Fires

Key Points

- Fires are among the deadliest of hazards nationally. They include a broad range of incidents from wildland fires especially where urban areas abut natural areas, large single structure fires, multi-structure fires, ship fires, industrial fires and vehicle-related fires.
- Seattle has lost six firefighters since 1989 and 65 civilians since 1994. The trend in the number of casualties seems be dropping, but it is still statistically impossible to verify the drop. The number of structural fires has also been dropping, but the dollar losses have not been.
- Seattle has experienced large fires, including the 1889 fire that destroyed downtown and the 1970 Ozark Hotel fire that killed 20 people. Both fires occurred under different historical circumstances than exist today. The 1889 fire occurred before a modern fire code and the Ozark Fire happened when Seattle had many multi-unit dwellings without sprinklers.
- The 1970 Ozark fire led to legislation mandating that safety systems, such as sprinklers, be retrofitted into older buildings. In an unintended consequence, many owners chose to leave floors unoccupied because the costs of retrofitting outweighed the revenues they produced.
- Fires are a deadly secondary impact of earthquakes and civil disorders. In the 1995 Kobe and 1906 San Francisco earthquakes, more people died from fire than building collapse. Following the 1992 Rodney King verdict, multiple fires were set in Seattle, taxing Fire Department resources.
- Wildfires a significant hazard for some cities in the West and Florida, but they are unlikely here because Seattle does not have urban – wildland interface.
- Large structural fires remain a substantial risk and are most likely to occur in areas with older buildings, i.e., Downtown, the International District, First Hill, Ballard, and the University District.
- Fires in underground electrical vaults have caused prolonged outages in downtown and other dense areas where power has been undergrounded. The effects of these power outages are covered in the chapter on power outages.

Context

Fires have long been a major hazard in urban areas. A series of catastrophic 19th century fires, including one in Seattle, led to the creation of modern fire departments. Even now fires are among the deadliest of hazards nationally.

This section covers all major types of fires: multi-structure fires, large single structure fires, ship fires and fuel tanker fires. Seattle can even be affected by rural fires in its Cascade watersheds. Electrical fires are a special category that is covered under the power outage section. Nationally, some of the worst urban fires have been in cities with a large urban-wildland interface. Seattle doesn't have such areas.

Seattle Office of Emergency Management
Seattle Hazard Identification and Vulnerability Analysis
Fires

Nationally, structural fires are on the decrease, both in total number and in the number of deaths and injuries. Better education, a decline in smoking and an increase in the number of smoke detectors seems to be behind this decrease.

Effective firefighting depends on speed. Firefighters have the best chance to respond effectively when they can detect a fire and reach it quickly in overwhelming numbers. The first step is to isolate the fire to prevent it from spreading; only then do firefighters try to extinguish it. Fires get out of hand when they spread too quickly to be contained, like the Oakland wildfires, when automated suppression systems do not work properly or when they occur in places that are difficult to reach.

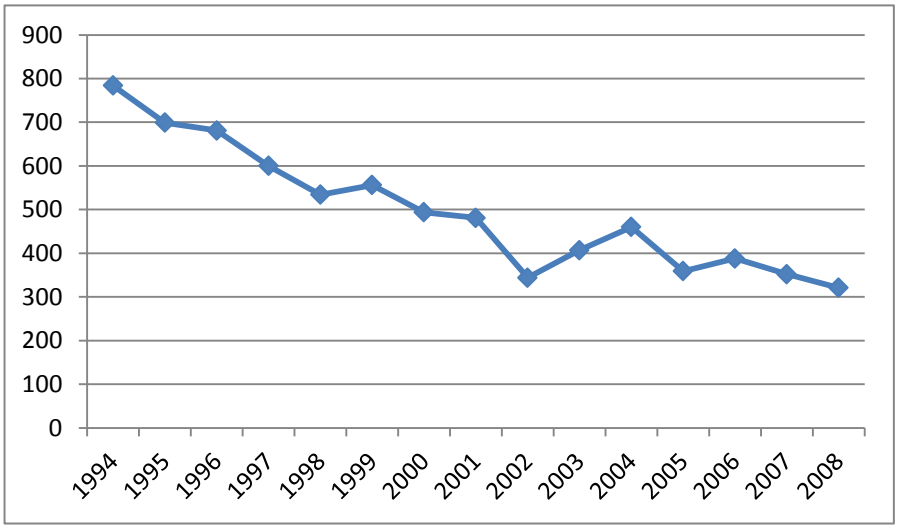
Fires are secondary impacts of other hazards. Fires after earthquakes and during riots are especially threatening. Due to damage to transportation infrastructure or security problems, fire fighters may be unable to reach fires quickly or in adequate strength. An earthquake may damage the water distribution system, lowering water pressure at hydrants. In these circumstances, unattended fires could grow and threaten large areas. From 1900 to 1995 there have been nine large fires following quakes, including Kobe[i]. They can be extremely devastating. The 1906 San Francisco fire destroyed 28,000 buildings. Civil disorder presents the other major fire risk. Arson fires are commonly set during disorders. The 1992 LA riots produced large fires that engulfed whole city blocks. Some of these fires were left to burn after fire fighters were assaulted. The use of accelerants often makes these fires worse

History

Seattle is a city shaped by fire. The catastrophic fire of 1889 consumed 60 acres of downtown Seattle just as the city was poised to become Washington State's leading urban center[ii]. Amazingly, it caused no fatalities or major injuries. Equally impressive was the speedy and complete recovery. The fire occurred right before the biggest period of growth in Seattle's history. Seattle was able to totally rebuild the downtown within eighteen months, doing so with masonry instead of wood. This experience demonstrates how complete a recovery can be given the right circumstances and how vulnerability to a hazard can be mitigated during the recovery process.

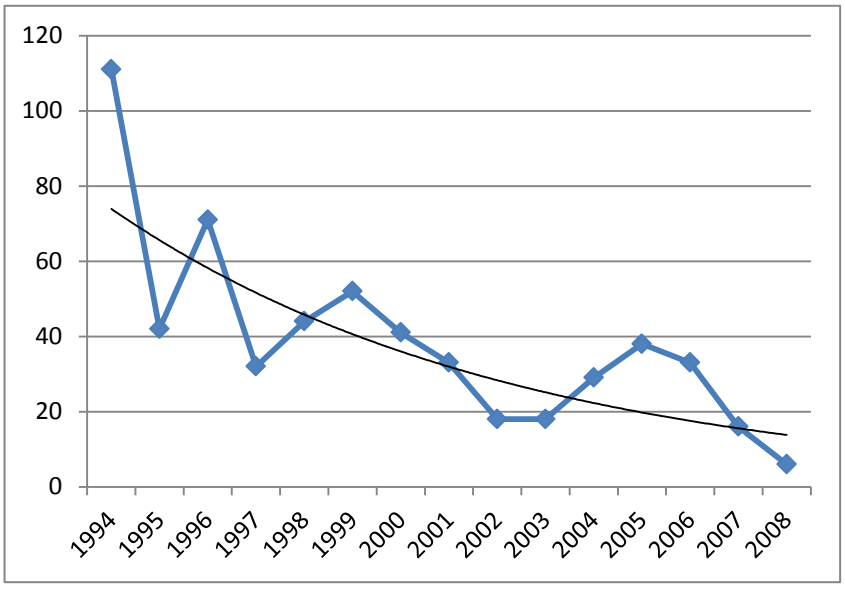
In the past 16 years, the number of structural fires has decreased, following national trends. This has occurred despite recent building booms that have added a considerable number of new structures. As with the rest of the country a combination of better education, decrease in smoking and increased use of smoke detectors is responsible.

Figure 1. Structural Fire Trend



Besides the decrease in incidents there has been a decrease in casualties. The number of deaths is dropping, but it is still too soon to know is this is a part of a trend or a temporary dip.

Figure 2. Casualty Trend.



What has not decreased is the amount of property loss. While the number of casualties correlates with the number of incidents, property loss does not. This is because a few large fires dominate losses every year.

Non-structural fires (i.e., brush, dumpster, vehicle fires, etc.) are another class tracked by the Seattle Fire Department. Like structural fires, highway vehicle fires show a decline. The other categories do not, they have held steady or slightly increased in recent years. It is not clear why.

Significant Fires After the Great Seattle Fire

The Seattle Fire Department has kept records of all multiple alarm fires since 1912. While Seattle has not experienced an event as large as the Great Seattle Fire since 1912, there have been a number of large fires.

July 30, 1914. Colman Dock Fire. Colman Dock stood at the site of the current ferry dock in downtown Seattle. The dock was the largest on the west coast. Five people were killed and 29 injured. Wooden docks, often treated with creosote as a preservative, are very vulnerable to fire.

June 30, 1916. Bell Street Pier. This fire at an army ammunition depot exploded much ordinance, included artillery shells. A bystander, a young boy, was killed by one of them.

April 20, 1920. Lincoln Hotel Fire. A large hotel in downtown Seattle burned completely, resulting in four deaths.

April 30, 1935. City Light South Lake Union Steam Plant. The fire caused a power outage and severe traffic disruption but no deaths.

February 18, 1943. B-29 Crash and Fire. This fire, detailed above in Transportation Incidents, resulted in 32 deaths.

September 9, 1945. St. Vincent de Paul Fire. An arson fire set by unhappy homeless man destroyed a whole block of property and caused four deaths.

July 6, 1948. Lyle Branchflower Explosion. An explosion and fire at a Ballard fish oil producer killed three workers and blew a car off the Ballard Bridge.

May 20, 1958. Seattle Cedar Lumber. Another major fire near the north end of the Ballard bridge resulted in no deaths.

November 11, 1961. Pike Place Market. Fire destroyed 20 stalls and stores, a pedestrian overpass over Western Ave. and a meat market connected to Pike Place Market.

March 20, 1970. Ozark Hotel. This arson fire killed 20 people and had a major impact on Seattle's older neighborhoods. The Ozark was a single room occupancy (SRO) hotel, a type of housing then common that served homeless and seasonal workers. It was a known fire risk. The fire department had inspected in often, but was still vulnerable. It was in disrepair, had no sprinklers and a poor escape route.

April 25, 1971. Seventh Avenue Hotel. A little over one year after the Ozark fire, another SRO burned, killing 12. Following these fires, stringent new fire ordinances were passed. One of the key provisions was the introduction of new, active fire suppression technology like smoke detectors and sprinklers as well as passive systems, such as improved fire engineering in building design. One major unintended consequence of the code revision was the abandonment of the upper floors of older buildings. Owners were required to retrofit these floors if they wanted to continue to occupy them. Most owners found it was not financially viable to do the retrofits and simply abandoned the floors.

December 4, 1975. Fuel Tanker Explosion/Fire on Alaskan Way Viaduct. (Also listed under Transportation Incidents and Hazardous Materials). A gasoline tanker truck crashed. Gasoline leaking

from the truck caught fire, causing extensive damage to surrounding buildings. The fire caused a major downtown power outage when it burned though a power trunk line.

December 22, 1976. Pike Place Market. An apparent arson fire burned the Economy Market Building at 89-99 Pike St.

March 4, 1985. Health Sciences Center. A complex fire occurred on the 13th story of a 17-story building housing an infectious disease lab and trace amounts of radioactive material.

May 9, 1989. M.V. Golden Alaska. A 340-foot seafood processor caught fire below decks, initiating a complex incident requiring days to fully extinguish.

September 9, 1989. Blackstock Lumber. An arson fire at a lumberyard caused the death of one firefighter and severely injured another.

September 16, 1991. M.V. Omnisea. Another fish processor fire involved Seattle Fire units on site for five days.

September 21, 1991. Villa Plaza Apartment Fire. The day after the last units left the scene of the M.V. Omnisea fire, a huge fire broke out in the Villa Plaza Apartments. The complex was grandfathered in under the Ozark Ordinance and did not have sprinklers. There were no deaths, but 232 people were displaced. Because of the media stories alleging that it was a haven for criminals, many residents found it hard to find new housing.

January 5, 1995. Mary Pang Fire. An arson fire in a warehouse resulted in the deaths of four firefighters. The Seattle Fire Department came under heavy criticism and undertook major reforms after this fire.

May 21, 2001. UW Center for Urban Horticulture. An arson fire set by environmental extremists caused $7 million in damage and destroyed years of research.

Likelihood of Future Occurrences

As noted above, the total number of incidents and casualties is decreasing for all structural fires and highway vehicle fires. This is a major success. It reduces the cumulative impact of all fires.

The amount of property loss is increasing rather than decreasing. It seems that the number of large fires it holding steady. Seattle is experiencing fewer fires, but a higher percentage of those that occur are major fires.

One very important fact the data show is that fires do not have to be large to cause injury and death. The number of casualties correlates well with the total number of incidents but very poorly with property loss.

The number of non-structural fires (any fire outside a building: trash fires, grass fires, vehicle, and ship fires) is holding steady with the exception of vehicle fires which are showing a major decrease.

Based on the trends and an analysis of the historical data, there is a strong likelihood that Seattle will continue to have fires that result in high property losses but that are less likely to result in high numbers of casualties.

The 1889 Fire remains the largest in Seattle's history. Seattle was a very different place when it occurred. The chances of another fire like it are remote. The most likely scenario for a multi-block fire like is a post-earthquake fire. Large sections of Kobe, Japan were destroyed is a huge blaze following the earthquake. Damage to the water system crippled the response.

Vulnerability

A review of all multiple alarm fires reveals a clear profile of vulnerability to major fires. Several factors emerge repeatedly:

1. Businesses that contain a lot of fuel. Lumberyards, furniture stores, carpet warehouses, and other businesses using flammable materials are overrepresented in the record because fires started in these businesses are more likely to develop into major blazes.
2. Apartments and hotels. These structures are vulnerable because of their high occupancy.
3. Nightclubs, stadiums, and theaters. Also vulnerable due to high occupancy.
4. Substandard buildings.
5. Arson Targets.
6. Ships.
7. Bridges.

In general, there are two types of fire vulnerability: the first are factors that are more likely to turn an ignition into a major fire and the second is the concentration of people and property. Where the two factors overlap is the area of greatest vulnerability.

In the first category, factors that are more likely to turn an ignition into a major fire, are fuel-rich environments, substandard buildings, arson targets and ships (because of the challenges in fighting them). To these must be added the capabilities of the fire suppression resources. Response time is a key variable. If fires grow quickly before fire apparatus can arrive, single structure fires can spread to other structures. A response time under five minutes is considered good. Seattle's average is under four minutes.

Building architecture governed by building and fire codes the other critical factor in reducing fire risk. Many high-population areas are now made from fireproof materials like brick, steel and concrete that reduces the risk of fire spread. However, most of the city's residential structures are wood, which is vulnerable. In these places, the key variables are early detection, spacing between structures to isolate a large fire and easy access for fire trucks. Seattle requires smoke detectors in all new and existing residential buildings and most other types as well. This law improves the chance the Fire Department will detect fires early, decreasing the probability a fire will get out of control. Due to these factors, the older neighborhoods, where the houses are closer and the streets are narrower, are more vulnerable to a multi-structure fire than new areas.

The second category is concentration of lives and property. Some would add environmental resources as well. Seattle has the densest residential areas between San Francisco and Vancouver, B.C. and this density is increasing. More people are working and living in big structures. If a fire were to occur, more people would be at risk. Density has many positives aspects like reducing sprawl, but its risks must along be acknowledged. Dense residential areas include Downtown, Pioneer Square, Belltown, the International District, Capitol Hill and the University District. Seattle's deadliest fire, the Ozark Hotel fire,

occurred on the edge of downtown in the Denny Triangle area at 7th Ave and Westlake. Because of the heightened vulnerability of dense areas of the city, more effort has been made to reduce frequency, mitigate the effects of and heighten the response to fires in these areas.

In large buildings, the most critical factor is the functioning of passive and automatic systems. In skyscrapers the upper floors are impossible to reach from the outside and HVAC and elevator shafts create corridors to spread a fire throughout the whole structure. Compartmentalized refuge areas, detectors and excellent sprinkler systems are the most effective means to deal with this type of fire. Seattle's codes employ all of these devices. The most vulnerable area, as measured by the size of the exposed population, is Downtown. Fortunately, most of the high-rise buildings there were built after 1970, when fire codes improved. Seattle still has some older high-rise buildings, but these buildings are being replaced or retrofitted due to developmental pressures.

Wildfire exposure is greatest near large open areas, especially those with large fuel loads. Few of these areas are close to high population areas. Areas near transportation corridors seem to have an increased frequency of fires, especially in the summer as brush dries out. At least once, brush along I-5 has burned, threatening homes adjacent to it. The Seattle Fire Department was able to put this fire out using its own crews. Seattle has never experienced devastating urban wildfires as has happened in California, New Mexico and Florida because it lacks large tracts of wildlands. Additionally, the Fire Department has good access to most areas where they could occur. Wildland fires are a threat to Seattle's watersheds, which are heavily forested, remote location. Their greatest impact is on water supply, which is covered in a separate chapter. Seattle Public Utilities maintains its own wildland firefighting capability to combat fires in the City's watersheds.

Consequences

Because of a long term effort to reduce the effects of fires through fire codes, vehicle safety standard, public education and professional firefighting services, the number of fires and the number of casualties is dropping, mainly through a reduction in structural and vehicle fires. Reducing yearly property loss has remained elusive mainly because yearly losses are dominated be a few big incidents.

Large fires are likely to happen again. There are just too many potential targets. One of the main goals in any response is to contain the fire in the structure, vessel or location where it started. Despite some tragic fires, the strategy of containing these fires has largely been successful. This reduces the likelihood of another Great Seattle Fire. While unlikely, it is also possible Seattle could experience a large outdoor fire like those that have occurred in southern California. Sometimes, even a single structure fire can be disastrous as in the case of the MGM Grand Fire that caused 85 deaths or the Station nightclub fire that caused 100 deaths.

Due to the factors outlined above, the scenario that Seattle is most likely to face is a large, deadly structural fire or a fire associated with a transportation incident. Large structural fires still occur every year. Despite all the mitigation efforts, it is not implausible for a major fire to occur in a vulnerable structure. The result could easily be a large number of fatalities and property loss. Damage would probably be contained as long as adequate resources could be brought to bear. Economic effects would probably be limited unless there was destruction of critical infrastructure, e.g., for example a bridge that had to be closed force transportation detours.

Seattle Office of Emergency Management
Seattle Hazard Identification and Vulnerability Analysis
Fires

Most Likely Scenario

A fire onboard a cruise ship erupts shortly after guests have arrived. The vessel is underway in Elliott Bay. The crew cannot contain the fire and requests help from SFD and Coast Guard resources. 7 people are killed. Thousands evacuate. The fire is deep in the ship and difficult to reach. Bunker fuel is leaking from the ship.

Category	Impacts 1 = low 5 = high	Narrative
Frequency	4	Large fires have occurred with regularity in Seattle. Overall trends show a decrease in the annual number of structural fires, but property losses show no decrease. A handful of big fires seem to be dominating fire losses. Casualty trends are decreasing, but there is large variability in the data.
Geographic Scope	2	The large ship fire is centered on a single site but the incident's complexity affects a part of the waterfront.
Duration	2	Ship fires are difficult to fight because it is hard to get at the fire itself. It takes 2 days to put out the fire and 1 more day to stabilize the ship. During this time, shelter must be found for guests and crew.
Health Effects, Deaths and Injuries	2	7 people are killed and 23 are critically injured.
Displaced Households and Suffering	5	The fire leaves thousands of guests and crew members (many are not Seattle residents) stranded and in need of shelter. The cruise line can help but there is a shortage of hotel space in the area.
Economy	1	The cruise line takes a big loss, but is able to keep its operation in Seattle running. Local businesses cater to stranded guests see an uptick in sales
Environment	2	The burning ship leaks bunker fuel into Elliott Bay. Crews are able to contain and skim more of it, but a significant amount escapes.
Structures	1	The fire does not damage buildings on shore.
Transportation	2	Most of the city is not impacted, but the area around the Bell St. pier is used as a staging area for on shore fire response and reception of guests. Traffic in this area is heavily impacted. Later a marine terminal is necessary to salvage the ship.
Critical Services and Utilities	2	Seattle Fire must commit many resources. Several eastside companies that would normally backfill are not available because they are on assignment in eastern Washington fighting wildland fires. As a result Fire must reduce its level of service.
Confidence in Government	1	The Seattle Fire Department is able to effectively fight the fire. The City of Seattle is able to work with the cruise line to find shelter for cruise guests and out of area crew. The public views the response as a success.
Cascading Effects	2	The fires cause a hazardous material incident in Eilliott Bay. It is a serious problem, but does not constitute a second disaster.

Seattle Office of Emergency Management
Seattle Hazard Identification and Vulnerability Analysis
Fires

Maximum Credible Scenario

An Amtrak train and a freight train carrying crude oil collide in the BNSF tunnel near the southern entrance. The oil train is only partially inside the tunnel. The tunnel lacks modern fire suppression technologies. The smoke collects in the tunnel overwhelming many passengers. 116 people die and 230 are injured. The Fire Department vents fumes from the southern end of the tunnel. The fire weakens the roof of the tunnel which collapses. The southwesterly wind blows the smoke into downtown forcing the evacuation of much of downtown including the Seattle EOC and the Seattle Municipal campus.

Category	Impacts 1 = low 5 = high	Narrative
Frequency	2	Seattle has not experienced a large tunnel fire, but had a fuel tanker catch fire on the viaduct in 1975.
Geographic Scope	2	The fire affects the whole tunnel, SR 99 and areas surrounding the tunnel entrances.
Duration	4	The initial response takes 1 day but stabilizing the tunnel and investigating the accident takes a week. The tunnel remains closed until the damage to tunnel infrastructure is repaired.
Health Effects, Deaths and Injuries	4	116 people are killed due toxic smoke and heat. The lack of adequate safety infrastructure in the tunnel adds to the casualties. 230 people are injured.
Displaced Households and Suffering	3	143 non-Seattle residents need temporary shelter until they can leave. 34 people have friends and relatives in hospital and want to stay longer to be with them.
Economy	3	The tunnel is severely damaged and must remain closed while repairs take place. The tunnel is a major freight corridor. Trains must use alternate routes that add hours to trips. Seattle shipping and manufacturing suffers as a result.
Environment	2	Venting of smoke and fumes into downtown causes evacuation of areas near the accident site.
Structures	2	The tunnel collapses near the fire. The sudden failure causes the ground above to fail damaging 2 buildings on the surface.
Transportation	4	Public safety cannot access parts of downtown due to toxic smoke, including routes to Harborview hospital. Surface transportation is affected by the evacuation of downtown. I-5 is closed while the plume covers it (12 hours). After the fire is out the tunnel remains closed for repairs. Surface transportation returns to normal but rail remains severely impacted.
Critical Services and Utilities	2	Toxic smoke drifts into Harborview. Health officials must decide whether to shelter in place or evacuate. Seattle Fire must backfill with mutual aid.
Confidence in Government	3	The accident begins a new tunnel controversy and the public blames the government for not making the tunnel safer.

Category	Impacts 1 = low 5 = high	Narrative
Cascading Effects	4	The fire has major secondary effects. The incident causes a disastrous hazardous materials incident and a tunnel collapse.

Conclusions

With many high-occupancy buildings and densely populated areas, Seattle has a high exposure to fire loss. The risk this exposure entails has been reduced by measures to decrease the frequency and mitigate the effects of disastrous fires. They include the adoption of stringent Fire and Building Codes and the maintenance of a four-minute Fire Department response time.

The most credible worst case risk is the outbreak of multiple large structural fires as a secondary impact from a civil disorder or earthquake. The Seattle Fire Department has prepared plans for triaging incidents in this situation. This planning emphasizes first performing windshield surveys to grasp the extent of the problem, then responding to the most critical situations. If resources are unable to command all incidents, some fires may be left to burn or only enough resources will be committed to prevent the fire from spreading to adjacent structures.

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[i] Council on Tall Building and Urban Habitat, 1992.
[ii] Sale, 1976.