CHAPTER 4: FIRE HAZARDS

4.1 Wildland Fires

Due to its weather, topography and native vegetation, the entire southern California area is at risk from wildland fires. The extended droughts characteristic of California's Mediterranean climate result in large areas of dry vegetation that provide fuel for wildland fires. Furthermore, the native vegetation typically has a high oil content that makes it highly flammable. The area is also intermittently impacted by Santa Ana (or Santana) winds, the hot, dry winds that blow across southern California in the spring and late fall. These winds often fan and help spread fires in the region. Combine these conditions with the fact that more people than ever are living and playing in wildland areas, and the potential for major wildland fires to occur increases even further. In fact, the wildfire risk in the United States has increased in the last few decades with the increasing encroachment of residences and other structures into the wildland environment and the enduring drought conditions that have affected some regions. Between 1990 and 1999 inclusive, there were on average 106,347 wildfires annually in the United States, for a combined average annual burn of nearly 3.65 million acres of brush (htpp://nifc.gov/fireinfo/1999/highlites.html). These fires are for the most part caused by people: between 1988 and 1997, human-induced fires burned nearly eight times more acreage than fires caused by lightning.

A wildfire that consumes hundreds to thousands of acres of vegetated property can overwhelm local emergency response resources. Under the right wind conditions, multiple ignitions can develop as a result of the wind transport of burning cinders (called brands) over distances of a mile or more. Wildfires in those areas where the wildland approaches or interfaces with the urban environment (referred to as the urban-wildland interface or UWI) can be particularly dangerous and complex, posing a severe threat to public and firefighter safety, and causing devastating losses of life and property. This is because when a wildland fire encroaches onto the built environment, ignited structures can then sustain and transmit the fire from one building to the next. This is what happened at three of the most devastating fires in California: the Oakland Hills/Berkeley Tunnel fire of October 1991, the Laguna fire of 1970 in northern San Diego County, and the Laguna Beach fire of 1993. In the Oakland Hills fire, 25 lives were lost, and 2,900 structures were damaged for a total of $1.7 billion in insured losses. The September 1970 fire, which started as a result of downed power lines, burned 175,425 acres, destroyed 382 structures and killed 5 people. The Laguna Beach fire of 1993 burned 14,437 acres and destroyed 441 homes, but thankfully no lives were lost. It is clear that continuous planning, preparedness, and education are required to reduce the fire hazard potential, and to limit the destruction caused by wildfires.

Fires usually last only a few hours or days, but their effects can last much longer, especially in the case of intense fires that develop in areas where large amounts of dry, combustible vegetation have been allowed to accumulate. If wildland fires are followed by a period of intense rainfall, debris flows off the recently burned hillsides can develop. Flood control facilities may be severely taxed by the increased flow from the denuded hillsides and the resulting debris that washes down. If the flood control structures are overwhelmed, widespread damage can ensue in areas down gradient from these failed structures. This happened in several communities in and near the base of the San Gabriel Mountains during the winters of 1934, 1969, 1978, and 1980, with areas below burned watersheds receiving the bulk of the damage. In November 1933, there was a large fire in the Montrose-La Crescenta area that burned more than 5,000 acres. Then, on January 1, 1934, the recently burned watershed experienced an exceptionally intense rainstorm. Debris-laden flows that overtopped canyons impacted the La Crescenta and Glendale areas. Streets were clogged with debris, several bridges were washed out, and several people died (see Chapters 2 and 3).

However, this does not need to happen if remedial measures following a wildfire are taken in anticipation of the next winter. Studies (Cannon, 2001) suggest that in addition to rainfall and slope steepness, other factors that contribute to the formation of post-fire debris flows include the underlying rock type, the shape of the drainage basin, and the presence or absence of water-repellant soils (during a fire, the organic material in the soil may be burned away or decompose into water-repellent substances that prevents water from percolating into the soil.)

Other effects of wildfires are economical and social. Homeowners who lose their house to a wildfire may not be able to recover financially and emotionally for years to come. Recreational areas that have been affected may be forced to close or operate at a reduced scale. In addition, the buildings that are destroyed by fire are usually eligible for re-assessment, which reduces income to local governments from property taxes.

The impact of wildland fire on plant communities is generally beneficial, although it often takes time for plant communities to re-establish themselves. If a grassland area has been burned, it will re-sprout the following spring. A chaparral community, however, takes three to five years to recover. Oak woodland, which has had most of the seedlings and saplings destroyed by fire, will require at least five to ten years for a new crop to start.

Regardless of the comments above, we should not forget that wildland fire is a natural process. In the past, the presumption has been that all wildfire is bad, and that it should therefore be extinguished promptly. This has caused fire-dependent plant communities to grow more densely, which ultimately weakens the plants in their struggle for living space and increases their destruction by pests and disease. Dead and dying plants add fuel for fire. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas (http://www.nps.gov/gosp/resource/fire_nps.htm). Consequently, land management agencies are now committed to finding ways, such as prescribed burning, to reintroduce fire into natural ecosystems. Future efforts to reduce this hazard need to consider ways of managing wildland fire to benefit the natural environment, while reducing the potential for structural fires in the built environment. Policies developed to manage the fire hazard will be successful if a balance between both goals is obtained.

4.1.1 Wildland Fire Susceptibility Mapping

Wildfires have been part of the natural ecosystem in the rolling hillsides and mountains of southern California for thousands of years. Some of the plants native to this area actually require periodic burning to germinate and recycle nutrients that enrich the soils. Researchers have also determined that Native Americans in California used fire to reduce fuel load and improve their ability to hunt and forage. It is thought that as much as 12 percent of the State was burned every year by the various tribes (Coleman, 1994). In the early 20th Century, as development started to encroach onto the foothills, wildfires came to be unacceptable as they posed a hazard with the potential loss of property and even life. As a result, in the early 1920s, the fire service began to prevent wildfires from occurring. Unfortunately, over time, this led to an increase in fuel loads. Wildfires that impact areas with fuel buildup are more intense and significantly more damaging to the ecosystem than periodic, low-intensity fires.

The fire hazard of an area is typically based on the combined input of several parameters. Some of these conditions include:

- fuel loading (that is, type of vegetation, its density, and moisture content),
- topography (slope),

- weather,
- dwelling density and accessibility,
- building construction (with emphasis on combustible roof coverings),
- wildfire history, and
- whether or not there are local mitigation measures in place that help reduce the zone's fire rating (such as an extensive network of fire hydrants, fire-rated construction materials, fuel modification zones, fire sprinklers in structures, etc.).

Since the early 1970s, several fire hazard assessment systems have been developed for the purpose of quantifying the severity of the hazard in a given area. Those that have been developed in California are described further below. Early systems characterized the fire hazard of an area based on a weighted factor that typically considered fuel, weather and topography. More recent systems rely on the use of Geographic Information System (GIS) technology to integrate the factors listed above to map the hazards, and to predict fire behavior and the impact on watersheds.

HUD Study System: In April 1973, the California Department of Forestry and Fire Prevention (CDF) published a study funded by the Department of Housing and Urban Development (HUD) under an agreement with the Governor's Office of Planning and Research (Helm et al., 1973). As is often the case, the study was conducted in response to a disaster: during September and October 1970, 773 wildfires burned more than 580,000 acres of California land. The HUD mapping process relied on information obtained from US Geological Survey (USGS) 15- and 7.5-minute quadrangle maps on fuel loading (vegetation type and density) and slope, and combined it with fire weather information to determine the Fire Hazard Severity of an area.

California Department of Forestry and Fire Protection – State Responsibility Areas System: Legislative mandates passed in 1981 (Senate Bill 81, Ayala, 1981) and 1982 (Senate Bill 1916, Ayala, 1982) that became effective on July 1, 1986, required the CDF to develop and implement a system to rank the fire hazards in California. Areas were rated as moderate, high or very high based primarily on fuel types. Thirteen different fuel types were considered using the 7.5-minute quadrangle maps by the US Geological Survey as base maps (Phillips, 1983). Areas identified as having a fire hazard were referred to as **State Responsibility Areas** (SRAs) (Public Resources Code Section 4125). These are non-federal lands covered wholly or in part by timber, brush, undergrowth or grass, for which the State has the primary financial responsibility of preventing and suppressing fires.

Bates Bill Process: The Bates Bill (Assembly Bill 337, September 29, 1992) was a direct result of the great loss of lives and homes in the Oakland Hills Tunnel Fire of 1991. Briefly, the California Department of Forestry and Fire Protection (CDF), in cooperation with local fire authorities was tasked to identify Very High Fire Hazard Severity Zones (VHFHSZs) in Local Responsibility Areas (LRAs). To accomplish this, the CDF formed a working group comprised of state and local representatives that devised a point system that considers fuel (vegetation), slope, weather, and dwelling density. To qualify as a VHFHSZ, an area has to score ten or more points in the grading scale.

Once the boundaries of a VHFHSZ have been delineated, the CDF notifies the local fire authorities that are responsible for fire prevention and suppression within that area. Since the State is not financially responsible for Local Responsibility Areas, local jurisdictions have

final say regarding whether or not an area should be included in a VHFHSZ (Government Code Section 51178). As a result, although several areas in California have adopted the State-developed fire hazard maps, many local jurisdictions did not acknowledge the Bates system, and developed their own maps instead. Local jurisdictions that do not follow the Bates system are required to follow at a minimum the model ordinance developed by the State Fire Marshal for mitigation purposes. The City of Glendale is one of the cities that has developed its own fire hazard maps and has adopted stringent hazard mitigation programs that have often been years ahead of State regulations. This will be discussed further in the following sections of this report.

California Fire Plan: The 1996 California Fire Plan is a cooperative effort between the State Board of Forestry and Fire Protection and the CDF (California Board of Forestry, 1996). This system ranks the fire hazard of the wildland areas of the State using four main criteria: fuels, weather, assets at risk, and level of service (which is a measure of Fire Department's success in initial-attack fire suppression). The California Fire Plan uses GIS data layers to conduct the initial evaluations, and local CDF Ranger Units are then tasked with field validation of the initial assessment. The final maps use a Fire Plan grid cell with an area of approximately 450 acres, which represents 1/81 of the area of a 7.5-minute quadrangle map (called Quad 81). The fire hazard of an individual cell is ranked as moderate, high or very high. This system is expected to replace the current State Responsibility Areas process, but at the time of this writing, the California Fire Plan has not been implemented. For additional information regarding this system refer to http://www.fire.ca.gov/FireEmergencyResponse/FirePlan/FirePlan.asp.

FireLine System: The Insurance Services Office (ISO) developed a program used by the insurance industry to identify those areas where the potential loss due to wildfire is greatest (ISO, 1997). ISO retained Pacific Meridian Resources of Emeryville, California to develop the FireLine software, which uses satellite-imagery interpretation to evaluate the factors of fuel types, slope and roads (access) to develop the risk rating. Most insurance companies that provide insurance services to homeowners in California now use this system. This software is only available through ISO. Updated versions of this system are being developed that include the factors of elevation, aspect, and relative slope position.

National Fire Plan: Funding for the National Fire Plan was authorized by Congress in October 2000 in response to the wildfires of that year. The plan is a cooperative effort of the US Department of Agriculture's Forest Service, the Department of the Interior, and the National Association of State Foresters. National Fire Plan maps show communities that are within the vicinity of federal lands that are at high risk from wildland fire. The plan uses hazardous fuel reduction treatment techniques (including prescribed fire alone, mechanical treatment alone, mechanical treatment plus prescribed fire, and other/wildland fire use, such as allowing lightning-caused fires to burn) to reduce the impact of wildland fire on communities within the urban-wildland interface. For additional information refer to http://www.fireplan.gov/.

FARSITE, BehavePlus and FlamMap: These are PC-based computer programs that can be used by local fire managers to calculate potential fire behavior in a given area using GIS data inputs for terrain and fuels. The purpose of these models is to predict fire behavior. Data inputs that can be used in the analyses include elevation, slope, aspect, surface fuel, canopy cover, stand height, crown base height and crown bulk density.

The oldest of these models is the BEHAVE Fire Behavior Prediction and Fuel Modeling System (Burgan and Rothermel, 1984; Burgan, 1987; Andrews, 1986; Andrews and Chase, 1989; Andrews and Bradshaw, 1991) that has been used since 1984. A newer version of it is referred to as the BehavePlus Fire Modeling System (Andrews and Bevins, 1999). This software is undergoing additional updates to make it more user- friendly and provide additional fire modeling capabilities. FARSITE (Finney, 1995, 1998) "simulates the growth and behavior of a fire as it spreads through variable fuel and terrain under changing weather conditions" (http://fire.org/cgi-bin/nav.cgi?pages=JFSP&mode=9). This software can be used to project the growth of ongoing wildfires and prescribed fires, and can be used as a planning tool for fire suppression and prevention, and fuel assessment. The FlamMap fire behavior mapping and analysis system is still under preparation, although a prototype has been released and is being used for the Tahoe Basin project (http://fire.org/cgi-bin/nav.cgi?pages=JFSP&mode=11). FlamMap combines elements of the two older models. The Glendale Fire Department is considering the use of some of these computer models to simulate fire conditions and predict fire behavior in the fire hazard areas of the City.

Brian Barrette's Structural Vulnerability System: This system starts with the State Responsibility Area fire hazard severity rating described above, but also includes structural elements as rating factors (Barrette, 1999). The structural elements considered include roofing, siding, vegetation clearance, roads and signage, chimneys, structural accessories, water supply, and the location of the structure in relation to the surrounding conditions. This system is intended for use in assessing individual parcels, and is therefore not likely to be used by agencies, as it is time- and personnel-intensive. However, the system is easy to use and can therefore be used by individual homeowners or insurance companies to determine whether or not a specific property has a high fire hazard and is therefore a good candidate for specific fire hazard mitigation measures.

4.1.2 Wildland Fire Susceptibility in the Glendale Area

Several historical fires have impacted the Glendale area and vicinity over the years. In fact, as shown on Plate 4-1, the entire northern two-thirds of the City have burned at some time in the last 125 years. Historical records kept by the City and the County of Los Angeles indicate that significant acreage was impacted by fires in 1878, 1927, 1933, 1964, 1975, and 1980. The most recent wildland fire in the area occurred in September 2002 (see Figure 4-1). The worst fire in the City's history, however, is the College Hills fire of June 1990, which burned 100 acres and destroyed 64 homes in the foothills of the San Rafael Hills.

Figure 4-1: September 2002 Fire in Glendale

NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

Earth Consultants International (ECI) makes no representations or warranties regarding the accuracy of the data from which these maps were derived. ECI shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to any claim by any user or third party on account of, or arising from, the use of this map.

Explanation

Year of Last Burn

- 1990-2002
- 1970-1989
- 1950-1969
- 1900-1949
- Pre-1900

Glendale City Limit

Area Burned in September 11, 2002 Fire

N
W E
S

Scale: 1:60,000

1000 0 1000 2000 3000
Meters
5000 0 5000 10000 15000
Feet

Base Map: USGS Topographic Map from Sure!MAPS RASTER
Source: City of Glendale Fire and Los Angeles County Fire Departments

This map shows areas in Glendale that have burned between 1878 and 2002 based on maps prepared by the City of Glendale Fire and Los Angeles County Fire Departments.

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Historical Wildland Fire Map of the Glendale Area

Plate 4-1

- **Climate**: The Glendale area typically has mild, wet winters that lead to an annual growth of grasses and plants. This vegetation dries out during the hot summer months and is exposed to Santa Ana wind conditions in the fall. During Santa Ana conditions, winds in excess of 40 miles per hour (mph) are typical; gusts in excess of 100 mph may occur locally. Santa Ana winds are generally consistent in their direction, but when combined with winds generated from burning vegetation, the wind direction generally becomes extremely erratic. This can stress fire-fighting resources and reduce fire-fighting success.

- **Geography and Topography**: Although Glendale is a highly urbanized community, there are several large areas in the City that consist of undeveloped, grass- and chaparral-covered hillsides and mountains. The Verdugo Mountains, located in the western section of the City, are more than 2,300 feet higher in elevation than the valley floor. Similarly, at their highest point, the San Rafael Hills rise more than 1,200 feet above the alluvial plain in the eastern section of the City. The San Gabriel Mountains to the north have an elevation gain of as much as 2,700 feet within City limits. The rough topography that characterizes these areas not only facilitates the spread of fire but also impedes or hinders responding fire-fighting personnel and equipment. Traffic congestion in the urban areas and long travel distances and narrow, winding roads in the hillsides and mountains can also hinder fire department response to the urban-wildland interface areas. Thus, enhanced onsite protection for structures and people in or adjacent to these undeveloped areas is absolutely necessary, with property owners assuming responsibility for maintenance of their properties and adhering to construction standards that make their houses more fire-resistant.

Figure 4-2: Slopes Burnt During the September 9-11, 2002 Fire in Glendale

- **Geology**: Several major earthquake-generating faults affect the region, including the Verdugo, Sierra Madre, Raymond, and Hollywood fault systems. A moderate earthquake on any of these faults could trigger multiple fires, disrupt lifeline services (such as the water supply), and trigger other geologic hazards, such as landslides or rock-falls, which could block roads and hinder disaster response.

In addition to the natural conditions described above, some hillside areas in the City have a historical legacy of narrow roads, difficult access, insufficient water supplies, and non-rated flammable building construction. Furthermore, an increasing number of people use the surrounding undeveloped areas for recreation purposes, and as a result there is an increased potential for fires to be accidentally or purposely set in the difficult-to-reach portions of the City.

Given the above conditions, it is not surprising that the Glendale Fire Department rates almost two-thirds of the City as highly susceptible to wildland fires. The High Fire Hazard Areas in the City defined by the Glendale Fire Department are shown on Plate 4-2. These areas are based on vegetation, access, zoning and topography.

Notice that the Glendale Fire Department, consistent with the Bates Bill process described above, does not classify the fire hazard of an area as low, medium, high or extreme, but rather, a property is either in the fire hazard area, or it is not. [The City's High Fire Hazard Area includes all areas with a medium, high or extreme brush fire hazard as delineated in the City's 1975 Safety Element.] The reason for this yes - no approach is that California State law requires that fire hazard areas be disclosed in real estate transactions; that is, real-estate sellers are required to inform prospective buyers whether or not a property is located within a wildland area that could contain substantial fire risks and hazards [Assembly Bill 6; Civil Code Section 1103(c)(6)].

Real estate disclosure requirements typically ask two "yes or no" questions concerning fire hazards. The questions are formatted as follows:

THIS REAL PROPERTY LIES WITHIN THE FOLLOWING HAZARDOUS AREA(S):

- A VERY HIGH FIRE HAZARD SEVERITY ZONE pursuant to Section 51178 or 51179 of the Government Code. (The owner of this property is subject to the maintenance requirements of Section 51182 of the Government Code.) [Note that the Fire Hazard Areas in the City of Glendale are, for the purposes of real-estate disclosure purposes equivalent to the State's Very High Fire Hazard Severity Zones, however, the City rather than the State defines maintenance requirements.]

- A WILDLAND AREA THAT MAY CONTAIN SUBSTANTIAL FOREST FIRE RISKS AND HAZARDS pursuant to Section 4125 of the Public Resources Code. (The owner of this property is subject to the maintenance requirements of Section 4291 of the Public Resources Code. Additionally, it is not the State's responsibility to provide fire protection services to any building or structure located within the wildlands unless the Department of Forestry and Fire Protection has entered into a cooperative agreement with a local agency for those purposes pursuant to Public Resources Code Section 4142.) [Given that there are no State Responsibility Areas within the City of Glendale, this question is not applicable in the City of Glendale.]

NOTES:

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Explanation

High Fire Hazard Area

Glendale City Limit

N

W E

S

Scale: 1:60,000

1000 0 1000 2000 3000

Meters

5000 0 5000 10000 15000

Feet

Base Map: USGS Topographic Map from Sure!MAPS RASTER
Source: City of Glendale Fire Department

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Date: July, 2003

High Fire Hazard Areas

Glendale, California

Plate 4-2

Real-estate disclosure requirements are important because in California the average period of ownership for residences is only five years (Coleman, 1994). This turnover creates an information gap between the several generations of homeowners in fire hazard areas. Uninformed, new homeowners may attempt landscaping or structural modifications that could be a detriment to the fire-resistant qualities of the structure, with negative consequences. Appropriate landscaping and fire-resistive structural requirements in fire hazards areas are discussed in detail in the next sections.

4.1.3 Hazard Mitigation

Hazard mitigation programs in fire hazard areas currently include fire prevention, vegetation management, legislated construction requirements, and public awareness. Each of these programs is described further below.

***4.1.3.1 Fire Prevention**:* Fire prevention aims to reduce the incidence and extent of fire by preventing wildfires from occurring in the first place. Over the years, a variety of fire prevention programs have been developed and implemented by federal, state, and local agencies. These programs typically include education, engineering, patrolling, code enforcement, and signing (Greenlee and Sapsis, 1996). Smokey Bear is one of the best-known characters that both children and adults recognize, attesting to the success of public education programs aimed at fire prevention. Quantitative studies show that fire losses arising from human fires, especially those caused by children, have dropped substantially over the last 30 years or so, in some cases by as much as 80 percent (Greenlee and Sapsis, 1996). Therefore, fire prevention is a well-understood program with a high degree of success. However, as discussed above, by preventing fire from occurring, fuel loads are allowed to increase, with the potential for high intensity fires and resultant damage. Therefore, fire prevention needs to be complemented with a variety of other programs that will guarantee long-term success in reducing the losses resulting from fires.

Fire Prevention can include limiting access to fire hazard areas during certain times of the year. Although not apparent from Plate 4-2, the wildfire susceptibility of an area changes throughout the year, and from one year to the next, in response to local variations in precipitation, temperature, vegetation growth, and other conditions. When the fire danger in a High Fire Hazard Zone is deemed to be of special concern, local authorities can rely on increased media coverage and public announcements to educate the local population about being fire safe. For example, to reduce the potential for wildfires during fire season, the City of Glendale can opt to close hazardous fire areas to public access during at least part of the year. By monitoring site-specific wildfire susceptibility of a region, the Fire Department can establish regional prevention priorities that help reduce the risk of wildland fire ignition and spread, and help improve the allocation of suppression forces and resources, which can lead to faster control of fires in areas of high concern.

Restricted public access to hiking trails in and around the City of Glendale during the fire season may help reduce the opportunity for human-caused wildfires in the area. Continued use of signs during high and extreme fire conditions along the freeways and roads that cut through the wildland areas in the City and adjacent areas can also help reduce the fire hazard by alerting and educating motorists and residents.

The City of Glendale has a variety of fire prevention programs in place. Routine (annual or bi-annual) fire prevention inspections are conducted on a citywide basis by the Fire Department for residential, commercial, and industrial-type occupancies. The Fire

Prevention Bureau of the City's Fire Department inspects all new and existing public assemblies, educational facilities, institutions and hospitals, high-rise buildings, hazardous materials occupancies, malls and large retail centers, and all new residential dwellings (Glendale Fire Department, 1994). The inspections are conducted for the purpose of enforcing the Fire Code and hazardous materials regulations, for Fire Department personnel from within that jurisdictional area to become familiar with the premises (this is helpful in the event that they need to respond to a fire or emergency), and to instruct occupants about fire prevention methods and procedures. The Neighborhood Services Section of the Community Development Department provides assistance with the inspection of single-family residential dwellings as part of a community-wide beautification program. All personnel that conduct these surveys have received training in hazard recognition from the Fire Department.

Glendale's Fire Prevention Bureau is comprised of several different units, each with specific responsibilities. Fire Prevention Bureau members have the powers of a peace officer in enforcing the City's Fire Code. The responsibilities of each unit are described further below:

- Fire Code Inspection – conducts inspections of all new and existing structures.
- Development Plan Review – reviews proposed developments for conformance with fire protection requirements including fire-resistive construction, landscaping, emergency access, available fire flow, and built-in fire detection and suppression systems.
- Fire Investigation and Arson – investigates fire cause and origin, administers aggressive code enforcement, and analyzes cost recovery for negligent or malicious acts causing fire. All members of this unit have full police powers as set in California Penal Code Section 832 (Section 103.2.2.3 of the City's Building and Safety Code).
- Vegetation Management – reviews existing properties for compliance with fuel management requirements; administers and enforces the weed abatement and brush clearance program, and contracts for fire hazard reduction measures, including fuel breaks, fire roads, and non-compliant parcels.
- Hazardous Materials and Waste Management – administers hazardous materials disclosure laws and legislation, as well as conducts inspection of underground storage tanks and facilities that use or store hazardous materials for environmental compliance.
- Public Education – provides public fire safety education for groups or individuals on the hazards associated with the urban-wildland interface area.

4.1.3.2 ***Vegetation Management:*** Although, as discussed above, wildland fire is a significant potential hazard in large portions of Glendale, there are several management tools that can be implemented to reduce this hazard to manageable levels. Experience and research have shown that **vegetation management** is an effective means of reducing the wildland fire hazard in southern California. As a result, in areas identified as susceptible to wildland fire, jurisdictions typically require property owners to use a combination of maintenance approaches aimed at reducing the amount and continuity of the fuel (vegetation) available.

Fuel or vegetation treatments often used include mechanical, chemical, biological and other forms of biomass removal (Greenlee and Sapsis, 1996) or **hazard reduction** within a given distance from habitable structures. The intent is to create a defensible space that slows the rate and intensity of the advancing fire, and provides an area at the urban-wildland interface where firefighters can set up to suppress the fire and save the threatened structures. Defensible space is defined as an area, either ***natural*** or man-made, where plant materials and natural fuels have been treated, cleared, or modified. However, removal of the native

vegetation and maintenance of a wide strip of bare ground is not aesthetically acceptable and it increases the potential for water runoff and soil erosion. Native vegetation can be replaced with a green belt of low-lying, vegetation, but the increased use of water and maintenance requirements can make this option undesirable.

Another approach used in some areas of southern California is referred to as **fuel modification.** This method places emphasis on the space near structures that provides natural landscape compatibility with wildlife, water conservation and ecosystem health. Immediate benefits of this approach include improved aesthetics, increased health of large remaining trees and other valued plants, and enhanced wildlife habitat. **Fuel modification is used in the City of Glendale.**

In 1993, the City of Glendale adopted a Hillside Development Plan that provides guidelines regarding landscaping and vegetation modification to promote fire safety while protecting the visual quality of the hillsides (City of Glendale, 1993). The landscape guidelines provide lists of plants (referred to as plant palettes) that are drought tolerant and help control erosion to be used on engineered slopes. By using these plants instead of non-native species, the visual contrast between the natural hillsides and the engineered slopes can be diminished, making the man-made slopes resemble more closely the adjacent natural slopes. Two plant palettes are available: the naturalizing palette, which includes plants to be used on that portion of the engineered slopes closer to the natural hillsides; and the ornamental palette, to be used on that section of the slope closer to structures, adjacent to the ornamental vegetation. On large enough slopes, both plant palettes can be blended along a 150-foot wide interface. For the most recent version of the plant palettes acceptable in Glendale, request a copy from the City's Planning Department.

The Fire Zone Management Guidelines portion (Section 8.0) of Glendale's Landscape Guidelines Plan outlines the methods by which the two plant palettes discussed above are to be used around all flammable structures in the urban-wildland interface. A minimum buffer distance of 100 feet is required around all structures; in some cases, at the discretion of the City's Fire Chief, this buffer distance may be increased to 200 feet. Within this buffer distance, the City requires four distinct Fire Management Zones to be established. Each of these zones is described further below and shown graphically on Figures 4-3 and 4-4.

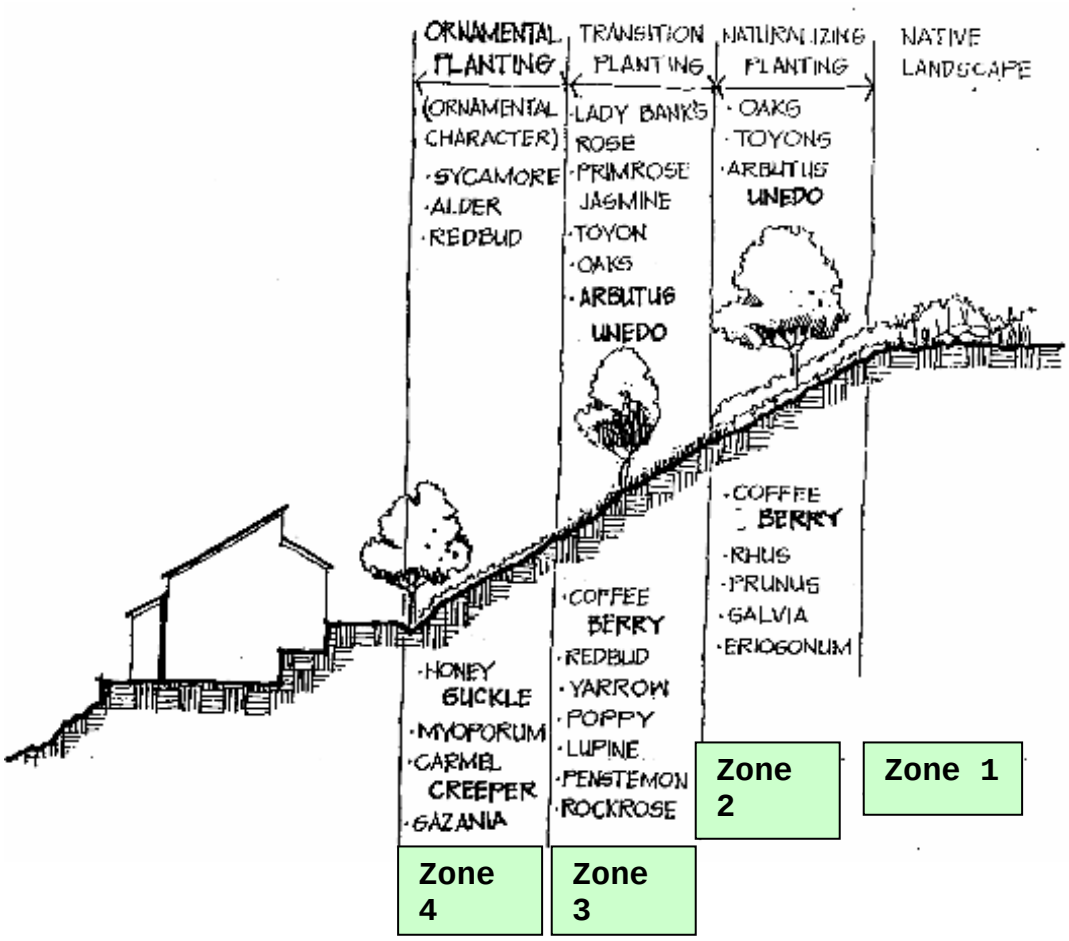
- **Zone 1:** Zone 1 includes the natural, ungraded slope and continues to the edge of the engineered slope. Existing vegetation in this zone needs to be thinned selectively to reduce the fuel volume and lower the intensity of any fire that may approach buildings. Foliage mass reduction is accomplished by removing large shrubby plants and dense groupings. The thinning of these plants needs to be conducted in such a way as to create a natural appearance and not expose excess soil areas that would then be susceptible to erosion.

- **Zone 2**: Zone 2 is the next zone inward from the natural, ungraded terrain, where low, slow-burning plantings should predominate. The volume of vegetation in this zone needs to be reduced and replaced with fire-resistant plant materials from both the naturalizing and ornamental plant palettes. Their low growth and limited foliage mass can diminish the intensity of wildfires, and prevent erosion of the slope.

- **Zone 3**: This zone can vary between 20 and 25 feet in width, depending upon the degree of fire risk in the area, and consists of fire-retardant plantings. This zone is referred to as

the fire buffer zone or maximum fire prevention edge, and includes plants from both the ornamental and naturalizing palettes that require regular irrigation and weed control. Although some drought tolerant plants may be acceptable in this area, higher water and maintenance demands actually help achieve the maximum fire barrier. The plants in this zone are typically ground covers and plants with low fuel volumes.

Figure 4-3: Glendale's Hillside Planting Zones
(from the City of Glendale Landscape Guidelines for Hillside Development)



- **Zone 4:** This zone is the area immediately surrounding the structure where ornamental plantings are preferred. The plants in this zone should be carefully selected and placed. The amount of tall trees should be limited. Foliage should be thinned and dead branches and vegetation removed from those areas next to the building.

These standards require property owners in fire hazard areas, especially at the urban-wildland interface, to conduct maintenance, modifying or removing non-fire-resistive vegetation around their structures to reduce the fire danger. This affects any person who owns, leases, controls, operates, or maintains a building or structure in, upon, or adjoining the UWI area. An example of vegetation management is shown on Figure 4-4.

Figure 4-4: Example of Vegetation Management at the Urban-Wildland Interface
(Residential community in southern California that uses fuel modification to reduce its fire hazard. Note selective thinning of vegetation in the slope below the structures. Closer to the structures, there is a zone of fire-resistive ornamental plants that are irrigated. The vegetation in the foreground is in its natural state.)

Specific maintenance actions that can be undertaken by property owners in the fire hazard areas include:

- Remove all dead vegetation and keep grasses and weeds maintained within 100 feet of any building and within 10 feet of any roadway. These provisions are part of an amendment to the Hazardous Vegetation Ordinance adopted in 1990. In extreme cases, clearance up to 200 feet from a structure and 50 feet from a roadway may be required by the Fire Department.
- Grasses and other vegetation located more than 30 feet from any building and less than 18 inches in height may be maintained where necessary to prevent erosion. Large trees and shrubs in that area should be at least 18 feet apart.
- Remove leafy foliage, dead wood, combustible ground cover, twigs, or branches within 3 feet of the ground from mature trees located within 100 feet of any building or within 10 feet of any roadway.
- Remove dead limbs, branches, and other combustible matter from trees or other growing vegetation adjacent to or overhanging any structure.
- Remove any portion of a tree that extends within 10 feet of a chimney or stovepipe.
- Trim and maintain all vegetation away from the curb line up to a height of 13.5 feet to accommodate emergency vehicles.
- Maintain 5 feet vertical clearance between roof surfaces and any overhanging portions of trees.
- Property owners in the urban-wildland interface area can request that the Fire Department conduct a comprehensive fire safety survey of their homes and property. The Fire Department inspects the residences for compliance with applicable regulations, and prepares a report for use by the homeowner to reduce its fire hazard. Implementation of

the recommended mitigation measures may help the homeowner obtain a reduction in the cost of fire insurance.

Prescribed Fire: As discussed previously, before modern settlement began, the area experienced small but frequent wildfires that impacted primarily the grasses and low-lying bushes, without severely damaging the tree stands. As man-made structures were built in these fire-susceptible areas, there was a strong effort to suppress fires, since these would threaten the structures and people living there. As a result, dense stands of vegetation have accumulated locally in the outlying areas, while increasingly larger numbers of people have moved into the urban-wildland interface. Over time, fire suppression and increasing populations have produced these results:

- Increased losses to life, property, and resources.
- Difficulty of fire suppression, increased safety problems for firefighters, and reduced productivity by fire crews on perimeter lines.
- Longer periods between recurring fires for many vegetation types by a factor of 5 or more.
- Increased volume of fuel per acre.
- Increased fire intensities.
- Increased taxpayer costs and property losses.

Recognition of these problems has led to vegetation management programs such as those described above, and in some areas, prescribed fires. A prescribed fire is deliberately set under carefully controlled and monitored conditions. The purpose is to remove brush and other undergrowth that can fuel uncontrolled fires. Prescribed fire is used to alter, maintain or restore vegetative communities, achieve desired resource conditions, and to protect life and property that would be degraded by wildland fire. Prescribed fire is only accomplished through managed ignition and should be supported by planning documents and appropriate environmental analyses.

Since 1981, prescribed fire has been the primary means of fuel management in Federal and State owned lands. Approximately 500,000 acres — an average of 30,000 acres a year — have been treated with prescribed fire under the vegetation management program throughout the State. In the past, the typical vegetation management project targeted large wildland areas. Now, increasing development pressures (with increased populations) at the urban-wildland interface often preclude the use of large prescribed fires. Many still find the notion of "prescribed fire" difficult to accept since for the last 100 years or so, humans have attempted to suppress and fight fires. Prescribed fire also carries a risk, as recent experiences in New Mexico and Arizona have shown. The Cerro Grande fire began when a prescribed burn escaped, destroying several hundred homes in Los Alamos, New Mexico and burning more than 50,000 acres. It is likely that this fire will lead to revisions in the guidelines for performing prescribed burns. Furthermore, a recent program review by the CDF has identified needed changes, with focus on citizen and firefighter safety, and the creation of wildfire safety and protection zones.

Prescribed fire is not presently being used in the City of Glendale to mitigate the wildland fire hazard. However, the cities of Glendale and La Canada Flintridge have entered into a cooperative agreement with Los Angeles County Fire Department to conduct prescribed fires in the Descanso Gardens area. This effort will include open space areas within the City of Glendale at the north end of the San Rafael Hills. The proposed plan has been approved by

all parties involved and is ready to be implemented as soon as all conditions for a safe prescribed fire are met.

Hazard Abatement Notices: Each spring, the Glendale Fire Department mails information and hazard brush pamphlets to approximately 4,500 residences located in designated High Fire Hazard Areas. The purpose of this mailing is to remind and inform property owners of their specific responsibility to mitigate hazardous vegetation conditions. The mailing is followed-up, commencing May 1, by Fire Department fire company inspections of residences and lots to ensure compliance. Fire department personnel are assigned inspection districts throughout the City. Fire Department personnel survey the hillside areas and issue notices of violation for hazardous vegetation on an annual basis. If abatement work is not completed in a timely manner, a "Notice to Abate Fire Hazard" is sent and a compliance inspection is conducted 30 days later. If abatement is still not satisfactory a "Notice of Intention to Abate Public Nuisance" is sent, and a final inspection made after 15 days to ensure compliance. If voluntary compliance is not achieved, the Fire Department may abate the hazardous vegetation using an approved contractor, and charge the owner or impose a lien on the property.

At this time, per an agreement between Glendale and the County of Los Angeles, the Los Angeles County Agricultural Commissioner provides for weed abatement on non-compliant improved properties and approximately 800 vacant lots in the City of Glendale.

4.1.3.3 Legislated Construction Requirements in Fire Hazard Areas: Building construction standards for such items as roof coverings, fire doors, and fire resistant materials help protect structures from external fires *and* contain internal fires for longer periods. That portion of a structure most susceptible to ignition from a wildland fire is the **roof**, due to the deposition of burning cinders or brands. Burning brands are often deposited far in advance of the actual fire by winds. Roofs can also be ignited by direct contact with burning trees and large shrubs (Fisher, 1995). The danger of combustible wood roofs, such as wooden shingles and shakes, has been known to fire fighting professionals since 1923, when California's first major urban fire disaster occurred in Berkeley. It was not until 1988, however, that California was able to pass legislation calling for, at a minimum, Class C roofing in fire hazard areas. Then, in the early 1990s, there were several other major fires, including the Paint fire of 1990 in Santa Barbara, the 1991 Tunnel fire in Oakland/Berkeley, and the 1993 Laguna Beach fire, whose severe losses were attributed in great measure to the large percentage of combustible roofs in the affected areas. In 1995-1996 new roofing materials standards were approved by the California legislature for Very High Fire Hazard Severity Zones.

Significantly, the City of Glendale has been at the forefront of the State on this issue since the early 1980s. Specifically, in 1984, Glendale adopted a Fire Safe Roofing Ordinance that required a minimum Class B roof covering for all new and re-roof applications City-wide. In 1989, Glendale adopted legislation (the Fire Safe Roofing Code) that amended the City's roofing requirements to ban the installation of wood roof material City-wide, and to upgrade the minimum classification from B to A in the high fire hazard areas. Today, Glendale requires all new roofs and re-roofs amounting to more than 25 percent of the original roof area to be done in Class A roof covering.

So what do these Classes A, B and C mean? To help consumers determine the fire resistance of the roofing materials they may be considering, roofing materials are rated as to their fire resistance into three categories that are based on the results of test fire conditions that these

materials are subjected to under rigorous laboratory conditions, in accordance with test method ASTM-E-108 developed by the American Society of Testing Materials. The rating classification provides information regarding the capacity of the roofing material to resist a fire that develops outside the building on which the roofing material is installed (The Institute for Local Self Government, 1992). The three ratings are as follows:

Class A: Roof coverings that are effective against **severe** fire exposures. Under such exposures, roof coverings of this class:

- Are not readily flammable;
- Afford a high degree of fire protection to the roof deck;
- Do not slip from position; and
- Do not produce flying brands.

Class B: Roof coverings that are effective against **moderate** fire exposures. Under such exposures, roof coverings of this class:

- Are not readily flammable;
- Afford a moderate degree of fire protection to the roof deck;
- Do not slip from position; and
- Do not produce flying brands.

Class C: Roof coverings that are effective against **light** fire exposures. Under such exposures, roof coverings of this class:

- Are not readily flammable;
- Afford a measurable degree of fire protection to the roof deck;
- Do not slip from position; and
- Do not produce flying brands.

Non-Rated Roof coverings have not been tested for protection against fire exposure. Under such exposures, non-rated roof coverings:

- May be readily flammable;
- May offer little or no protection to the roof deck, allowing fire to penetrate into attic space and the entire building; and
- May pose a serious fire brand hazard, producing brands that could ignite other structures a considerable distance away.

Attic ventilation openings are also a concern regarding the fire survivability of a structure. Attics require significant amounts of cross-ventilation to prevent the degradation of wood rafters and ceiling joists. This ventilation is typically provided by openings to the outside of the structure, but these openings can provide pathways for burning brands and flames to be deposited within the attic. Therefore, it is important that all ventilation openings be properly screened to prevent this. Additional prevention measures that can be taken to reduce the potential for ignition of attic spaces are to "use non-combustible exterior siding materials and to site trees and shrubs far enough away from the walls of the house to prevent flame travel into the attic even if a tree or shrub does torch" (Fisher, 1995).

The type of **exterior wall construction** used can also help a structure survive a fire. Ideally, exterior walls should be made of non-combustible materials such as stucco or masonry. During a wildfire, the dangerous active burning at a given location typically lasts about 5 to 10 minutes (Fisher, 1995), so if the exterior walls are made of non-combustible or fire-resistant materials, the structure has a better chance of surviving. For the same reason, the

type of **windows** used in a structure can also help reduce the potential for fire to impact a structure. Single-pane, annealed glass windows are known for not performing well during fires; thermal radiation and direct contact with flames cause these windows to break because the glass under the window frame is protected and remains cooler than the glass in the center of the window. This differential thermal expansion of the glass causes the window to break. Larger windows are more susceptible to fracturing when exposed to high heat than smaller windows. Multiple-pane windows, and tempered glass windows perform much better than single-pane windows, although they do cost more. Fisher (1995) indicates that in Australia, researchers have noticed that the use of metal screens helps protect windows from thermal radiation. Some homeowners may consider the use of exterior, heavy-duty metal blinds that are dropped down into position, at least on the windows in the exposed portion of the structure facing the wildland area.

Fire **sprinklers** are very effective at controlling structural fires, saving property and lives. In 1988, Glendale passed an ordinance requiring automatic fire sprinklers in existing structures four stories or more in height, and since 1989, the City of Glendale has required all new one- and two-family structures to have fire sprinklers. Fire sprinklers can help contain a fire that starts inside a structure from becoming a potential incendiary source, impacting other nearby structures and brush. Fire sprinklers are not likely to protect a structure from an external wildland fire, however. Sprinklers permanently mounted on the roof have been suggested as a defensive measure, but most authorities argue against the value of external sprinklers as a viable alternative to fire-resistant roofing materials (http://www.fs.fed.us/psw/publications/documents/gtr-050/struct.html).

The City of Glendale has adopted the California Building and Fire Codes with local additions and amendments (City Ordinance 5329 - Glendale Building and Safety Code, Volume I, Section 715 which deals with construction requirements in fire hazard areas, and Volume VI, which pertains to fire and life-safety requirements). These additions and amendments make the Glendale Building and Safety Code more restrictive than the minimum State Code / model ordinance. For specific requirements regarding roofing standards (non-combustible Class A roofs), construction materials and standards including fire resistive siding and eaves, the orientation and placement of window glazing, sprinklers, etc., contact the Fire Prevention Bureau and Building Section of the City of Glendale.

4.1.3.4 Access: Fires at the urban-wildland interface tend to move quickly, with most of the damage or losses generally occurring in the first few hours after the fire starts (Coleman, 1994). Therefore, access to the urban-wildland interface for the purposes of emergency response is critical. This requires streets that meet minimum access and egress requirements so that they can be traversed by fire apparatus. The Glendale Municipal Code includes minimum width standards for local streets and width and length standards for cul-de-sacs. The Glendale Fire Code (Volume VI, Article 10, Section 10.207) requires an all-weather surface roadway with a minimum width of 20 feet (without parking) that can support loads of 55,000 pounds, minimum 13-feet 6-inches of vertical clearance, a grade that does not exceed 12 percent, and an approved turnaround when in excess of 150 feet in length. Chapter 28, Section 28-59 of the Municipal Code stipulates that any local street or cul-de-sac street that is abutted by more than ten residences shall be no less than 24 feet wide from curb to curb, within a 28-foot wide dedication. The length of cul-de-sacs is regulated based on the number of dwelling units and distance from the point of dual access, but the maximum distance for dead-end or no-outlet streets is 2,600 feet. In fire hazard areas, easy access for fire equipment shall be provided.

Unfortunately, many streets in the hillside areas of Glendale are of insufficient width because they were built prior to the development of the current standards. Several other roads are non-compliant because they are dead-end streets more than 1/2-mile long, or do not have a turnaround at their end. There are several non-compliant residential streets off of East Chevy Chase Drive, and in the southeastern corner of the City, off of Adams Street. Several other roads in the eastern and southern Verdugo Mountains are also narrow and do not have proper turnarounds. The streets that do not meet Glendale's Municipal Code requirements are shown on Plate 4-3.

Although not shown on the map, the City's Fire Department also considers the east end of Glenoaks Boulevard, east of the Glendale Freeway as a potentially hazardous road because it does not have a secondary outlet. A wildland fire, earthquake or another disaster in the area could place a substantial number of people at risk of not being able to evacuate this neighborhood if and when necessary.

Figure 4-5: Firefighters putting out the September 2002 "Mountain Incident" Fire in Glendale

4.1.3.5 ***Public Awareness***: Individuals can make an enormous contribution to fire hazard reduction and need to be educated about their important role. The Glendale Fire Department has several outreach programs aimed at providing fire safety education to the public. These presentations are given to local schools, service clubs and associations, homeowners groups, the Chamber of Commerce, Board of Realtors, businesses and other professional organizations. The Jr. Fire Program, which is more than 50 years old, sends firefighters into all of the 5th grade classes in the area to teach fire safety and awareness. A picnic at the end of the school year is held to honor those students that demonstrated exceptional participation in the program. Every October, the Fire Department also contracts with a theater group to present fire safety programs to all elementary schools in Glendale.

NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

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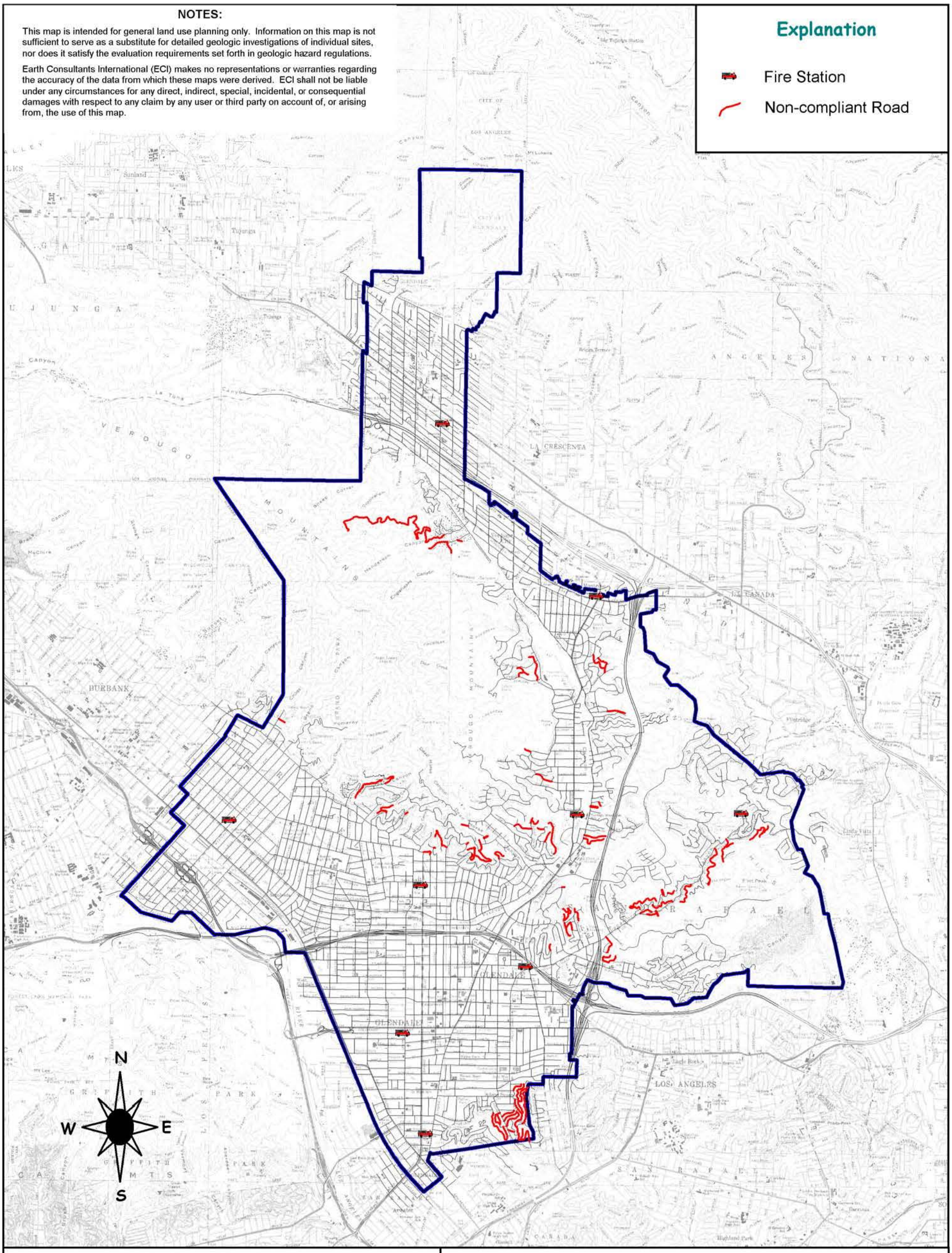
Explanation

- Fire Station
- Non-compliant Road



Scale: 1:60,000

1000 0 1000 2000 3000

Meters

5000 0 5000 10000 15000

Feet

Base Map: USGS Topographic Map from Sure!MAPS RASTER
Source: City of Glendale Planning Department

Earth Consultants International

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Date: July, 2003

Non-compliant Roads in the City of Glendale

Plate 4-3

One of the most recent public education tools used by the Fire Department is the Fire Safety Trailer, which is operated in conjunction with the Burbank and Pasadena Fire Departments. The trailer provides a scaled version of a house, where children can learn and practice life-saving procedures. These and many other public education and outreach programs that the Fire Department offers are described in the Fire Department's effective web site (http://fire.ci.glendale.ca.us/). This web site is also an education tool that residents can refer to for additional information regarding how to deal with fire and other natural and man-made hazards.

The Fire Department has also prepared and distributes informational brochures to hillside property owners. The brochures describe mitigation measures that can be implemented to reduce the fire hazard, and describe how property owners can help themselves to prevent loss of property or life as a result of a wildland fire. In addition to the specific requirements in the Municipal Code mentioned in the sections above regarding appropriate landscaping and construction materials, there are other steps that homeowners can take to reduce the risk of fire on their property. Some of these are listed below. This list is not all-inclusive, but provides a starting point and framework to work from.

- Mow and irrigate your lawn regularly.
- Dispose of cuttings and debris promptly, according to local regulations.
- Store firewood away from the house.
- Be sure the irrigation system is well maintained.
- Use care when refueling garden equipment and provide regular maintenance for your garden equipment.
- Store and use flammable liquids properly.
- Dispose of smoking materials carefully.
- Do not light fireworks (in accordance with the Municipal Code).
- Become familiar with local regulations regarding vegetation clearing, disposal of debris, and fire safety requirements for equipment.
- Follow manufacturers' instructions when using fertilizers and pesticides.
- Keep the gutters, eaves, and roof clear of leaves and other debris.
- Occasionally inspect your home, looking for deterioration, such as breaks and spaces between roof tiles, warping wood, or cracks and crevices in the structure.
- Use non-flammable metal when constructing a trellis and cover it with high-moisture, non-flammable vegetation.
- Install automatic seismic shut-off valves for the main gas line to your house. Information for approved devices, as well as installation procedures, is available from the Southern California Gas Company.

Figure 4-6: Command Post During the September 2002 "Mountain Incident" Fire in Glendale

4.2 Structural Fires in Urban Areas

Glendale's permanent residential population is currently about 200,000. Since the 1970s, multiple family units (apartments and condominiums) have been the predominant housing type in the City, with most of these units located in the City's flatland areas. Many of these multiple-family units are high-rise and mid-rise buildings that have special fire protection needs. Such buildings are required to have fire and life safety systems in place, including automatic fire sprinklers and smoke detectors, in conformance with the City's Building and Safety Code.

Single-family units predominate in the hillside areas. The majority of Glendale's residential stock dates from between 1940 and 1969 (54 percent), but more than 18 percent of the homes were constructed prior to 1940 (City of Glendale 1998-2005 Housing Element). Since the City's fire sprinkler ordinance for all new residences and businesses was adopted in 1986 (with 1989 amendments), there are many older single-family units that are not sprinklered, unless the sprinklers have been added as part of additions, alterations or repairs to the structure.

In order to quantify the structural fire risk in a community, it is necessary for the local fire departments to evaluate all occupancies based upon their type, size, construction type, built-in protection (such as internal fire sprinkler systems) and risk (high-occupancy versus low-occupancy) to assess whether or not they are capable of controlling a fire in the occupancy types identified. Simply developing an inventory of the number of structures present within a fire station's response area is not sufficient, as those numbers do not convey all the information necessary to address the community's fire survivability. In newer residential areas where construction includes fire-resistant materials and internal fire sprinklers, most structural fires can be confined to the building or property of origin. In older residential areas where the building materials may not be fire-rated, and the structures are not fitted with fire sprinklers, there is a higher probability of a structural fire impacting adjacent structures, unless there is ample distance between structures, there are no strong winds, and the Fire Department is able to respond in a timely manner.

The major urban conflagrations of yesteryear in large cities were often the result of closely built, congested areas of attached buildings with no fire sprinklers, no adequate fire separations, no Fire Code enforcement, and narrow streets. In the past, fire apparatus and water supplies were often inadequate in many large cities, and many fire departments were comprised of volunteers. Many of these conditions no longer apply to the cities of today. Nevertheless, major earthquakes can result in fires and the loss of water supply, as it occurred in San Francisco in 1906, and more recently in Kobe, Japan in 1995. Several structural fires, many as a result of broken gas mains, also occurred in southern California near the epicenter of the Northridge earthquake of 1994. For additional information regarding the Northridge Earthquake, refer to Section 4.5 below. Although the threat that existed in San Francisco was and is far greater than that in Glendale, there are some sections of Glendale where, due to ground failure as a result of either fault rupture or liquefaction, breaks in the gas mains and the water distribution system could lead to a significant fire-after-earthquake situation. The potential surface fault rupture areas in the City are shown on Plate 1-2 and the liquefactions susceptible areas are shown on Plate 1-3 (in Chapter 1 of this document).

4.2.1 Structural Target Fire Hazards and Standards of Coverage

Fire departments quantify and classify structural fire risks to determine where a fire resulting in large losses of life or property is more likely to occur. Structures at risk are known as Target Hazards and are catalogued utilizing the following criteria:

- The size, height, location and type of occupancy;
- The risk presented by the occupancy (probability of a fire and the consequence if one occurs);
- The unique hazards presented by the occupancy (such as the occupant load, the types of combustibles therein and any hazardous materials);
- Potential for loss of life;
- The presence of fire sprinklers and proper construction;
- Proximity to exposures;
- The estimated dollar value of the occupancy;
- The needed fire flow versus available fire flow; and
- The ability of the on-duty forces to control a fire therein.

Target Hazards encompass all significant community structural fire risk inventories. Typically, fire departments identify the major target hazards and then perform intensive pre-fire planning, inspections and training to address the specific fire problems in that particular type of occupancy (for example, training to respond to fires in facilities that handle hazardous materials is significantly different than training to respond to a fire in a high-occupancy facility such as a mall, auditorium or night club). Typically, the most common target hazard due to the life-loss potential, 24-hour occupancy, risk and frequency of events, is the residential occupancy, however, the consequences of residential fires can be high or low, depending on the age, location, size, and occupancy load, among other factors. Four classifications of risk are considered, as follows:

- High Probability/High Consequences (Example: multi-family dwellings, single-family residential homes in the older sections of the City, hazardous materials occupancies, shopping centers).
- Low Probability/High Consequences (Example: hospitals; senior housing projects, group homes, and other assisted projects; shopping malls such as the Glendale

Galleria; industrial occupancies, large office complexes and newer upscale homes in the high fire hazard area).

- High Probability/Low Consequences (Example: detached single-family dwellings in the non-vegetated, flatland areas of town).
- Low Probability/Low Consequences (Example: newer detached single-family dwellings in non-vegetated areas and small office buildings).

In order to address the Fire Department's capability to respond effectively to the structural fire risk in Glendale, "Standards of Coverage" need to be determined based upon the various risks. Those risks are: Single-family detached residential, multi-family attached residential, commercial and industrial. Some of these risks exist in various areas throughout the City, rather than in well-defined separate areas. For example, residential areas adjoining and intermixed with commercial areas occur in the older portions of the City, such as between the Verdugo Mountains on the north and Glenoaks Boulevard on the south, and especially within the inverted triangle defined by Glendale Avenue on the east, Glenoaks Boulevard on the north, and San Fernando Road on the west. Similarly, in the Montrose Business District and surrounding areas adjacent to Honolulu Avenue, there is also significant intermix of residential and commercial space. Given these combined risks within the same geographic areas, it is appropriate for the Glendale Fire Department to have fire stations within or near these areas. For the location and distribution of the fire stations in the City of Glendale, refer to Plate 4-3 and especially Plate 4-4.

4.2.2 Model Ordinances and Fire Codes

Effective fire protection cannot be accomplished solely through the acquisition of equipment, personnel and training. The area's infrastructure also must be considered, including adequacy of nearby water supplies, transport routes and access for fire equipment, addresses, and street signs, as well as maintenance. To that end, the City of Glendale has adopted the 2001 California Fire Code with City amendments and some changes referring to the adopted document as Volume VI of the 2002 Building and Safety Code of the City of Glendale. The City's Fire Chief is authorized and directed to enforce the provisions of the Fire Code throughout the City (Section 101.2.1. of Volume VI of the City's Building and Safety Code). These provisions include construction standards in new structures and remodels, road widths and configurations designed to accommodate the passage of fire trucks and engines, and requirements for minimum fire flow rates for water mains. The construction requirements are a function of building size, type, material, purpose, location, proximity to other structures, and the type of fire suppression systems installed. For building construction standards refer to the City's Building and Safety Code.

4.3 Fire Suppression Capabilities

The Glendale Fire Department is responsible for fire suppression on all lands within the City of Glendale. The Department constantly monitors the fire hazard in the City, and has ongoing programs for investigation and alleviation of hazardous situations. Fire fighting resources in the immediate Glendale area are provided by Glendale Fire Department Station Nos. 21, 22, 23, 24, 25, 26, 27, 28, and 29. The Fire Department is comprised of 12 fire companies with nine engine companies and three truck companies. The Department also staffs four rescue ambulances. These data are summarized by fire station on Table 4-1 below. The locations of the fire stations are shown on Plates 4-3 and 4-4. Staffing at these stations is as follows: 4 crew per each ladder truck and engine company, and 2 firefighter paramedics per rescue ambulance. The Glendale Fire Department is a member of the

Verdugo Fire Communications Center (VFCC) that provides dispatch services to nine cities, including Glendale. Additional information regarding the VFCC is provided in Section 4.4.1.

Fire Stations 26 and 29 are no longer adequate for the Fire Department's needs due to the buildings' age, physical condition and size. Efforts are ongoing to find adequate alternative locations for these two stations. The preferred alternatives are expected to be located south of the 134 Freeway.

Table 4-1: Fire Stations and Facilities in the City of Glendale

Fire Station No.	Street Address	Fire Companies and Ambulances		
		Engine Companies	*Ladder Truck Companies*	*Rescue Ambulances*
21	421 Oak Street	1	1	1
22	1201 S. Glendale Ave.	1	0	0
23	3303 E. Chevy Chase Drive	1	0	0
24	1734 Canada Blvd.	1	0	0
25	353 N. Chevy Chase Drive	1	0	1
26	1145 N. Brand Blvd.	1	1	1
27	1127 Western Ave.	1	0	0
28	4410 New York Ave.	1	0	0
29	2465 Honolulu Ave.	1	1	1

Facility	Street Address
Fire Mechanical Maintenance	210 E. Palmer Avenue
Verdugo Fire Communications Center	421 Oak Street
Fire Prevention Bureau	420 Harvard Street
Fire Training	541 W. Chevy Chase Drive
Environmental Management Center	780 Flower Street

For emergencies, dial 911.

According to the VFCC (2002), there were 14,158 incidents reported for Glendale in 2002. The twenty-year (1983-2002) history of Glendale incidents is summarized on Figure 4-7. The number of incidents reported has nearly doubled in that time period, reflective of the population growth that this area has experienced in the last 20 years. Table 4-2 shows that the number of medical emergencies compared to fire calls has increased over time; in 1983, fire calls amounted to 26 percent of the incidents reported, while in 2002, the figure was 12.6 percent. Significantly, 49.5 percent of the fire incidents that the Fire Department responded to in 2002 were for fire alarms, so the actual number of true fire incidents was actually smaller.

NOTES:

This map is intended for general land use planning only. Information on this map is not sufficient to serve as a substitute for detailed geologic investigations of individual sites, nor does it satisfy the evaluation requirements set forth in geologic hazard regulations.

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Explanation

Fire Station

Fire Station 28
4410 New York Ave.

Fire Station 29
2465 Honolulu Ave.

Fire Station 27
1127 Western Ave.

Fire Station 24
1734 Canada Blvd.

Fire Station 23
3303 E. Chevy Chase Dr.

Fire Station 26
1145 N. Brand Blvd.

Fire Station 25
353 N. Chevy Chase Dr.

Fire Station 21421 Oak Street

Fire Station 22
1201 S. Glendale Ave.

N
W E
S

Scale: 1:60,000

1000 0 1000 2000 3000
Meters

5000 0 5000 10000 15000
Feet

Base Map: USGS Topographic Map from Sure!MAPS RASTER
Source: City of Glendale Planning Department

Earth Consultants International

Project Number: 2103
Date: July, 2003

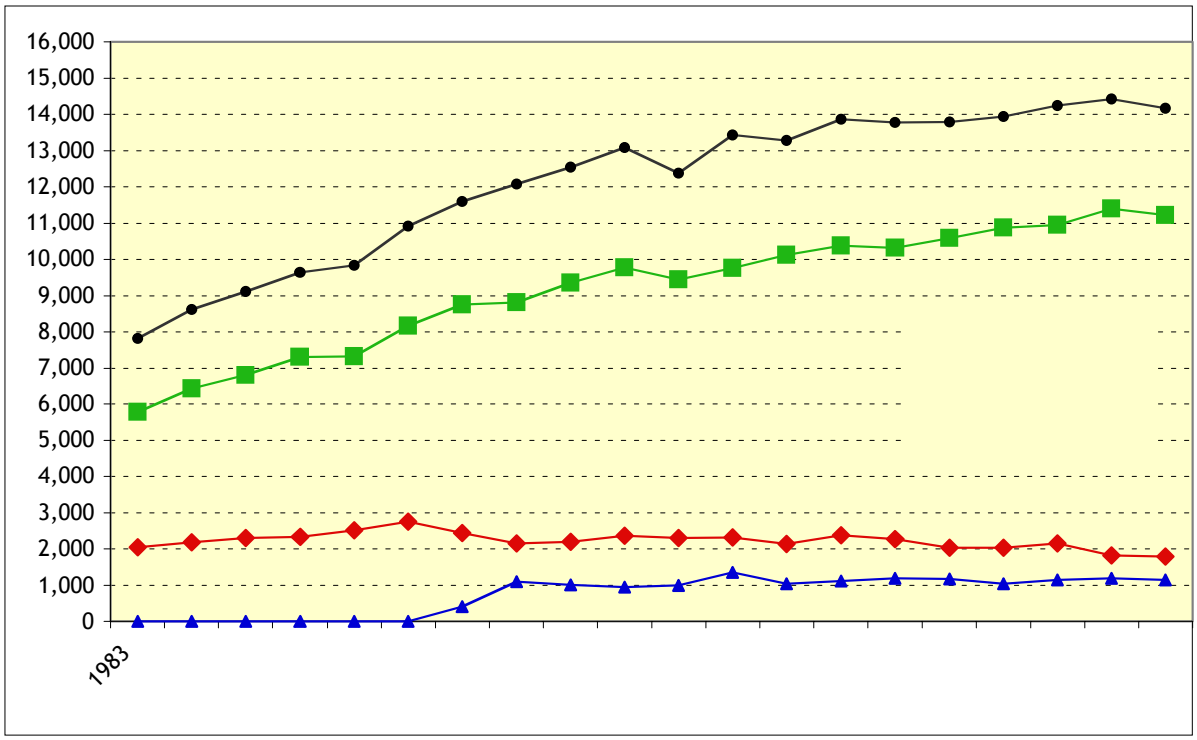
Fire Station Location Map

Glendale, California

Plate
4-4

In 2002, 79 percent of the responses were medical emergency calls, while in 1980, they amounted to 74 percent of the calls. That medical emergency calls far outnumber fire calls is typical of most communities. These medical emergencies are handled primarily by the four fire stations in the City with rescue ambulances (Fire Stations 21, 25, 26, and 29), and other neighboring fire stations that are part of the Verdugo system that staff rescue ambulances. In 2002, assuming that all medical emergencies were handled by the four local fire stations with rescue ambulances, each fire station responded to an average of 2,806 medical emergencies, or an average of 7.7 medical calls per day. This amount of medical responses could be an issue if engine companies provide support to the rescue ambulances by responding to medical aid calls, and this impacted the fire department's response to structural fire calls. If the number of medical emergency responses continue to increase, and this is found to have an impact on the availability of fire-fighting personnel and equipment, it may be prudent to add another rescue ambulance and support squad vehicle and increase staffing at the fire station in the area of the City with the highest rate of medical incidents.

Figure 4-7:
20-Year History of Incidents in the City of Glendale Responded to by the Fire Department



Source: Verdugo Fire Communications Center 2002 Annual Report

In 2002, vehicle fires exceeded any other type of fires reported in the City (11 percent of the fire incidents). Miscellaneous outside fires, illegal burning, refuse fires, brush fires, and other vegetation fires combined also add to about 11 percent of the fire incidents. Although wildland fires do not occur very often, they do have the potential to involve a substantial portion of the fire department's forces, and often, additional help is requested from other jurisdictions. Since fires comprise a small percentage of the fire department responses, it could be argued that fighting fires nowadays is a "seldom used skill," and that this can lead to an increase in firefighter injuries. It could also be argued that this could result in fires larger than those that occurred in past years, when fire departments were

accustomed to responding to more severe structural fires due to the absence of sprinkler systems, poor construction, and lack of ongoing Code enforcement. Glendale Fire Department personnel, however, participate in extensive, almost daily training exercises on a variety of subjects and specialties, such as fire prevention, mechanical maintenance, emergency response, and brush fires, to name a few. Several Fire Officer Certification classes are also offered on a regular basis, including EMT-D certification of all firefighters, and defibrillator program (in excess of minimum EMT certification).

The National Fire Protection Association (NFPA Standard 1710, 2001) recommends that in 90 percent of the time, fire departments respond to fire calls within 5 minutes of receiving the call. These time recommendations are based on the demands created by a structural fire: It is critical to attempt to arrive and intervene at a fire prior to the fire flashing over the entire room or building of origin, which results in total destruction, and flashover can occur within 3 to 5 minutes after ignition. Response time is generally defined as 1 minute to receive and dispatch the call, 1 minute to prepare to respond in the fire station or field, and 3 minutes driving time. The 90 percent figure is stated as a goal to be achieved. Regular management audits by the Fire Chief should be conducted to reveal if the goal is being met. In many communities it is difficult to exceed the 90 percent figure in a cost-effective manner due to the following limiting factors:

- Low staffing
- Insufficient equipment available
- Fire stations located too far from area impacted by fire, or insufficient number of fire stations to service the area
- Access obstructions
- Traffic-calming devices and median strips on major highways and roadways
- Traffic congestion
- Weather
- Multiple alarms
- Delayed response
- Winding access roads in the hillsides
- Road grades
- Gated communities
- Multiple story buildings or large buildings where it takes time to reach the source of the fire after arrival at the occupancy.

The Verdugo Fire Communications Center (2002) reports that in Glendale, during 2002, the Fire Department arrived on-scene in less than 5 minutes from receiving the dispatch in 80.4 percent of the responses, and in less than 6 minutes in 91 percent of the responses. In Glendale, response times vary as a result of traffic density, the time of day or night, road conditions, emergency unit availability and the City's geographical layout. In some communities with traffic congestion, traffic-signal actuation devices (Opticom) are being installed at critical intersections with traffic lights and on all fire apparatus to improve the driving time response. The use of these devices is being evaluated at this time in Glendale.

In addition to these components, there is another component called "set up" time. This is the time it takes firefighters to get to the source of a fire and get ready to fight the fire. This may range from 2 minutes at a small house fire to 15 minutes or more at a large or multi-story occupancy, such as an apartment complex or condominium, industrial park, shopping mall or hospital.

Structural fire response requires numerous critical tasks to be performed simultaneously. The number of firefighters required to perform the tasks varies based upon the risk. Obviously, the number of firefighters needed at a maximum high-risk occupancy, such as a shopping mall or large industrial occupancy would be significantly higher than for a fire in a lower-risk occupancy. Given the large number of firefighters that are required to respond to a high-risk, high-consequence fire, fire departments increasingly rely on automatic and mutual aid agreements to address the fire suppression needs of their community. If additional resources are needed due to the intensity or size of the fire, a second alarm may be requested. The second alarm results in the response of at least another two engine companies and a ladder truck. Additional fire units may be requested via automatic and mutual aid agreements.

4.3.1 Automatic and Mutual Aid Agreements

Although the Glendale Fire Department is tasked with the responsibility of fire prevention and fire suppression in Glendale, in reality, fire departments and other agencies team up and work together during emergencies. These teaming arrangements are handled through automatic and mutual aid agreements.

The California Disaster and Civil Defense Master Mutual Aid Agreement (California Government Code Section 8555-8561) states: "Each party that is signatory to the agreement shall prepare operational plans to use within their jurisdiction, and outside their area." These plans included fire and non-fire emergencies related to natural, technological, and war contingencies. The State of California, all State agencies, all political subdivisions, and all fire districts signed this agreement in 1950.

Section 8568 of the California Emergency Services Act, (California Government Code, Chapter 7 of Division 1 of Part 2) states that "the State Emergency Plan shall be in effect in each political subdivision of the State, and the governing body of each political subdivision shall take such action as may be necessary to carry out the provisions thereof." The Act provides the basic authorities for conducting emergency operations following the proclamations of emergencies by the Governor or appropriate local authority, such as a City Manager. The provisions of the act are further reflected and expanded on by appropriate local emergency ordinances. The act further describes the function and operations of government at all levels during extraordinary emergencies, including war (www.scesa.org/cal_govcode.htm). Therefore, local emergency plans are considered extensions of the California Emergency Plan.

Glendale has automatic aid agreements with the adjacent cities of Burbank, Pasadena, and Los Angeles, and with the County of Los Angeles. These agreements obligate the departments to help each other under pre-defined circumstances. **Automatic aid** agreements obligate the nearest fire company to respond to a fire regardless of the jurisdiction. **Mutual aid** agreements obligate fire department resources to respond outside of their district upon request for assistance.

The Glendale Fire Department is party to an agreement that authorizes calls for emergency response to be dispatched through the **Verdugo Joint Fire Communications Center**, which coordinates 33 different stations in the region. This "region" includes stations not only from Glendale, but also from Burbank, Pasadena, San Marino, South Pasadena, Monrovia, Arcadia, Sierra Madre and San Gabriel. The Verdugo Joint Fire Communications Center is located on the third floor of Fire Station 21 in Glendale, at 412 Oak Street. Dialing 911 in any of the cities served by the Verdugo Fire Communications Center connects the caller to

police or California Highway Patrol dispatchers, who determine the nature of the emergency, and transfer fire and paramedic calls to the Verdugo Communications Center. A dispatcher at Verdugo enters the pertinent details into the computer for transmittal via radio to the fire station that is dispatched for that particular incident. Emergency personnel are on the road within 1 to 2 minutes of receiving the call, and remain in constant radio contact with the Verdugo Communications Center as additional details are received.

Numerous other agencies are available to assist the City if needed. Several Federal agencies have roles in fire hazard mitigation, response, and recovery, including: the Fish and Wildlife Service, National Park Service, US Forest Service, Natural Resource Conservation Service, Office of Aviation Services, National Weather Service, and National Association of State Foresters. The State Office of Emergency Services can be called upon for further aid if necessary, as can Federal agencies, including the Department of Agriculture, the Department of the Interior, and, in extreme cases, the Department of Defense. Private companies and individuals may also assist.

4.3.2 Standardized Emergency Management System (SEMS)

The SEMS law refers to the Standardized Emergency Management System described by the Petris Bill (Senate Bill 1841; California Government Code Section 8607, made effective January 1, 1993) that was introduced by Senator Petris following the 1991 Oakland fires. The intent of the SEMS law is to improve the coordination of State and local emergency response in California. It requires all jurisdictions within the State of California to participate in the establishment of a standardized statewide emergency management system.

When a major incident occurs, the first few moments are absolutely critical in terms of reducing loss of life and property. First responders must be sufficiently trained to understand the nature and the gravity of the event to minimize the confusion that inevitably follows catastrophic situations. The first responder must then put into motion relevant mitigation plans to further reduce the potential for loss of life and property damage, and to communicate with the public. According to the State's Standardized Emergency Management System, local agencies have primary authority regarding rescue and treatment of casualties, and making decisions regarding protective actions for the community. This on-scene authority rests with the local emergency services organization and the incident commander.

Depending on the type of incident, several different agencies and disciplines may be called in to assist with emergency response. Agencies and disciplines that can be expected to be part of an emergency response team include medical, health, fire and rescue, police, public works, and coroner. The challenge is to accomplish the work at hand in the most effective manner, maintaining open lines of communication between the different responding agencies to share and disseminate information, and to coordinate efforts.

Emergency response in every jurisdiction in the State of California is handled in accordance with SEMS, with individual City agencies and personnel taking on their responsibilities as defined by the City's Emergency Plan. This document describes the different levels of emergencies, the local emergency management organization, and the specific responsibilities of each participating agency, government office, and City staff.

The framework of the SEMS system is the following:

- Incident Command System – a standard response system for all hazards that is based on a concept originally developed in the 1970s for response to wildland fires
- Multi-Agency Coordination System – coordinated effort between various agencies and disciplines, allowing for effective decision-making, sharing of resources, and prioritizing of incidents
- Master Mutual Aid Agreement and related systems – agreement between cities, counties and the State to provide services, personnel and facilities when local resources are inadequate to handle and emergency
- Operational Area Concept – coordination of resources and information at the county level, including political subdivisions within the county; and
- Operational Area Satellite Information System - a satellite-based communications system with a high-frequency radio backup that permits the transfer of information between agencies using the system.

The SEMS law requires the following:

- Jurisdictions must attend training sessions for the emergency management system.
- All agencies must use the system to be eligible for funding for response costs under disaster assistance programs.
- All agencies must complete after-action reports within 120 days of each declared disaster.

4.3.3 ISO Rating for the City of Glendale

The Insurance Services Office (ISO) provides rating and statistical information for the insurance industry in the United States (insurance carriers use this information to establish insurance rates in different parts of the country). To do so, ISO evaluates a community's fire protection needs and services, and assigns each community evaluated a Public Protection Classification (PPC) rating. The rating is developed as a cumulative point system, based on the community's fire-suppression delivery system, including fire dispatch (operators, alarm dispatch circuits, telephone lines available), fire department (equipment available, personnel, training, distribution of companies, etc.), and water supply (adequacy, condition, number and installation of fire hydrants). Insurance rates are based upon this rating. The worst rating is a Class 10. The best is a Class 1. The City of Glendale is rated as a Class 1, and therefore has the distinction of being one of only 44 communities in the United States that have achieved this rating at this time.

4.4 Earthquake-Induced Fires

A large portion of the structural damage caused by the great San Francisco earthquake of 1906 was the result of fires rather than ground shaking. More recently and closer to home, the moderately sized, M 6.7 Northridge earthquake caused 15,021 natural gas leaks that resulted in three street fires, 51 structural fires (23 of these caused total ruin) and the destruction by fire of 172 mobile homes. In one incident, the earthquake severed a 22-inch gas transmission line and a motorist ignited the gas while attempting to restart his stalled vehicle. Response to this fire was impeded by the earthquake's rupture of a water main; five nearby homes were destroyed. Elsewhere, one mobile home fire started when a downed power line ignited a ruptured transmission line. In many of the destroyed mobile homes, fires erupted when inadequate bracing allowed the homes to slip off their foundations, severing gas lines

and igniting fires. There was a much greater incidence of mobile home fires (49.1 per thousand) than other structure fires (1.1 per thousand).

The California Division of Mines and Geology (Toppozada and others, 1988) published in 1988 a study that identified projected damages in the Los Angeles area as a result of an earthquake on the Newport-Inglewood fault. The earthquake scenario estimated that thousands of gas leaks would result from damage to pipelines, valves and service connections. This study prompted the Southern California Gas Company to start replacing their distribution pipelines with flexible plastic polyethylene pipe, and to develop ways to isolate and shut off sections of supply lines when breaks are severe. Nevertheless, as a result of the 1994 Northridge earthquake, the Southern California Gas Company reported 35 breaks in its natural gas transmission lines and 717 breaks in distribution lines. About 74 percent of its 752 leaks were corrosion related. Furthermore, in the aftermath of the earthquake, 122,886 gas meters were closed by customers or emergency personnel. Most of the leaks were small and could be repaired at the time of service restoration.

History indicates that fires following an earthquake have the potential to severely tax the local fire suppression agencies, and develop into a worst-case scenario. Earthquake-induced fires can place extraordinary demands on fire suppression resources because of multiple ignitions. The principal causes of earthquake-related fires are open flames, electrical malfunctions, gas leaks, and chemical spills. Downed power lines may ignite fires if the lines do not automatically de-energize. Unanchored gas heaters and water heaters are common problems, as these readily tip over during strong ground shaking (State law now requires new and replaced gas-fired water heaters to be attached to a wall or other support).

Many factors affect the severity of fires following an earthquake, including ignition sources, types and density of fuel, weather conditions, functionality of the water systems, and the ability of firefighters to suppress the fires. Casualties, debris and poor access can all limit fire-fighting effectiveness. Water availability in Los Angeles County following a major earthquake will most likely be curtailed due to damage to the water distribution system — broken water mains, damage to the aqueduct system, damage to above-ground reservoirs, etc. (see Chapter 1 – Seismic Hazards, and Chapter 3 – Flooding Hazards).

4.4.1 Earthquake-Induced Fire Scenarios for the Glendale Area using HAZUS

HAZUS™ is a standardized methodology for earthquake loss estimation based on a geographic information system (GIS). The user can run the program to estimate the damage and losses that an earthquake on a specific fault would generate in a specific geographic area, such as a city. Detailed information on this methodology is covered in Sections 1.8 and 1.9 of Chapter 1. One of the HAZUS components is earthquake-induced fire loss estimation.

Loss estimation is a new methodology, and our understanding of fires following earthquakes is limited. An accurate, fire-following-earthquake evaluation possibly requires extensive knowledge of the level of readiness of local fire departments, as well as the types and availability (functionality) of water systems, among other data. Although these parameters are not yet considered in the fire-after-earthquake module, preliminary results obtained from this HAZUS component are encouraging.

Current data suggest that about 70 percent of all earthquake-induced fire ignitions occur immediately after an earthquake since many fires are discovered within a few minutes after an earthquake. The remaining ignitions occur about an hour to a day after the earthquake. A typical cause of the delayed ignitions is the restoration of electric power. When power is

restored, short circuits caused by the earthquake become energized and can start fires. Also, items that have overturned or fallen onto stove tops, etc., can ignite. If no one is present at the time electric power is restored, ignitions can develop into fires requiring fire department response.

HAZUS loss estimations were made for earthquake scenarios on the San Andreas, Sierra Madre, Verdugo, Raymond and Hollywood faults (refer to Chapter 1 for additional information on each of these earthquake scenarios). Four of the five scenarios are summarized below. Two wind speeds were used for each earthquake scenario. A value of 10 mph was used to model normal wind conditions. A speed of 30 miles per hour (mph) was assigned to evaluate fire spread as a result of Santa Ana winds. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area that each earthquake scenario is likely to generate.

Note that the HAZUS loss estimation does not consider effects of reduced water pressure due to breaks in the water distribution system. These are expected to be widespread where ground failure occurs, and could further reduce functionality at some stations.

Table 4-2: Earthquake-Induced Fire Losses in Glendale based on HAZUS Scenario Earthquakes

Earthquake Scenario (refer to Chapter 1 for additional information)	No. of Ignitions		Population Displaced At a Wind Speed of		Building Value Burnt At a Wind Speed of (US$ millions)	
	10 mph	30 mph	10 mph	30 mph	10 mph	30 mph
San Andreas	3	3	30	308	0.14	1.59
Sierra Madre	11	11	116	2,047	5.6	99.8
Verdugo	11	11	142	2,295	7.1	116
Raymond	10	10	354	2,224	16.6	106
Hollywood	10	10	244	2,919	11.3	151.8

Table 4-2 shows that earthquakes on the Sierra Madre, Verdugo, Raymond and Hollywood faults have the potential to cause significant fire-after-earthquake losses in the City of Glendale. The HAZUS results show that wind speeds definitely have an impact on the damage extent. The Hollywood fault fire-after-earthquake scenario is modeled as the worst case for the City of Glendale if Santa Ana wind conditions are present at the time of the earthquake, with the Verdugo and Raymond fault earthquakes coming in second. Rupture of the Verdugo and Sierra Madre faults, given their location across developed portions of the City and surrounding communities, is anticipated to cause many breaks in the gas and water distribution systems. Therefore, retrofitting those pipe sections across and near the mapped trace of these faults with flexible plastic polyethylene pipe and flexible joints should be a priority.

The Glendale Fire Department has procedures in place to follow immediately after an earthquake. In accordance with their Earthquake Response Plan, immediately after an earth tremor, fire apparatus and other response vehicles are taken out of the stations and parked outside. Personnel from each station then drive around their district to assess the damage, if any, and provide assistance as needed.

At the time of this writing, the Glendale Fire Department was in the process of re-establishing an Urban Search and Rescue (USAR) program, with emphasis on trench, confined space, water, technical rope, and some limited shoring rescue. The Department has acquired a USAR apparatus and has a full complement of new confined space hose and fittings, and a winch system that allows them to put a two-line rope system in place, off the apparatus, in less than two minutes. They also have the only "Victim Locator" in the Verdugo system. Certification training is ongoing, with monthly training drills. The emphasis of the monthly drills is rotated among the different disciplines of USAR so that each discipline is covered four times a year. The Department also plans to drill together with the Burbank and Pasadena USAR teams at least once a year.

4.5 Summary of Findings

The City of Glendale includes brush-covered areas of significant topographic relief in the Verdugo and San Gabriel Mountains and the San Rafael Hills that are susceptible to wildland fires. In fact, Glendale's Fire Department places nearly two-thirds of the City in the high fire hazard area. The historical record supports this mapping: since the late 1800s, the entire northern two-thirds of the City have burned at least once. The most recent wildland fire in Glendale occurred in September 2002.

Although large areas of the Verdugo Mountains and San Rafael Hills are undeveloped, there are many, mostly single-family, residential neighborhoods that have been developed in the canyons, and at the base or edges of the hillsides, within the high fire hazard area. In these areas, referred to as the urban-wildland interface, the wildland fire hazard is of significant concern. This is especially true for those older residential areas in the hillsides that are reached by narrow roads that do not meet the current fire safety standards for access and egress of fire apparatus. Many roads in the hillsides are also dead-end roads that are too long, do not have appropriate turnarounds at their end, have no secondary access, or service many more residential units than what is recommended. These roads should be improved to provide access to emergency vehicles, with the retrofit prioritized so that roads that provide access to the largest number of residences are retrofitted first. Of the roads with no secondary access, Glenoaks Boulevard in the San Rafael Hills poses by far the most serious concern regarding accessibility, as this is the only way out for hundreds of residents. In the event of a disaster, it may not be possible to evacuate this area, with the potential for multiple loss of life. Establishing a secondary outlet from Glenoaks Canyon should be a priority for the City.

To reduce the wildland fire hazard, especially at the urban-wildland interface, the City of Glendale has adopted an aggressive fuel modification ordinance that requires property owners to maintain a defensible space around their properties. The defensible space consists of a buffer zone 100 feet wide (the City's Fire Chief may require the buffer zone to be 200 feet wide in some areas) where the native vegetation is thinned and/or replaced with City-approved, drought-tolerant and fire-resistant ornamental plants. The Fire Department conducts annual inspections of residences and lots in the City to ensure compliance with the fuel modification ordinance, and issues notices of violation where appropriate. If voluntary compliance is not achieved, the Fire Department contracts with the Los Angeles County Agricultural Commissioner for weed abatement in non-compliant properties and

vacant lots. Glendale should continue to require property owners to conduct maintenance on their properties to reduce the fire danger in accordance with the City's Building and Fire Safety Code. The single most important mitigation measure for a single-family residence is to maintain a fire-safe landscape, thereby creating a defensible space around the structure.

In addition to vegetation management to reduce the fire hazard, the City of Glendale has adopted several ordinances that require the use of fire-resistant construction materials that protect structures from fire damage. Most of the City-adopted ordinances have become effective years ahead of the rest of California, setting an example for other communities, and are also more stringent than California Fire Code requirements. These include Class A roof coverings for all new roofs and re-roofs amounting to more than 25 percent of the original roof area, and fire sprinklers in all new one- and two-family structures. The Class A roof-covering ordinance first applied only to structures within the high fire hazard area, but is now enforced Citywide.

Most development in Glendale occurs in the flatlands, where the predominant housing type is multiple-family units (apartments and condominiums) that have special fire protection needs. To that end, City ordinances require all of mid-rise and high-rise buildings to have fire and life safety systems in place, including automatic fire sprinklers and smoke detectors. The specific construction requirements are contained in the Glendale Building and Safety Code (Volume I, Section 715 which deals with construction requirements in fire hazard areas, and Volume VI, which pertains to fire and life-safety requirements).

Fire incidents comprise only 12.6 percent of the total number of incidents that the Glendale Fire Department responds to in a yearly basis (medical emergencies make up about 79 percent of the calls based on 2002 figures), and structural fires amount to about 5 percent of these fire calls. Therefore, structural fires in the City do not occur very often, due in great part to the various fire prevention programs that the Fire Department has in place, and the prompt reply to fire calls by fire fighting personnel. The only concern is that a large percentage of the single-family residential structures in the City were built before 1986, when the first fire sprinkler ordinance in Glendale was adopted. If the Fire Department determines that a large percentage of the few structural fires in the City occur in non-sprinklered structures, homeowners should be encouraged to retrofit their residences to add sprinklers.

Some of the fire prevention programs that the City uses include fire prevention inspections on a yearly or bi-yearly basis to a variety of buildings, including residential, commercial and industrial, with emphasis on multiple-occupancy structures (both high probability/high consequences and high probability/low consequences risk assets). Glendale's Fire Prevention Bureau also reviews all proposed development plans for conformance with fire protection requirements, and has an extensive public education and awareness program aimed at various groups, including school children. These programs are clearly working and should therefore be continued.

The Glendale Fire Department has nine fire stations distributed throughout the City. Dispatch calls are received through the Verdugo Fire Communications Center, and most calls in the City are responded to within 5 to 6 minutes of the dispatch center receiving the call. Improving these already excellent response times is generally difficult, especially in a city like Glendale, where traffic is intense at several times throughout the day, there are many structures accessed by long, winding roads in areas of significant topographic relief, and the City's layout is not geometric. The last two conditions are difficult to modify. However, if review of the data indicates that the response time is a function primarily of congestion during peak traffic hours, there are several methods that can be used to improve the firefighters' response time, including traffic signal pre-emption devices installed at critical intersections and elimination of traffic calming devices such as speed humps and speed bumps.

As discussed above, normal, day-to-day fire conditions in the developed portions of the City are readily manageable with the resources at hand. In fact, the Glendale Fire Department has an excellent fire-suppression delivery system that has earned the City an Insurance Services Office (ISO) rating of Class 1, the best possible. If the Glendale Fire Department requires assistance from neighboring fire departments, it can request so via the automatic aid agreements that the City has in place with the cities of Burbank, Pasadena, and Los Angeles, and with the County of Los Angeles. If these resources are still not sufficient, the City can request assistance from other jurisdictions in accordance with the provisions of the California Mutual Aid Agreement (California Government Code Section 8555-8561). As the City grows, and the infrastructure ages, however, the City should regularly re-evaluate specific fire hazard areas, conducting periodic Fire Station location and Resource studies to ensure that the Fire Department can continue to provide the level of service expected. This includes reviewing the adequacy of the water supplies (fire flow) on a regular, possibly yearly basis.

After-earthquake fires have the potential to severely impact a community, especially if gas transmission lines break due to ground rupture (surface fault rupture, liquefaction, landsliding, or other geologic conditions that results in ground deformation). Several faults in the area have the potential to cause extensive earthquake-induced fire damage. According to loss-estimation models the Raymond, Hollywood and Verdugo faults have the potential to cause the most fire damage in Glendale. Because the effects of an earthquake are regional, earthquake-induced fires can occur throughout a community and adjacent areas, immediately taxing the regional fire suppression system. The rupture of water mains, and the failure of water storage facilities that result in insufficient water or water pressure to fight the fires can also hinder fire suppression. The Verdugo and Sierra Madre faults may rupture the ground surface during an earthquake, causing many breaks in the gas and water distribution systems. This would be especially serious if the Verdugo fault broke, since many of the reservoirs in the City are on the north side of the this fault, and breakage of the distribution pipes would limit the amount of water available to fight fires in the extensively developed southern portion of Glendale. Therefore, retrofitting of the pipe sections across and near the mapped traces of these faults with flexible pipe and joints should be a priority.

The Glendale Fire Department conducts training exercises that simulate natural and man-made disasters. City staff, as well as elected officials, should participate in earthquake-induced fire-scenario exercises based on this study's HAZUS loss estimates, using the adopted emergency management system (SEMS). They are also re-starting their Urban Search and Rescue (USAR) program that will specialize in techniques that other USAR teams from neighboring cities are not emphasizing, so as to not duplicate efforts. Support for this program should be maintained.