazard presented by the available fuels. This combination usually occurs during the summer months, months that are associated with their “fire season,” but this late occurrence prolonged the fire season into the fall. In several places record high temperatures were established for dates so late in the year.

A cold front dropped from Alaska on October 15 and brought rains to western Washington. The same front brought only high winds to the eastern part of the state.

Fuel Types

The primary fuels in interface areas in Spokane County are Ponderosa pine, intermingled with farmland and grass. Higher elevations have lodgepole pine gradually changing to Douglas fir and western larch. Cedar and hemlock are present in Pend Orielle County. In the burned areas, Ponderosa pine and grasslands comprise 90 percent of the acreage. The remaining acres are cropland in production or houses in subdivisions or on individual lots.

Grassy areas respond more quickly than forested areas to precipitation changes, and these were especially affected by the weather factors of 1991. Wet months early in the growing season contributed to the abundant growth of grasses into the summer months. At the end of the growing season, when dry conditions prevailed along with continued warm temperatures, cured grass covered wide areas of the land and provided large quantities of fine fuels which are easily ignited.

Much of the Ponderosa pine, even near some of the more popular housing areas, grows in dense stands, up to 10,000 stems per acre. This species tolerates low-intensity fires, but in high-intensity fires it is highly flammable due to the makeup of its resin and needles. Further, pine needles add to the ground fuels. Ponderosa pines may also have dead branches at the base of trees that are in close proximity to the ground fuels. When a ground fire involves the lower dead branches, intensity is increased and can conduct the fire into the tops of the trees. If high winds are present in this fire growth scenario, a resulting fast-moving “crown fire” develops, usually with disastrous results.

Homes also provide additional fuel in interface areas. In the Spokane fires, 60 percent of the land parcels contained residences. Homes built in the interface vary in style and construction, and few homeowners have taken adequate precautions to reduce the risk from wildfire. Analysis of fires in interface areas has shown that combustible roofs were common. Even noncombustible roofs were found susceptible to ignition when a buildup of pine needles was on them. Besides combustible roofs, many of the homes lost or damaged were found to have other factors that facilitated their destruction including combustible vegetation adjacent to the home and open eaves that provided embers access to roof areas. These variables are often referred to as “predetermined factors” that affect the ignition of homes in interface areas. When these variables are present, and the home has a long, narrow driveway that would prohibit fire crew’s approach, disaster is likely to result. However, it was also found that luscious, well-kept grass around a home often prevented a running ground fire, which dominated the Spokane fires, from endangering the structure. Further, awareness of less combustible decorative shrubs and trees about a home has been gaining much needed attention.

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<td>unincorporated</td>
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Fire Protection

The Washington State Department of Natural Resources (DNR) is responsible for fire protection on state and private forest lands and intermingled grasslands. Federal agencies are responsible for the protection of federal lands, this includes the state’s national forests and national parks. Cities protect structures within their jurisdictions with municipal fire departments.

In other developed areas, fire protection districts staffed with volunteer fire fighters are supplemented by a small cadre of career fire fighters. They protect structures, improved properties, and crop-lands within the defined district. If a developed area does not have its own organized fire protection, no organized structural protection is available except under special contracts.

Adjacent organizations and jurisdictions often enter into cooperative fire protection agreements. In these agreements one fire protection district may come to the aid of a neighbor district, or a district fire department may work side by side with state forest fire protection crews where both homes and wildlands are threatened by the same fire.

State tax codes provide for the joint funding of DNR and fire protection districts (FPD) where forested areas are intermingled with homes in organized districts. Most of Spokane County outside the city limits is a joint jurisdiction for fire protection. In some areas of low population density, the DNR has sole fire responsibility. In practice, because of the distance from DNR crews, a fire protection district may make first response for forest and grasslands, as well as structures within its boundaries.

In Spokane County about 70 fire stations house approximately 210 fire apparatus, including engines, tankers, and smaller

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Resident's living in high-risk wildland areas can optimize their situation by choosing firesafe locations, designing and building firesafe structures, and maintaining firesafe landscaping.

SITE:
Choose as flat a site as possible. Wildfire spreads uphill rapidly.
Avoid narrow, steep or winding roads or driveways that can obstruct firefighting equipment.
Consider placing a driveway on the downhill or windward side of the building, where it can act as a fire barrier.

STRUCTURE9
Do not build on poles or pilings.
Choose noncombustible roof materials.
Install fire-resistant siding, decking and trim.
Box in eaves; screen vents.
Screen beneath porches, decks and the house.
Keep chimneys above the roof line.
Top chimneys with a spark arrester of half-inch wire mesh. Put a water faucet on two sides of the house and one near each outbuilding. Attach a hose to each faucet.

LANDSCAPE DESIGN:
Clearly mark the entrance to the property.
Design the yard as a firebreak. Decorative mason walls at least 2 feet high and free of vegetation work well as a barrier.
Select the least-flammable vegetation possible; hardwood trees tend to be less flammable than conifers.
Clear all flammable vegetation from a safety zone 30 feet around the structure. Keep grass low in this area. This zone is the "defensible space," which not only reduces the threat of a fire spreading to the building but also improves the fire agency’s ability to fight a fire.
Avoid planting trees and shrubs within 30 feet of windows.
Within 100 feet of any structure, keep evergreen trees at least 20 feet from structures and each other. The wider the spacing between the trees, the better. Do not allow a property to sport a continuous canopy.

REMOVE LIMBS
*within 15 to 20 feet of the ground.
*over the roof.
*within 15 feet of, or directly above, a chimney.
Eliminate excessive understory plantings. Small trees underneath large trees allow grass fires to climb into the trees.
Site shrubs carefully; they are particularly dangerous. Keep them at least 15 feet from a structure. Thoroughly wet shrubs down if a fire approaches.

LANDSCAPE MAINTENANCE:
Use bedding mulch or straw sparingly.
Clear all vines from structures.
Keep roofs free of debris-leaves, pine straw, moss and twigs.
Mow grass closely once it has stopped growing, and collect the clippings.
Beyond 100 feet, remove dead wood and remove or thin older trees.
Remove all moss, abandoned nests, dead limbs and flammable material.
Rake up all needles and leaves within 30 feet of a building.
brush fire units. Fire fighters number about 1,300, although not all are available at any particular hour. Training in wildland fire fighting is an on-going and continual effort in the fire districts.

**Availability of Fire Fighters**

Because of the seasonal nature of high fire risk periods in Washington (and in other states also), it is not economically feasible for the state to maintain a year-round full-strength wildland fire fighting force. As a result, temporary seasonal fire fighters supplement the full-time DNR staff during the fire season. Because the highest risk (warm temperatures and low humidity) is during the summer months, college students are the backbone of Washington’s seasonal fire fighting forces. Their schedules generally require a return to school in early September. Consequently, only one-half of the seasonal staff was available when the fire season extended into October.

Municipal fire departments, such as in the city of Spokane, employ fire fighters available for immediate response 24 hours a day year round. Most fire protection districts in the more rural areas of the county rely on volunteers at all times. Volunteers hold other full-time jobs but respond to fires as quickly as possible. During the week, most of these volunteers are at work, and many of their jobs are in the city of Spokane. A daytime emergency may mean delayed response from these fire fighters due to travel distances in the county and the time required for notification or for each individual to hear of an emergency. As a result, in areas with high incident rates, fire districts have begun to add paid daytime fire fighters to supplement the volunteers.

**Interface Fires**

The DNR and FPDs have been jointly fighting interface fires in northeast Washington for more than 20 years. They average about 100 joint fires per year in the Spokane area, and many small fires which do not require or need a joint effort. They fight 1 major fire requiring a joint effort about every 2 years.

In the early years of the interface fires only 1 or 2 homes were threatened by the worst fires. A 1975 incident threatened 5 homes. In July 1987, however, the Hangman Hills fire destroyed 24 homes in a subdivision near Spokane. High winds and spotting spread the flames that destroyed the homes. Fire agencies were alarmed at how quickly a fire could exceed the capability of available forces. They quickly understood why such large fires require massive interagency support.

After the Hangman Hills fire, fire agencies began to make preparations for preventing and suppressing large-scale interface fires. A local review of the fire identified 4 problem areas: command; communications; media interaction; and
A Washington State Department of Natural Resources meteorologist noted during a 1988 statewide wildfire conference that fire activity had peaked every three years in terms of both fires and acres burned for the past 30 years. He analyzed meteorological data as well as social and economic data but found no direct correlation or a reason for the cycle. Lightning data was eliminated since it was determined that it was not related to the cycle. The Hangman Hills fire of 1987 reminds that major fires can still occur during a non-peak year. Looking at the 30-year trend in 1988, the next expected year of peak activity was to be 1991.

Traffic control. The county fire chief’s association and the DNR created 4 committees to address the problems. The committees and their action included:

**The Committee on Communications:**
Established a new S-frequency radio network with four tactical channels and a separate command channel.

**The Media Relations Committee:**
Recognized the need for an early assignment of a fire information officer to keep the media and the public informed of the progress of the fire and suppression or evacuation efforts. A fire information workshop was held in 1988.

**The Fire Prevention Committee:**
Prepared proposed changes to Spokane County regulations to better reflect fire agency concerns. The plan addressed access for emergency apparatus and building standards (including fire safe roofing) based on risk zones in the county.

**The Committee on Interagency Cooperation:**
Developed a county incident command system manual and training for incident command personnel. In 1990 and 1991 training was conducted for numerous levels of command personnel.

The review of the Hangman Hills fire also showed the need for an annual interagency fire disaster drill and the formation of an area incident command team. Fire officials conducted a 4-hour disaster drill in 1990 to test all of the new changes in a major interface area. More than 140 personnel participated from 14 fire districts and other agencies. Regional fire agencies were confident that they were ready for the next Hangman Hills-type incident.

Proof of their readiness was demonstrated later in 1990 when a fire threatened 10 homes in the same residential development where the drill took place. Three fire districts and the DNR responded, holding the fire to 10 acres. No homes burned.

The DNR prepared a video, “Wildfire Hits Home,” to inform the public of the fire risks of living in the wildlands. The video detailed what residents could do to better protect themselves. The DNR identified 12 high-risk interface areas in the state and prepared a fire safety booklet on reduction of risks for residents in those areas. Spokane County was one of the high-risk areas identified.

Fire officials increased interagency cooperation. The first statewide wildfire conference was held in May 1989. That was followed by the Northeast...
Further, fire officials in Spokane County recommended imposing county restrictions on housing developments in heavily wooded areas—including a ban on wood shake roofs—to help prevent another Hangman Hills-type disaster. However, none of the recommendations were adopted by the county officials. Opponents of the restrictions claimed that the Hangman Hills fire was an isolated incident and never would happen again.

A month before the Spokane fires, another Washington county, Clark, completed a 10-month, DNR-funded survey of the fire risk faced by 800 homes in wildland/urban interface areas. The survey predicts the likely outcome of a severe wildland fire in the area in terms of survivability of the homes. Fire risk specialists developed a fire risk rating score for each home visited, based on construction features, terrain, and adjacent fuel conditions. Results of the survey showed that only 1 percent of the homes were scored low for fire danger; 68 percent rated moderate fire danger; and 31 percent scored a high fire danger rating, meaning that many would likely be lost in a severe wildfire. The study found that people who were relative newcomers to the area were significantly more likely to plan or make fire safety improvements than those who had lived in the area for many years.

Fire Season 1991

“Closed season” is an official designation by the Washington State Department of Natural Resources for the wildfire season. This is when weather conditions combine high temperatures and low humidity to lower the moisture content of wildland vegetation and allow easier ignition of wildfires. The same conditions that allow easier ignition also contribute to faster spread of any fire. The fire season in Washington is usually from April 15 to October 15.

During the closed season, fires are carefully regulated to reduce opportunities for escaped fires. For example, campfires or burning of brush may be prohibited when surrounding grass and forest fuels are especially dry, or when windy conditions are expected.

The 1991 fire season was adjusted for the year’s early precipitation. The wet spring resulted in higher fuel moisture vegetation contents and the DNR delayed the start of the closed season from April 15 until May 16.

Further, the ample rainfall held the number of fires on DNR-protected lands to 82 for May and June. Only 165 acres burned in these fires, or an average of only 2 acres per fire.

However, September’s lack of rainfall and lower fuel moisture content concerned DNR officials enough to cause them to continue the closed fire season from its normal end on October 15 until October 31.
THE FIRE

Arrival of the Winds

Steadily increasing winds and unseasonably warm temperatures in eastern Washington described the morning of Wednesday, October 16 at 6:00 a.m. It was a normal school and work day, but fire agencies saw the increasing threat. In various ways across the area, these agencies were checking equipment and making what other preparations they could.

Daily temperatures had been reaching the mid-70s. Such temperatures in mid-October were 10 degrees above normal, acting as a drying effect on forest fuels. An approaching cold front would bring some reduction in temperature, but Wednesday, the first day of the fire, would still have a high of 67 degrees.

Residents noticed the increasing winds. First there was the dust, both local and carried from the dry and fallow farmlands miles to the west. Pine needles blew from the trees and carpeted the ground. Smaller branches fell away, and then larger branches as well. Finally whole trees were blown over.

Power lines were not immune to the winds, either. In some cases, its sustained or gusting pressure on the lines made them snap. In other cases, nearby limbs and trees fell onto the lines and brought them down. When the downed lines hit the ground and arced, the grass and other dried vegetation provided the material for ignition, development, and rapid fire spread. (See further discussion in fire growth and spread considerations.)

Winds laden with dust shielded many fires from quick discovery. A news report described the setting that day as a "brown blizzard" that reduced visibility to almost zero. Residents rushed indoors and closed open windows to keep out the dust. One woman’s account declared that the dust was worse than when Mount St. Helens erupted. An automobile accident on Interstate 90 involved 20 cars and 2 trucks when blowing dust reduced visibility. Several highways were closed later in the day because of poor visibility. Several of these closed highways were the access routes for supplemental fire resources traveling to the Spokane area from across the state.

The First Alarms

The City of Spokane’s Fire Central dispatch center reported its first alarm at 8:49 a.m. adjacent to the Spokane airport. Smoke from the fire forced the airport to close for an hour. Over the next hours that first fire became a relatively insignificant incident. The City of Spokane had another three alarm-all fires caused by power lines-in the next 5 minutes. Another regional dispatch center marked its first wind storm call at 8:51 a.m. Within minutes, the fast-spreading fires were reported to be threatening structures.

In the next hour, between 9:00 and 10:00, dispatchers throughout the affected area answered phones from people...
reporting fires or other emergencies non-stop and dispatched alarms on the average of every 60 seconds.

Although the number of alarms was high, individual fire fighters working the early alarms did not yet know that an unprecedented day was beginning. The fire fighters were not fully aware of the activities of other fire crews all over the county because they were on other radio frequencies.

Between 10:00 and 11:00 the alarms being dispatched maintained their earlier pace. Incoming telephone calls rang before dispatchers could send out the previous alarm. In the first 24 hours they would receive more than 3,000 “911” calls (2,000 calls in the first 12 hours) and dispatched 420 alarms. The alarms and the resulting radio traffic, consisting of reports on arrival at the scene and requests for more help, saturated the available radio frequencies. Later in the morning dispatchers often could respond only with, “There are no units available at this time.”

During the third full hour, between 11:00 and 12:00 another 84 alarms were received, some from people reporting the same fire. By the end of this hour, every available county and local DNR fire crew had been committed to the growing number of fires. For the rest of the day, alarms were dispatched in “triage” fashion. Only life-threatening or structure-threatening fires would have resources reassigned from other incident or fires.

Fire Growth and Spread Considerations

Most of the reported fires that day had similar ignition scenarios and fire crews in the area reported similar growth and spread rate factors. Once the fires ignited dried grasses and other ground fuels, the high winds determined the fire spread. The head of the resulting ground fire, the most rapidly spreading portion, moved with the direction of the wind. Its flanks moved more slowly, but still rapidly, by many crews’ descriptions.

The type of fuels ignited determined the initial rate of spread. For example, if the ignition occurred in a large field of dried grass (as many did), the intensity and spread of the fire increased rapidly. The rapid buildup of the fire’s intensity could then more easily involve adjacent, heavier fuels like scrub brush and fallen branches. The fire scenario at this point would have sufficient enough intensity to continue to build and grow into significant wildland fire that could consume everything in its path if there were no intervention.

Some of the fires of Fire Storm ‘91 were indeed successfully suppressed by the fire departments at this point, however, many typical fires on this day were ones that continued to grow. Eventually they reached the heavier fuels, like stands of Ponderosa pines, and began to threaten homes, Typically stands of Ponderosa pine contain dead branches extending to the ground. In some cases these “ladder fuels” enabled the fire to reach the crowns of the 30-to 100-foot pine trees and would result in the fire spreading at extremely high rates. Unlike other severe wildland fires, however, this “crowning” was fairly limited. The high velocity of the winds did not allow the thermal columns from the fires to reach the crowns. Fast-moving ground fires were more typical of the fires. Once wildland fires reach this magnitude, fire crews need weather changes or for the fire to run out of fuel for suppression to be possible.

Further, when fires reach this magnitude (and in some cases earlier), fire intensity is sufficient to ignite homes in its path and to generate burning embers that will be carried by the winds to locations in front of the main fire. Depending on the size of the burning embers and the type of fuels where they land, additional ignitions can occur and the resulting fires may well eventually join the main body of the fire. This is called “spotting”. It is common on large fires and illustrates wildfire danger and the danger presented to fire crews who may become trapped by such phenomenon.

When homes are threatened in such severe fires, the complexity of the suppression effort is greatly increased. This may detract resources from stopping the wildfire and presents a complicated dilemma. In addition to their own fire safety, fire fighters also must then be concerned with residents and with proper deployment of their limited resources in protecting their properties. Fire fighters assess their ability to protect threatened structures based on ignition and safety factors. These factors include access roads for the crews to escape, if necessary the combustibility of roofs, and fuels adjacent to the home.

The continued growth of the fire is influenced by spotting and if homes in the area have combustible roofs, wooden decks, combustible woodpiles and adjacent vegetation, they can become ignited. Then the production of burning shake embers and other airborne brands land on and ignite adjacent combustible roofs. Ignition of homes from this phenomenon can be independent of the main path of the fire and tends to further deplete limited available fire crews.

Although the hazard of combustible roofs did not dominate Fire Storm ‘91 as
in other severe fires, the Ponderosa housing development lost a significant number of homes with combustible roofs that clearly demonstrated the hazard from spotting. Fortunately, the spread to even more homes in the Ponderosa development was prevented because of effective intervention by fire crews and homeowners.

**Structural Fire Crew Operations**

Local volunteer fire crews faced unusual difficulties even before arriving on the scene of a fire. Those who were at work did not get immediate notification of the fires.

Even when notification was rapid, the volunteer generally drove a personal vehicle from home or from work to the fire station and responded from there in the appropriate emergency apparatus. He/she faced several visual and physical obstacles to reaching the station and then responding to the fires:

- The dust storm and smoke from the fire reduced driving visibility and made rapid response dangerous.
- Winds that blew power lines down also blew down trees that blocked or partially blocked roads.
- Winds blew vast quantities of pine needles from the trees and onto the roads, sometimes covering them completely. This produced a very slick roadway that made turning and braking more dangerous.
- Roadways became more congested than normal due to an increased number of concerned residents returning home from work after hearing that their homes were threatened. Later, congestion continued from people evacuating threatened areas. In many cases their driving skills were reduced by the stress and direct threat of the fires. Sightseers flocked to the area to view the devastation, further contributing to traffic problems.
- Loss of power lines made traffic lights and other equipment inoperable. (At Washington Water Power Company in Spokane, 40 telephone service operators handled 11,000 calls in a few hours.)
- Apparatus drivers had to remain especially alert because of the increased number of other emergency vehicles operating in the area. Other large vehicles, such as power company trucks attempting to repair downed lines, presented obstructions to fire response.
- Protection areas are large. For example, Fire Protection District 4 in north Spokane County protects 380 square miles with fewer than 200 fire fighters operating from nine stations. If crews from multiple stations converge on one fire and another fire is discovered nearby, travel distance from the remaining stations can be many miles.

One result of the increased travel time for volunteer fire fighters was that many of the first-response fire units left their stations without fullcrews.

Normally when fire protection district crews arrive on the scene they move to designated tactical radio channels. As increasing alarms were dispatched, personnel at several incidents had to operate on primary dispatch channels to avoid overlapping another incident’s radio traffic. With more than 200 units deployed, and more alarms being dispatched, all area frequencies became saturated with radio traffic. As a result, local fire district chief officers began to use cellular phones to communicate.

Each fire had its own fire department incident commander, and in most cases a joint DNR incident commander. They were responsible for size-up, development of strategy, and ordering and directing their on-scene resources.

However, because of poor visibility during the first 12 hours, most command officers had difficulty in assessing the magnitude of the fires and deployment of resources.

Besides having trouble communicating with dispatch centers, initial attack crews faced a nightmare scenario of having more homes to protect than resources available. The structural triage procedures were used. Under this system a fire crew arrived on the scene, and if several homes were immediately and simultaneously threatened, the officer in charge made a quick determination of whether individual homes were defensible. They deployed available resources to protect only those homes determined to be defensible. The strong winds hampered fire fighters by accelerating fire spread and causing spotting across firelines and natural fire breaks, such as roads. And fire fighters faced the danger of not knowing the fire behavior conditions that could be directly affecting them because of poor visibility. Further, the high winds prevented airplanes and helicopters from operating and providing reconnaissance and suppression flights dropping water or retardant.

The wind speed declined in the afternoon and evening of Wednesday, giving better visibility and opportunities to contain the fires. Small fires began to be controlled. Fresh fire fighters began to arrive in the area, and after 8:00 p.m. no more homes were destroyed.

A deputy chief assigned to the Ninemile fire went up in a helicopter at 9:30 p.m. on Wednesday night for his first view of the fire. He recalled seeing a wall of flames a few miles away and asking the pilot, “Whose fire is that?” The pilot
indicated that was part of the Ninemile fire. That was the first time the deputy chief realized the magnitude of his tire.

The following is an analysis of 3 of the 92 fires that were responsible for the majority of the homes destroyed or threatened.

**Ninemile Fire**

The elongated perimeter area of the Ninemile fire is typical of a wind-driven wildland fire, i.e., fire spread primarily in the direction of prevailing winds. Investigators have determined that the Ninemile fire had 4 separate points of ignition. Three of the fires grew and combined, resulting in an overall burned area of approximately 10 1/2 miles long by 4-1/2 miles wide, comprising 13,840 acres.

The western portion of the Ninemile fire began on Wednesday at approximately 12:00 noon and within the first hour, threatened a dozen homes, destroying 1 of them. An initial 45 minute downslope burn brought the fire to the homes that were positioned in a valley between two rolling hills. Such a relationship of fuels and homes can, and did, produce high fire intensities that are difficult to control, spread rapidly, and make it difficult for the fire department to protect the exposed homes. That more than 50 percent of the homes affected in this initial run of fire were lost is not unexpected, considering the short interval of time before the homes were threatened and the high intensity of the fire. Fire department intervention helped save some homes, but several predetermined factors (e.g., lack of defensible space) resulted in the ignition of others that could not be saved. After assaulting the homes, this portion of the Ninemile fire took a more rapid uphill pace and then burned in more flat terrain until it reached its final perimeter at 6:00 p.m.

The eastern portion of the Ninemile fire threatened the greatest number of homes. The terrain of this portion of the hum also consisted of rolling hills, similar to the western portion of the fire. Elevation changes were from approximately 1,600 to 2,400 feet. Rapid initial runs of the 3 separate fires conformed to predicted rates of fire spread. Two of the fire starts were at approximately the same time, and both had short runovers the first half hour during which fire intensities built. As their intensity grew, their rate of spread increased significantly, and within the next hour even higher intensities and the rates of spread would be experienced. Over the next 2 hours both of these fire spread variables would be affected even more by the combining of the tires, making intervention very difficult.

The fire start at the eastern portion of this section of the Ninemile fire began at 11:47 a.m., by spotting from the other fires. This is a common and dangerous phenomenon in the fire spread of wildland fires, and can enable the fire to spread over long distances and many times beyond established tire defense lines. This fire then combined with the other two fires into a massive fire that threatened the homes. The Ninemile fire burned near the Spokane River, which fire officials hoped to use as a wide, natural firebreak. However, news about the approaching second windstorm caused much concern. The officials worried that if the remaining hot spots were not completely extinguished before the new winds arrived, new fires could jump the river. If that happened, the Chattaroy fire was only a few miles further. If the Ninemile and Chattaroy fires joined, even more homes would certainly be lost. Fortunately, that did not happen. When the second winds hit Monday morning, new starts were immediately controlled.
PONDEROSA FIRE - INITIAL RUN

First 60 min.

Fire Start
11:00 AM

3 Miles

Home Loss

Of the 7 homes destroyed in the western portion of the Ninemile fire, 6 were mobile homes that were found to have little or no defensible space and were subjected to a high intensity fire. Of the 5 homes that survived, one was a mobile home and the remainder were “stick-built” homes. Fire department intervention was a significant factor in the saving of homes. Considering the intensity of this fire it is likely that these homes would have been lost without their intervention.

On the eastern portion of the fire, fire spotting was responsible for threatening homes more quickly than expected. As a result, homeowners and the fire department had only a short time interval in which to prepare. Fire defenses were brought to position near the homes, and with the help of homeowners many of the homes were saved. The homes located at the eastern perimeter of the Ninemile fire were subjected to extremely high fire intensities, and this portion of the fire was the area in which a homeowner lost her life while attempting to escape the fire. This cluster of tires threatened more than 70 homes and destroyed 26 of them.

PonderosaFire

The Ponderosa fire’s perimeter area was approximately 3 miles long and 1 mile wide. The eastern perimeter of the fire encroached on a large housing development where the fire department made a major tactical stand to protect the homes from the approaching fire. The fire began just after 11:00 a.m. on Wednesday when, as with the other fires, many area residents were at work or at school. The initial fire was caused by downed power lines on the slopes of the 3,144-foot Browne Mountain. Like the other fires, the topography of the area is characterized by its rolling hills. The housing development was positioned at the top (outer edge) of one of the hills. Terrain was difficult for those fire fighters who were sent from a nearby fire to attack the new start and protect the homes. Before finding the fire they had to cut several trees that had fallen across the road. They had to stop momentarily when the road virtually disappeared in
the dust and smoke. When they found the fire they could not see to assess its size.

Once the fire began, it spread slowly over the first half hour as its intensity built. Few homes were contained in the initial burn area. The intensity after this time grew as more and more fuels began to burn. As the magnitude of the fire grew, spotting was responsible for igniting fuels at the base of a valley, resulting in a new ignition, and the fire began an upslope run toward the cluster of homes.

The fire’s approach gave the residents of the houses and fire district crews approximately 90 minutes to prepare a defensive line of protection. The majority of homes lost at this fire were at this perimeter area, ignited by the high intensities resulting from the uphill run. Combustible vegetation around some of the homes was ignited as were combustible roofs. Once this happened, these homes added to the flaming brands about the housing development. Although more homes were in danger of ignition as well, the fire department and homeowners intervened and saved many.

**Home Loss**

The housing development is characterized by a high percentage of homes with combustible wood shake roofs. Of the 14 homes destroyed in the Ponderosa fire 10 had wood shake shingles, but the homes were also exposed to extremely high-intensity fire and the fire department was limited in the number of homes it could protect. Lack of defensible space also characterized the homes that were lost. Homeowner and fire department intervention were effective in limiting the continued spread of this intense fire to other homes within the development. They were somewhat aided in their efforts by the fact that fuel densities lowered significantly from natural to ornamental fuels. Although there were ignitions of combustible shrubs, etc., within the development, these fuels presented less dense and more easily suppressed fuels than would have been the case if there had been homes among a dense stand of Ponderosa pine. Had this not been the case, it is likely that the homeowner intervention (using garden hoses, etc., on combustible roofs) would have been ineffective.
CHATTAROY WEST/CENTRAL FIRE

The Chattaroy fire is broken into 3 components: Chattaroy west, Chattaroy central, and the Chattaroy (east) fire. The west and central portions were approximately 3 miles long while the main Chattaroy fire was approximately 6 miles long. The Chattaroy fires were the scene of the highest loss of homes in Spokane County, where 49 were burned, along with a total of 4,760 acres. All 3 sections had perimeter shapes that were typical of a wind-driven fire.

The Chattaroy west fire was reported at 10:40 a.m. and immediately exposed 2 homes, 1 of which was lost. Its intensity grew over the next hour and threatened 14 other homes. Fire department intervention saved most of the homes and was also responsible for "spurs" on the perimeter area. Spotting was a significant problem for the fire department on this fire.

The Chattaroy central fire began at 2:00 p.m. and had 4 separate ignition points caused from spotting. The starts immediately threatened a cluster of 12 homes, destroying 3 of them. As the fire intensity built within the next hour, 16 more homes would be threatened, but all would be saved because of fire department intervention.

The Chattaroy east fire was reported at 10:45 a.m. and immediately threatened numerous homes in its path. The intensity of the fire grew quickly and crowning was observed as the fire moved toward a mobile home park, close to the area of ignition. All 15 homes were destroyed in the park. The fire then jumped a major highway and threatened 40 additional homes in the immediate area within the next hour of burning. Again, fire department intervention helped save all but 8 of the homes.

Home Loss

The Chattaroy fires had just over 200 homes at risk, of which 49 were lost. The majority of the homes were lost within the first 2 hours of the fires. Many of these homes were in a mobile home park, and all were subjected to extremely high fire intensities. Little time existed for intervention. It is fortunate that no lives were lost. As the fire continued to burn for the next 2 hours, fewer homes were lost. All of those lost homes were also subjected to high-intensity fires, had little defensible space, and had no fire department intervention.

The Chattaroy west fire had 13 homes that were at risk, and 3 of these homes were totally destroyed. The homes were destroyed within the first 60 minutes after being exposed to a high-intensity fire. There was no fire department intervention and little defensible space.

The Chattaroy central had approximately 20 homes that were exposed. Three were lost, all early within the fire’s initial burn. The lost homes were exposed to high intensities, had little or no defensible space, and the fire department had no chance to intervene.

Chattaroy central fire had 4 fire starts and lost a cluster of homes within the first 60 minutes of burn. There was no fire department intervention and high-intensity fire spread with little defensible space.
Homes located at the easternmost section of this portion of the fire were effectively saved by the fire department.

Other Fires
The Ponderosa, Ninemile, and Chattaroy fires represented only 3 of the 92 fires of this overall incident. Many of the fires in this “Other” category were as small as 1/10 of an acre, often indicating that nearby residents discovered the fires quickly after ignition and were able to extinguish them before any response from fire crews. However, some were quite large, e.g., Wilbur fire 5,627 acres, Moses fire 1,800 acres. There were 22 fires greater than 100 acres. The Wilbur and Moses fires threatened the greatest number of homes in this category.

Evacuation
Timing of evacuation decisions was complicated because of poor visibility. Public safety personnel could not get overviews of particular fires nor determine how big they were. They could not tell how fast a fire was approaching and which way to send evacuating residents. Once the evacuation decision was made, many residents defied the recommenda-
tion of fire officials and the direct orders from sheriff’s deputies, responsible for the evacuation.

In most cases residents made decisions to ignore an evacuation request or order because they chose to attempt to save their homes. In one case at the Ponderosa fire, a father and son were working on their roof to keep the shingles wet. They pulled up their ladder to keep a sheriff’s deputy from forcing them down.

Thankfully, many residents from areas of high fire intensities followed the evacuation orders or greater loss of life might have been experienced.

The Ponderosa fire forced the evacuation of more than 2,500 residents. They received the word to leave their homes at 12:25 p.m. Thirty minutes later flames raced up the slope to the first homes.

In other places, fire raced so quickly that public safety or sheriff’s officials could not organize an evacuation. Communications problems were one reason, when radio channels became saturated from the number of units operating at one time in the field.

Establishment of Unified Command

By 11:00 a.m. the DNR was ordering outside resources, including overhead teams, overhead crews, engines, liaisons, fire information officers, and weather forecasters. While some DNR personnel continued to respond to incoming fire reports, others were putting together an overall fire organizational plan. The plan was changed several times as conditions changed and as more information became available.

The DNR faced the same difficulties in planning that local fire protection districts faced. In the early hours it was very difficult to get any solid information on the complexity of the situation. With additional help mobilizing from elsewhere in the state as well as neighboring states and federal agencies, the DNR did know that many major fires were burning in at least three counties.

At 5:00 p.m. the DNR called the Spokane County Emergency Management Office and set up a meeting for all agencies (DNR, fire protection districts, law enforcement, and other emergency management agencies). The intent was to gather all of the information each agency had collected on its own. Then they could begin to build an operational plan for the next day.

Their overview was not very encouraging: More than 50 separate fires were still burning, at least 20 of which were major fires burning more than 100 acres each. More than 100 homes had been lost, and there had been one fatality. Concerns to address included determining available and needed resources, whether a joint DNR and fire protection district incident command was needed, evacuation plans, investigation of the fire origins, and how to deal with new fire starts.

By Thursday morning seven fire teams had been activated to control fires in the four-county area. Four of the teams, including three DNR teams and one Oregon state team, were placed under the jurisdiction of the DNR. The USDA Forest Service had one team working the Marshall Lake fire, and a Bureau of Indian Affairs team worked the Moses fire. An Idaho state team managed the Hauser Lake fire burning on the Washington and Idaho boundary.

The fierce winds of Wednesday were not a factor on Thursday and Friday. Conditions improved considerably. On Friday, however, the national weather service fire weather meteorologist assigned to the situation detected ominous changing conditions. He forecasted the approach of a second wind storm. The new winds could equal those of Wednesday. The expected arrival was late Sunday or early Monday.

Good progress had been made in controlling the fires. By Friday at 6:00 p.m., all fires except Ninemile were contained. Containment of the Ninemile fire was at 50 percent. All existing fire complexes were alerted to the new forecast. They were requested to provide whatever resources were available to complete containment of the Ninemile fire in the next 48 hours.

Fire management teams at the Wilbur and Deer Park complexes each provided two divisions of overhead and equipment. They were on line at Ninemile on Saturday.

The fire command feared that the new winds would probably start additional fires and could help the Ninemile fire break through its lines and cross the Spokane River. If it did, it could easily merge with the Chattaroy fire 6 miles away.

A Friday night strategy meeting at 9:00 p.m. alerted all participants of the predicted second storm. Each agency began developing new plans.

Spokane County Commissioners and the City of Spokane jointly declared a state of emergency on Saturday, October 19.
More than 100 people attended a Saturday morning meeting at 10:00 a.m. in an attempt to build a new fire management organization blending all players, including the teams in place (DNR area command), existing dispatch organizations, local fire districts, emergency services, law enforcement, and support organizations. They prioritized the fires in terms of their threat to the urban population. Resource allocations were matched to meet priority needs. Participants planned how to provide timely information to the general public and the media.

Participants were divided into 4 groups (fire, law enforcement, emergency service, and media/public information). Each had 90 minutes to come up with a planned strategy for the second storm. The groups then discussed their plans and determined how all the plans would fit together. A unified command was described and proposed as the organization structure to bring this joint effort together.

The challenge in setting up a unified command was to create an simple system that would be effective in reaching the objectives and priorities of this situation. Extensive prior use of the incident command system (ICS) in the area facilitated this process. Key ICS positions were staffed with both local fire department and DNR personnel.

The unified command sent out a request for 40 structural engines, 100 wildland engines, 20 water tenders, 12 dozers, and 2 Class A foam units. Various agencies in western Washington and in Oregon were the primary responders to the request. Unified Command designated 3 staging areas to coordinate resources. This massive buildup of equipment and manpower was unprecedented in the state of Washington. If the predicted forecast came true, the strategy would be to quickly detect fires and dispatch strike teams to the incident.

The area and fires were divided into four branches, and branch managers were appointed to coordinate and control resource needs and assignments in each branch. The key element to a coordinated effort was the assignment of an on-scene commander to the existing major fires who could communicate face-to-face with the existing DNR incident commander. This on-scene commander would provide instant radio reports to his branch manager of situation status or resource needs. With this information, Unified Command could respond quickly to any situation that the new storm might bring.

By 11:00 a.m. on Saturday, October 19, a DNR summary of the fires showed that 34,804 acres had burned and 2,562 personnel were at work on SO remaining fires, 34 of which involved 100 acres or more. The fires were said to be at the following stages of containment:

- Spokane complex, including Chattaroy and Ponderosa: 80 percent.
- South Stevens fires, including Ninemile: 65 percent.
- Ninemile fire: 50 percent.
- Several fires were 100 percent contained (Kettle Falls, Wilbur, Moses, Marshall Lake), and resources were moved from them to Ninemile. All seemed to be prepared and functional for terminating the current fires or dealing with what might occur during the new wind conditions.

### Staging

The influx of mutual aid fire apparatus and personnel from all over the state created a challenge. Extra assistance was certainly needed, assuming it could be applied properly. If the assistance arrived without organization, however, chaos could result. Staging officers had to consider and answer many questions:

- How many units and what type are coming?
- How many people are on the units?
- What is their level of training in wildland fires?
- Will fuel will be available after the long drive?
- Will food be available?
- Will lodging be available?
- Where should the rigs assemble?
- With all the different radio frequencies in use, how will the command communicate with them?
- Will telephones be available so that the personnel can let families know of their status?
- What extra consumable supplies will be needed, including the mundane, such as toilet paper, and the critical, such as batteries for cellular phones?
- How will the out-of-town drivers find an assigned fire area in a strange rural setting?
- How many local personnel will be needed to assist the crews from out of town?

All of these questions and others were addressed by each of the staging managers working with the unified command. Resources to support the influx of manpower were provided. Each of the staging areas functioned smoothly as the numbers of arriving crews and engines grew.
Approximately 200 engines and 580 crew members responded to Spokane after the multistate mutual aid call went out. Many were assembled into strike teams before leaving their home areas.

After the call went out Saturday afternoon for out-of-area units to respond to Spokane, staging management personnel expected the first new units to arrive between 1:00 and 2:00 p.m. on Sunday, October 20. Instead, eager crews started arriving at 9:30 a.m. Sunday.

By the time many of the strike teams in the western part of the state received the notification to respond, alerted the necessary personnel, readied the equipment and apparatus, and started on the long trip to Spokane, it was 3:00 to 4:00 in the morning. These trips were very difficult for responding personnel. Emergency fire apparatus is not designed for long-haul travel; in many cases travel distance was greater than 300 miles. The maximum speed of the engines is usually limited. The units consume fuel at a relatively high rate. The riding spaces for fire fighters are not designed for comfort and long trips. Noise and vibration remained high for long periods of time. When they arrived in Spokane, crews were often worn out and needed rest before receiving fire fighting assignments.

Staging management personnel set up 3 areas for receiving the units. Each was chosen for the available space, proximity to the fires, and relative convenience of assembling the needed supplies:

**The Spokane County Fairgrounds.** All crews were instructed to first report to the fairgrounds staging area to be checked in and sent to their specifically designated staging area. The fairgrounds location in Spokane was centrally located, but it did not offer all the conveniences for arriving crews. The plan called for 50 of the units to remain staged here.

**Joe Albi Stadium.** This location in north Spokane was closer to some of the biggest fires. A nearby naval reserve training center facility was used for lodging. The stadium allowed for staging apparatus in 5 rows, each extending to 20 units deep.

**Fairchild Air Force Base.** This location to the west of Spokane provided the best food and lodging arrangements for arriving crews. The plan called for 2.5 of the units, with 75 fire fighters, to assemble at the base. The availability of the base resulted from good efforts at interagency cooperation.

People familiar with the fire areas were recruited to coordinate the new crews. Assigned areas needed to be found with a minimum of delay. Maps remained a critical need.

At the 10:00 p.m. briefing on Sunday, staging managers reported that all crews were staged and ready at the 3 locations, fed and rested from their response journeys.

### Public Information

Communications to and from the public quickly became one of the critical tasks of managing this disaster. When the fires started, concerned individuals overwhelmed the Spokane County 911 system with more than 2,600 calls, including both alarms and nonemergency requests for information.

Regular telephone lines into fire districts were also jammed. Local radio and television stations broadcast information on fire locations and conditions, but most of their information came from overhearing scanner radios and on-scene fire reports. Much of the information focused on the three or four biggest fires, while others were not mentioned.

In the early hours no one had an overview of the regional situation. The problem was two fold. Visibility was so low that fire size could not be determined, and fire fighters were working so hard to contain the large number of fires with limited numbers of personnel that they did not take the time to report what they were doing.

Fire information officers from DNR developed a plan to provide additional official information. The plan had 3 components:

1) Provide information to homeowners so they could better prepare their homes to withstand potential new fire starts. Homeowners were encouraged to clean their roofs and yards of dangerous pine needles, dry grass and other debris. The effort provided them with a direct action they could take at a time when just waiting and not knowing anything was especially stressful. A flyer was prepared to remind residents of the coming winds and detail what could be done to prepare. The flyer told residents that they could reduce their risk by creating a defensible space around their homes, having a water reserve, having a practiced family emergency plan, having a list of emergency numbers, and keeping current on changing weather conditions.

   The county established 4 collection points over the weekend where homeowners could deposit their debris. More than 1,500 loads of debris were delivered to these sites. County employees worked through the weekend to haul the material to the landfills.

2) Provide timely and accurate fire information to the media on new fires and changing conditions on existing fires. The unified command prepared news releases for major media briefings.

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### HOME LOSS VS. FIRELINE INTENSITY*

<table>
<thead>
<tr>
<th>FIRE INTENSITY DESTROYED</th>
<th>THREATENED</th>
<th>TOTAL</th>
<th>PERCENT DESTROYED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme &gt;1000</td>
<td>67</td>
<td>89</td>
<td>156</td>
</tr>
<tr>
<td>High 500-999</td>
<td>23</td>
<td>119</td>
<td>142</td>
</tr>
<tr>
<td>Medium 100-499</td>
<td>91</td>
<td>58</td>
<td>59</td>
</tr>
<tr>
<td>low &lt;100</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

*Not all destroyed/threatened homes reported.
FIRE SUPPRESSION INTERPRETATIONS OF
FIRELINE INTENSITY AND FLAME LENGTH CHART

<table>
<thead>
<tr>
<th>FIRELINE INTENSITY (BTU/SECOND/FOOT)</th>
<th>FLAME LENGTHS (FEET)</th>
<th>FIRE SUPPRESSION INTERPRETATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 100 (low)</td>
<td>&lt; 4</td>
<td>Fires can generally be attacked at the head of flanks by persons using hand tools. Handline should hold the fire.</td>
</tr>
<tr>
<td>100 - 500 (Medium)</td>
<td>4 - 8</td>
<td>Fires are too intense for direct attack on the head by persons using hand tools. Handline cannot be relied on to hold fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective. Fires are potentially dangerous to personnel and equipment.</td>
</tr>
<tr>
<td>500 - 1000 (High)</td>
<td>8 - 11</td>
<td>Fires may present serious control problems, i.e., torching, crowning, and spotting. Control efforts at the head will probably be ineffective.</td>
</tr>
<tr>
<td>&gt; 1000 (Extreme)</td>
<td>&gt; 11</td>
<td>Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.</td>
</tr>
</tbody>
</table>

3) Provide a telephone service for the general public, where they could get answers about any fire or to any other question about the disaster. A special telephone number was set up and staffed with emergency services volunteers and 3 fire information officers. Residents were urged not to call 9 11 for this type of information. Teams remained at the phones for another 42 continuous hours and reported that the public seemed pleased to speak with a real person instead of a recording. An evaluation of the concerns revealed during these calls led to the Community Recovery Program.

The Fires, Phase 2

From the time fire management officials learned on Friday of the second wind storm predicted to arrive on Monday, they began to assemble the necessary resources to mount an assault on any subsequent fires that might occur. Concerns of the unified fire commanders were numerous: Would the status of the current fires be such that rekindles would be unlikely by Monday? Would Monday's winds create visibility problems similar to those that hampered accurate assessments of the extent of the fires? Would the returning high winds result in numerous new starts from downed power lines that would be spread over a large geographical area? These concerns and others troubled commanders throughout the weekend, and contingency plans were developed that addressed scenarios such as current fires combining into a massive fire front that endangered residents and homes, and numerous simultaneous fire starts spread throughout the county. These scenarios and others were carefully examined. As Monday approached, the fire crews prepared for the assault of any subsequent fire.

The predicted second storm arrived by 10 a.m. Monday, October 21, bringing with it winds gusting to 52 miles per hour. Again the fires flared up. This time the on-scene incident commanders were in place and ready to evaluate the situation and request additional resources. Strike teams quickly responded to these requests. Sixteen strike teams deployed throughout the day to fires started as a result of the winds. Preparation had obviously paid off. None of these fires developed as the previous fires had, and no lives or additional homes were lost.

Six hours later the winds again calmed, and all major fires were contained within the existing lines.

By 6:00 p.m. on Monday, Unified Command determined that the incident was under control and that mutual aid crews could begin to be released. Crews relaxed and prepared to demobilize, beginning at about 7:00 a.m. Tuesday morning.

Community Recovery Program

After the fires, a community recovery program was established. The intent of the program was to go into the affected communities and hold public meetings to provide additional information to residents about what happened, what services were still available, and what to expect next. Many agencies, including the Red Cross, Salvation Army, neighborhood centers, state and local emergency services department, critical incident stress teams, fire agencies, law enforcement, and the power companies, participated.

Each program lasted about an hour and ended with questions from the residents, either in a public setting or one-on-one, if preferred. Follow-up stress counseling and support continued after the meetings.
**Fire Fighter Safety**

Fast-moving fires and structural triage required fire crews to move from house to house in a highly mobile attack to protect as many defensible homes as possible. Dust and smoke made it impossible to know with certainty what the fire front was doing. Miscalculations could place fire crews and equipment in jeopardy. Crews had to keep their options open for rapid escape every time they stopped their trucks. Hundreds of feet of hose were burned in incidents where crews were forced from their positions by erratic fire behavior. This is a serious problem in suppressing wildland fires. Normally, incident commanders carefully plot the speed and direction of fire travel. They deploy fire crews so as not to endanger them. Then, if sudden and unexpected changes in the behavior of the fires occur, commanders can quickly warn vulnerable units. Such effective communications and assessment by incident commanders depends upon aerial observation and feedback from fire crews regarding fire behavior. This type of control was very difficult in the first 12 hours of Fire Storm '91.

In at least two cases, engine crews were caught in sudden wind shifts. Their positions were burned over after they retreated to areas of lighter fuels for makeshift safety zones. They sought protection in their engines.

With so many incidents underway, normal hazards of fire suppression worsened by weather, and lack of reliable radio communications, fire fighters might become distracted from safety considerations. In Spokane County District 4, they prevented distractions by providing safety warnings on the radio throughout the day. In particular, crews were warned not to get themselves and their apparatus into dangerous locations with limited ability for fast escape.

It was possible (and even likely) for fire fighters to be in hazardous locations without being aware of the danger. For example, a crew of volunteers who were intently focused on trying to save mobile homes threatened by the Chattaroy fire were not aware at first that their apparatus was parked under power lines. Visibility was so limited by smoke and dust that they could not see more than a few feet.

Another “near miss” occurred when some fire fighters, trying to stay warm in below freezing temperatures, kept their engine running and narrowly escaped fatality from carbon monoxide poisoning.

Fortunately, injuries to fire fighters were few and relatively minor. This strongly implies that the preparation, training, and experience of fire crews assigned to the fires paid off.

---

**HOMES LOST AND LOCATION OF MAJOR FIRES**

<table>
<thead>
<tr>
<th>FIRE NAME</th>
<th>SIZE (ACRES)</th>
<th>HOMES DESTROYED</th>
<th>HOMES THREATENED</th>
<th>ESTIMATED $ LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Ninemile</td>
<td>13,840</td>
<td>31</td>
<td>81</td>
<td>3,190,000</td>
</tr>
<tr>
<td>8. Chattaroy</td>
<td>4,760</td>
<td>49</td>
<td>157</td>
<td>7,267,000</td>
</tr>
<tr>
<td>C. Ponderosa</td>
<td>1,587</td>
<td>14</td>
<td>105</td>
<td>4,620,000</td>
</tr>
<tr>
<td>1. Springdale</td>
<td>625</td>
<td></td>
<td></td>
<td>3,000</td>
</tr>
<tr>
<td>2. Happy Hill</td>
<td>398</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Rambo</td>
<td>250</td>
<td>1</td>
<td>11</td>
<td>50,000</td>
</tr>
<tr>
<td>4. Salnave</td>
<td>471</td>
<td>1</td>
<td>5</td>
<td>35,000</td>
</tr>
<tr>
<td>5. Jennings</td>
<td>282</td>
<td></td>
<td>3</td>
<td>41,000</td>
</tr>
<tr>
<td>6. Marshall</td>
<td>982</td>
<td>4</td>
<td>27</td>
<td>823,000</td>
</tr>
<tr>
<td>7. Hangman</td>
<td>125</td>
<td></td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td>8. Keson Pit</td>
<td>150</td>
<td></td>
<td>7</td>
<td>39,000</td>
</tr>
<tr>
<td>9. Midway</td>
<td>42</td>
<td>1</td>
<td>8</td>
<td>117,500</td>
</tr>
<tr>
<td>10. Greenbluff</td>
<td>128</td>
<td>1</td>
<td>3</td>
<td>301,000</td>
</tr>
<tr>
<td>11. Holcomb</td>
<td>760</td>
<td>2</td>
<td>11</td>
<td>358,000</td>
</tr>
<tr>
<td>12. Temple Road</td>
<td>191</td>
<td></td>
<td>9</td>
<td>49,900</td>
</tr>
<tr>
<td>13. Homestead</td>
<td>287</td>
<td>2</td>
<td>1</td>
<td>184,000</td>
</tr>
<tr>
<td>14. Trent</td>
<td>808</td>
<td>2</td>
<td>38</td>
<td>190,100</td>
</tr>
<tr>
<td>15. Jefferson Road</td>
<td>695</td>
<td>2</td>
<td>50,000</td>
<td></td>
</tr>
</tbody>
</table>

**MAJOR FIRES BEYOND**

**SPOKANE COUNTY (NOT SHOWN):**

<table>
<thead>
<tr>
<th>Location</th>
<th>Size (ACRES)</th>
<th>Homes Destroyed</th>
<th>Homes Threatened</th>
<th>Estimated $ Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilbur</td>
<td>5,627</td>
<td>2</td>
<td>13</td>
<td>163,000</td>
</tr>
<tr>
<td>Moses (DNR portion)</td>
<td>1,800</td>
<td>4</td>
<td>13</td>
<td>336,000</td>
</tr>
<tr>
<td>Pend Oreille County (13 fires)</td>
<td>364</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>North Stevens County (30 fires)</td>
<td>565</td>
<td></td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**SMALLER FIRES NOT SHOWN ON MAP:**

<table>
<thead>
<tr>
<th>Complex</th>
<th>Size (ACRES)</th>
<th>Homes Destroyed</th>
<th>Estimated $ Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spokane Complex (24 fires)</td>
<td>51</td>
<td>14</td>
<td>128,000</td>
</tr>
<tr>
<td>South Stevens Complex (4 fires)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Stevens Complex (25 fires)</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pend Oreille Complex (10 fires)</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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24
MAJOR FIRES IN AND AROUND SPOKANE

Location of major fires (see table on previous page)

35 Miles
Fire Fighter Stress

As fire management officers of the Washington State Department of Natural Resources unified the attack on the many fires, they set up several specialist teams to assist. One was a critical incident stress debriefing team.

Stress debriefing teams are normally associated with incidents where deaths are involved. The series of Spokane County fires resulted in only a single death of a resident and no fire fighter deaths. Nevertheless, several conditions contributed to high stress levels and the need for a critical incident stress debriefing team:

The overwhelming number of fires. Many members of fire protection districts had been fire fighters for many years. None had ever faced such a complex situation before. One fire commander surveyed what he could see of one large fire and assumed that perhaps 70,000 acres had burned. He thought that perhaps 200 homes were lost in that one fire. As long as conditions seemed to support such assumptions, stress remained very high.

The length of time firefighters were on duty. Some fire fighters remained on the firelines for long hours over several days with only brief rests. The chronic fatigue of such long hours reduces the normal coping mechanisms.

The uncertainty of the safety of fire fighters' families. Overload of telephone and radio systems made it difficult for fire fighters to be assured that their families were safe. They feared that even schools were not safe. Schools closed due to the emergency, and fire fighter parents had the added worry of wondering where their children would go.

The possibility of losing their own homes. Fire fighters often heard that fire was heading generally toward their homes but were not able to monitor more detailed progress of that fire. They had no way of leaving their current duties to leave and protect their own homes. At least three fire fighters lost their homes.

The pressure of structural triage decisions. During the hit-and-run operations of structural triage, fire fighters were frequently stopped by residents. These residents frantically approached fire fighters with requests and demands for assistance. Where the location or condition of the home made it too dangerous to defend, and resources could be used better elsewhere, fire fighters had to make the correct, but difficult, decision not to take action. The emotional residents could not understand the lack of assistance. Their reaction to the departing fire fighters ranged from tears to disbelief to curses.

Awareness of home losses experienced by personal friends. It was common in the affected areas for fire fighters to know the victims whose homes were destroyed. Personal relationships added to the burdens of fire fighters.

---

BY THE NUMBERS

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum wind gust</td>
<td>62 mph</td>
</tr>
<tr>
<td>Homes destroyed</td>
<td>114</td>
</tr>
<tr>
<td>Most homes destroyed in a single fire</td>
<td>49, Chattaroy</td>
</tr>
<tr>
<td>Acres burned</td>
<td>35,000 approx.</td>
</tr>
<tr>
<td>Homes threatened</td>
<td>511</td>
</tr>
<tr>
<td>Separate fires</td>
<td>92</td>
</tr>
<tr>
<td>Fires caused by power lines</td>
<td>86</td>
</tr>
<tr>
<td>Percent of fires caused by power lines</td>
<td>93.5</td>
</tr>
<tr>
<td>Maximum air temperature during fire</td>
<td>67-F</td>
</tr>
<tr>
<td>Minimum air temperature during fire</td>
<td>18-F</td>
</tr>
<tr>
<td>Firefighters at fire</td>
<td>4000</td>
</tr>
<tr>
<td>Fire engines response</td>
<td>400</td>
</tr>
<tr>
<td>Aircraft responding</td>
<td>20</td>
</tr>
<tr>
<td>Fatalities</td>
<td>1</td>
</tr>
<tr>
<td>Largest single fire</td>
<td>13,840 acres</td>
</tr>
<tr>
<td>Amount of rainfall, previous 41 days</td>
<td>0 inches</td>
</tr>
<tr>
<td>Fires intentionally set</td>
<td>2</td>
</tr>
<tr>
<td>Alarms dispatched, first hour</td>
<td>89</td>
</tr>
<tr>
<td>Alarms dispatched, second hour</td>
<td>57</td>
</tr>
<tr>
<td>Alarms dispatched, third hour</td>
<td>93</td>
</tr>
<tr>
<td>Alarms dispatched, first eight hours</td>
<td>354</td>
</tr>
<tr>
<td>9-1-1 calls received, first 24 hours</td>
<td>3000</td>
</tr>
</tbody>
</table>
ANALYSIS

This series of wildland urban interface fires resulted in the loss of more homes and other structures than any other in Washington wildfire history. The significance of the fires is that similar conditions, which might lead to like disasters, exist elsewhere in Washington and in other states. This is because more people have moved to interface areas to escape the problems associated with urban living, choosing the pristine setting of the forest. Existing natural fuels, the prolonged drought, the wet spring, 41 days without precipitation, and unusually high temperatures and low humidity for October were variables in this disaster. These plus the “predetermined factors” regarding protection (or lack of adequate protection) of homes in the interface areas and high winds are common threads in all severe wildland fires and can produce devastating losses of life and property. Analysis of the destroyed homes indicates that over 50 percent were subjected to extreme fire intensities and over 60 percent had little or no defensible space. Much can be done to reduce such losses. However, the cooperation, commitment, and action of people from federal, state, and local governments, the fire community, developers, and homeowners is required. Many of the lessons learned from these fires are not new lessons but well-understood principles, often ignored, because people think it will not happen to them.

In addition to these factors, other unique aspects of Fire Storm ’91 are noteworthy. The number of fires resulting from the high winds, and the effect that the number of fires had on the ability of fire fighters to intervene and suppress them, illustrates the need for statewide preparedness and training. Typically, wildland urban interface fires do not have numerous fire starts spread over a wide geographical area. More often, they are characterized by one start spreading very rapidly.

The majority of fire starts of Fire Storm ’91 were caused when the high winds brought down power lines or by the winds toppling trees onto power lines. Once this occurred, ignition was almost certain due to the dry nature of the abundant available fuels. Utility line maintenance was not addressed in this report. However, it appears that it may be more important to address maintenance issues of power lines in eastern Washington because of the characteristics of its types of fuels and the fire season. The number of fires caused by downed power lines had a devastating effect on the fire service’s ability to intervene effectively. Multiple fire occurrences are much more complicated for fire incident managers as they organize efforts and direct resources. Reduction in the number of downed lines during such wind conditions should be an achievable objective.

One of the most frequent comments offered by homeowners as an explanation for not preparing for a wildfire is that the fire department will “handle” the fire. Once ignited and without immediate attack by fire personnel, however, many fires under the conditions found in Fire Storm ’91 would have been uncontrollable by any fire fighting forces.

The major factors contributing to this fire and the loss of structures are:

- **Weather conditions.** The hot, dry, windy weather lowered fuel moisture and prepared the area vegetation for easy ignition and rapid fire spread. These conditions occur each year in Washington but were unusual so late in the fire season. Fire protection agencies can predict when these conditions present the greatest fire danger, but they cannot otherwise control them. Homeowners who wait for an announcement of high fire danger to ready their properties have little time for appropriate and thorough preparation.

- **Topography.** The steep topography of some areas in Fire Storm ’91 created a chimney effect that funnelled the fire toward homes at the tops of the ridges. The direction of the prevailing winds, the slopes, and the rising of heated air combined to increase strong winds. This pushed heat closer to unburned fuels ahead of the flames, preheating the fuels and accelerating burning.

- **Fuel types and densities.** Fuel types in the area contributed to the unmanageable intensity of the fire. Fuel types have been rated according to their relative wildfire hazard. Ponderosa pine,
Douglas fir, and mixed conifer are rated in the highest hazard category. The fires started in an area where Ponderosa pine predominates. Abundant rainfall in the spring resulted in lush grass that grew tall but cured through the summer. The grasses provided a significant source of fuel to the resulting ground fires of the day. These fuels, with low branches of live trees, formed ladder fuels and otherwise combined with the heavier fuel types to produce intense fires.

**Fire spotting.** The windy conditions caused many of the fires to spot ahead of the main fire front and further accelerated fire spread, as well as expanding the affected area. This exposed more homes to the fires while reducing the time available for fire fighters to respond to each new outbreak. The additional fires diluted the number of available fire fighters for each particular burning area.

**Construction features.** Homes in the path of the highest fire intensity were often not able to be protected regardless of fire suppression efforts. Given the quantity and type of fuels in the fire zone, the amount of radiant energy generated could ignite combustible homes across normally safe firebreaks. In most cases the survival or destruction of a home was affected not by a single factor but by a combination of factors.

The most consistent factor associated with structure loss of the homes studied in these fires was the distance of the homes from adjacent combustible vegetation. In most cases, the proximity of homes to flammable fuels was 20 feet or less.

A wood exterior construction and open wood decks, porches, or balconies also provided a ready source of easily ignitable fuel. Decks, porches, and balconies did serve as an easy path for burning vegetation to reach structures, and were vulnerable to wind-carried brands from the main fire front. Such decks became even more hazardous when the areas underneath them were used to store combustibles such as firewood.

**Command and control.** The large number of fires throughout this large area overwhelmed fire fighting resources almost immediately. Individual incident commanders could not assess the magnitude of the fire because of the lack of visibility and overloaded communication systems. Fire crews were sent to additional incidents and operated in a hit-and-run structural triage mode. A unified command structure was established and effectively dealt with the fires. When a second weather/wind front was predicted, the unified command structure was able to deal with it.

**Emergency access.** Roadways and restricted driveways to homes limited response and operational choices of fire fighters. The terrain featured roads that twisted to follow the hillsides and ridges.

### Legislation

Soon after the devastating fires of Fire Storm '91, the state of Washington introduced 3 pieces of legislation intended to reduce the perils of future fires. The legislation was (1) State Fire Mobilization Act, (2) Fire Fighter Protection Act, and (3) Rural Homeowner’s Fire Protection Act.

The background section of one of the proposed acts cites that “Over 150 homes have been lost to wildfires in the last 7 years. Suppression costs are estimated to be $12,000,000 for the October fires in northeastern Washington alone.”

Among other issues, these bills attempted to address:

1. A statewide fire mobilization plan to enable fire departments to respond across municipal county or regional boundaries.
2. A means for reimbursement to fire jurisdictions that incur expenses.
3. Issues of liability and protection priorities by the DNR to ensure their first duty is to the public as a whole.
4. Identification of areas having a high or extreme wildfire hazard level.
5. Minimum standards to protect existing and future developments including at least Class B fire-resistance roofing material, defensible space, and vegeta-

6) Clearance requirements for electrical transmission and distribution lines for dead trees, or portions of trees, leaning toward the lines in high and extreme hazard areas only.

7) Requirements for building codes. The State Fire Mobilization Act was passed; in early 1992, the balance of this legislation was defeated. Primary opponents to the protection concepts within the bills were the home construction industry, electric utility companies, property owners, and local officials. Arguments that arose during the hearings included:

Fire protection was a local issue and should be addressed at the local level without state intervention. Spokane County officials in particular felt this was the best approach, even though their track record indicates they failed to enact safeguards recommended by the fire service following the Hangman Hills fire in 1987. As of this writing, after Fire Storm '91, they still have not dealt with the issue.

Requiring minimum building standards would result in increased costs for housing, which is an unfair burden on potential buyers and homeowners. However, increased suppression costs and losses in wildland/urban interface fires result in the general public having higher insurance premiums and taxes to pay for fire protection. The issue is what share of the burden should be borne by the homeowner who chooses to live in an environment susceptible to wildfire versus the general public’s responsibility to provide those homeowners fire protection and replace their losses.

*Increasing the standards on power line maintenance would be costly, as well as legally difficult. While utility companies in most cases can clear vegetation in the rights-of-way that threaten power lines, trees outside the rights-of-way cannot be removed without the owner’s permission. In many cases this permission is not provided. This issue has been adequately addressed in other states, particularly in the West.*
RECOMMENDATIONS

Tragic losses of homes in the wildlands are usually preventable. However, combined efforts of the community organizations, fire services, federal, state and local governments, and individual homeowners are necessary to minimize losses.

Fire Storm ‘91 has resulted in greater local and statewide awareness of the problems associated with the wildland/urban interface. Nevertheless, a continuing and expanded effort must be undertaken to inform the nation of the potential hazards involved in interface areas, to inform them of how they can assess the hazards in their area and to assist them in eliminating the hazards. Clearly, this effort cannot be accomplished by just the individual efforts of one of the listed groups.

**Fire Protection Agencies**

Fire protection agencies are the groups with the greatest knowledge of and experience with the current wildland/urban interface fire problem. Action needs to be taken by these agencies to further prepare them, as well as the people they protect, from the identified fire hazards associated with the wildland/urban interface. The public and lawmakers also rely on the fire service of the community to inform them of fire protection risk and mitigation strategies.

Fire protection agencies need to conduct assessments of the particular risks present in their jurisdictions and prepare strategic plans to reduce those risks in interface areas. Their plans should answer these questions: Are there measures currently within their jurisdiction that prevent construction of easily ignitable homes or that provide adequate access to them for fire suppression purposes? Which homes can be defended during a wildland fire without jeopardizing the safety of fire crews? Also, as part of this assessment, a baseline study to determine the level of awareness of the public concerning these issues should be completed.

Once the prospect for a local wildland/urban interface fire disaster is known, specific training should be conducted to prepare fire suppression agencies for the fire that can be expected.

If wildland fire agencies may be called upon to fight structure fires within wildland areas, they should arrange for the necessary cross-training and equipment (including communications equipment) to deal effectively with that type of fire fighting. Conversely, if structural fire agencies may be called upon to fight wildland fires that threaten structures, they should arrange for the necessary cross-training and equipment to deal effectively with wildland fire fighting.

As the fire fighters discovered in the early minutes of Fire Storm ‘91, conditions may be present that make it virtually impossible for available forces to control a wildfire quickly. Therefore, fire agencies should concurrently train the public to prevent fires and to react properly when a fire occurs.

A fire prevention and public education effort should combine direct-contact training with the distribution of additional informational materials to those individuals who may not initially respond to the offer of direct training. Libraries are also willing to maintain or distribute materials. The depth of this public education effort will depend on the results of the local assessment of the wildland/urban interface risks present.

Fire agencies should determine what interagency cooperative agreements are needed to improve the multijurisdictional coordination in both fire prevention efforts and fire suppression. Major fires will require this combined attack. When a fire occurs, it is too late to begin the preparations for different organizations to work together effectively.

Fire agency personnel should become better aware of the political process that influences items varying from agency funding to fire safety and building code regulations. Agencies should seek out information from other organizations on how best to work with lawmakers to prepare and justify proper regulations to help prevent unsafe development and lack of maintenance of fire safety features in the wildlands.

**The Public/Homeowners**

The people who choose to live in the scenic wildlands have the responsibility of taking necessary precautions when facing predictable hazards. Informed homeowners would be better prepared for surviving a wildfire, but some homeowners in the area of Fire Storm ‘91 admitted to a lack of knowledge about the wildfire risks where they lived.

Potential homeowners should determine the wildfire hazard potential of the immediate area before buying or moving into any home. This information can be obtained from the local fire department. NFPA 299, Standard for the Protection
of Life and Property from Wildfire, provides guidelines for rating the wildfire potential of an area.

Homeowners should contact federal, state, and local fire and forestry agencies for educational programs and materials to address the fire hazard in general. Information should also be shared with children. Information and publications covering numerous wildland home fire safety details are available from many sources, but until individual apathy is overcome the homeowner may not be motivated to take proper precautions. Here, the fire services can function as fire protection resource centers for the public.

It is the responsibility of the individual property owner to provide a defensible space around structures to help protect them. Extra measures to provide additional space are required for structures built on steep slopes or above canyons, and near combustible materials, and exposures.

When homeowners become aware of the wildfire risk of their own areas, they should join forces with other interested individuals and groups to urge lawmakers to respond with legislative assistance to require appropriate fire safety measures by all of those who live in the affected areas.

Community Planners and Officials

A community’s planning and building officials are often the first individuals who communicate local practices and standards to those who want to buy or build in the wildlands. Their understanding of the potential hazards of building in these areas is therefore vitally important.

A map indicating potential wildland fire risk should be created for existing and planned structures. The features specified for the map would include several topography-related factors: elevation, slope percent, drainages, prevailing wind direction, worst-case wind direction (toward structures), and broken topography features.

The wildland fire map should also include fuel types. Zones of possible high-intensity fire must be identified and communicated to property owners. Fuel modification—the removal, spacing, or volume reduction of fuel types to accomplish a reduction in fuel loading—is a primary mitigation measure.

Areas with abnormal accumulations of forest litter should be identified, and a review made of past fire history in each area’s fuel bed.

The authority having jurisdiction should evaluate all existing or planned housing developments to determine relative wildland fire protection ratings. In doing this, jurisdictions must review fire danger weather records to determine patterns of rain, heat, humidity, and fuel moisture. Then property owners must be advised of conditions and their responsibilities.

Developers

This event has also focused on the need to have construction standards for homes in the wildlands. The published version of NFPA 299, Standard for Protection of Life and Property from Wildfire, provides important guidance in this area, but it is fully effective only when adopted by local lawmakers.

In the absence of clear and meaningful regulations for the common good, the practices of uninformed developers may create potential hazards. Fire protection features, or their costs, may not be appreciated by uninformed buyers. However, decisions made at the early stages of a development will affect a home’s fire safety for many years in the future.

All developments should have more than one ingress-egress route and employ looped road networks. Roads should be wide enough for simultaneous access for emergency vehicles and the evacuation of residents. In consideration of the long wheelbase of tankers and other emergency vehicles, roads should be constructed with an adequate curve radius. Homes along dead-end roads and long driveways provide extra privacy for residents but also provide the potential for fire apparatus to become trapped by spreading fire. These roads and driveways should allow access by large emergency vehicles.

Developers should reconsider their frequent use of combustible exterior building materials, or at least offer options for more fire safe materials for potential buyers who may not yet understand the differences.

Developers should also consider the long-range implications of siting unprotected homes on slopes or where water supplies for fire fighting are low or nonexistent.

Developers can provide a valuable service to new buyers, who may initially be distracted by other moving details, by creating appropriate fuel breaks or greenbelt areas.

Lawmakers

Although the public determines acceptable levels of risk from fire in wildland areas, lawmakers react to the perceived needs of constituents and enact the regulations controlling that level of risk. Therefore, it is generally up to homeowners and fire protection agencies to articulate and justify acceptable and unacceptable levels of risk. When losses occur, they usually focus attention on the risks, but preventive actions are preferable. Legislation for such actions may be necessary for homes that are to be located in high hazard areas.

Lawmakers should take the initiative to examine existing laws, regulations, and standards from other jurisdictions that are available for local use in mitigating fire hazards associated with wildland fires.

Lawmakers are encouraged to adopt NFPA 299 as one part of the protection provided for new construction in the wildlands.

Authorities should provide strong building regulations restricting untreated wood shingle roofs and other practices known to decrease the fire safety of a
structure in the wildlands. In the past, untreated wood shingle roofs have repeatedly been shown to be a major contributing factor in the loss of structures to wildfires, yet today some residential subdivisions actually encourage, and some cases even require, wood shingle roofs for aesthetic reasons.

**Utility Companies**

Downed electrical power lines caused the majority of fires. The lines contained sufficient electrical energy to ignite available combustibles easily. Maintenance issues should be examined along with clearance issues to reduce the risk of devastating wildfires from this cause. Such attention and reduction of risk appears justified since such occurrences can result in multiple fires that easily outstrip fire department resources. Many western states have adequately addressed this issue.

**NFPA 299**

NFPA 299, Standard for Protection of Life and Property from Wildfire, presents minimum planning criteria for the protection of life and property from wildfire. It includes information on safe procedures and practices at the wildland/urban interface. The purpose of this standard is to provide this criteria to fire agencies, land use planners, architects, developers, and local government for fire-safe development in areas that may be threatened by wildfire.

The standard would allow homeowners to better evaluate their current homes and homesites—or homes being considered for purchase—with regard to wildfire survival.

Information in the standard provides assistance in determining the hazard rating for surrounding fuels, slopes, structures, and the broader wildland/urban interface area itself. Guidance is given for fuel modification planning and creation of defensible space, design requirements for roads and driveways, and other factors. An appendix addresses public fire safety and fire prevention education. Contact NFPA for additional information regarding this standard.

**SOURCE LIST OF ORGANIZATIONS**

For additional information, contact your local fire department or forestry agency, or contact the following organizations:

**National Association of State Foresters**

444 N. Capitol Street, NW  
Washington, DC 20001  
202-624-5415

**National Fire Protection Association**

One Batterymarch Park  
P.O. Box 9101  
Quincy, MA 02269-9109  
617-770-3000

**United States Department of the Interior**

Interior Building  
18th and C Street, NW  
Washington, DC  
202-653-8800

**United States Department of Agriculture, Forest Service, Fire and Aviation Management**

P.O. Box 96090  
Washington, DC 20090-6090  
703-235-3220

**United States Fire Administration**

16825 South Seton Avenue  
Emmitsburg, MD 21727  
301-447-6771

**Boise Interagency Fire Center**

Publications Management System  
3905 Vista Avenue  
Boise, ID 83705  
208-389-2512