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*** Document revised on October 25, 2004, to include recommendations by the State Office of Emergency Services.**

SECTION 1

INTRODUCTION

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SECTION 1

INTRODUCTION

What is a Natural Hazard Mitigation Plan?

Hazard mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from a natural hazard event. Natural hazards events include floods, wildfires, extreme heat/drought, tornadoes, tsunamis, windstorms, coastal storms, landslides, volcanoes and earthquakes. In developing a Natural Hazard Mitigation Plan, each community must identify all the natural hazards that affect their community and then determine which hazards are most likely to impact the community.

The results of a Natural Hazard Vulnerability Survey indicated that Duarte residents, businesses, and organizations are most concerned with earthquake hazard events and wildfire hazard events. Using a highest to lowest threat level indicator, the following natural hazards were selected:

- Earthquake
- Flood
- Landslide
- Wildfire
- Windstorm

Disaster Mitigation Act of 2000

The Disaster Mitigation Act of 2000 was signed into law by the President of the United States on October 10, 2000. This federal legislation emphasizes the need for every community to plan for natural disasters before they occur.

The Disaster Mitigation Act of 2000 mandates that city governments and local agencies have a local natural disaster mitigation plan in place to be eligible for both pre and post disaster federal funding. This new mitigation legislation emphasizes the reduction of risks from natural hazards through pre-event risk identification and assessment. The Federal Government is no longer willing to pay for repetitive disaster damage or damage that can easily be averted by pre-event actions.

The Disaster Mitigation Act aims at reducing risk from natural hazards through pre-event risk identification and assessment. For example, if a community is having reoccurring flooding then mitigation measures could be implemented to reduce the

damage from flooding such as constructing flood control channels or storm drains. This approach shifts much of the emphasis from the "disaster response" to "disaster mitigation:"

Why Develop a Mitigation Plan?

The most destructive wildfire season in California history occurred in the fall of 2003. In a ten-day period, 12 separate fires raged across Southern California. In San Diego County alone, the massive “Cedar” fire consumed 2,800 homes and burned over a quarter of a million acres. After the firestorms, federal and state officials approved more than $218 million to help residents, business owners, local government agencies and non-profit organizations recover from the wildfires and prepare for future disasters.

One of the most destructive earthquake events affecting Southern California was the Northridge earthquake that struck Southern California on January 17, 1994. The Northridge earthquake occurred at 4:31 A.M. and it registered 6.7 on the Richter Scale. The temblor caused at least 61 deaths and 6,500 injuries. Thousands of homes and businesses were without electricity; tens of thousands had no gas; and nearly 50,000 had little or no water. The quake destroyed or seriously damaged more than 1,000 buildings throughout the Los Angeles Basin and left 20,000 people homeless. Freeway overpasses collapsed creating traffic disruptions and commuter havoc on the freeway system. With the estimated damage bill running as high as $20 billion, the Northridge earthquake was one of the costliest natural disasters in American history.

The rising cost of natural disasters has increased the need to identify effective ways to reduce vulnerability to disasters.

The mitigation planning process is achieved by identifying natural hazards that may occur in a community and then developing mitigation goals and objectives. Past natural hazard events are reviewed for possible reoccurrence. Hazard events are also reviewed for likeliness to occur. Armed with an understanding of the risks posed by natural hazards, communities should then determine what their priorities should be and look at possible ways to avoid or minimize the undesired effects. The result is a natural hazard mitigation plan and strategy for implementation.

Who Participated in Developing the Plan?

The City of Duarte Natural Hazard Mitigation Plan is the result of a collaborative effort among Duarte residents, numerous city departments, local organizations, utility companies, the business community and regional and state agencies.

Public participation was a major factor in the development of this plan. A tremendous response by the public to the Disaster Assessment Survey established the foundation for developing the plan. Specialized surveys were also sent to and received from a myriad of local organizations, businesses, and utility companies.

Two public workshops were held to solicit input from community on the development of mitigation goals and action items. A project Steering Committee guided the process of developing the plan. A list of all Steering Committee Members is contained in Chapter 4, Public Participation. Chapter 4 further describes the development of the plan and includes minutes of Steering Committee meetings.

Whom Does the Mitigation Plan Affect?

The City of Duarte Natural Hazard Mitigation Plan affects all areas within the City's incorporated boundaries. The city presently has a total land area of 4,352 acres (6.8 square miles). A map of the city's boundaries is provided on the next page.

The Structure of the Plan

Each section of the mitigation plan provides information and resources to understand the hazard related threats to the community. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The plan is divided into three parts:

PART 1
Part I contains the Introduction, Community Profile, Mission Statement and Goals, Public Participation Summary and Risk Assessment.

PART 2
Part 2 contains the five natural hazard events. A section is provided for each of the natural hazards: Earthquake, Wildfire, Flood, Windstorm, and Landslide. Each hazard section contains a Hazard Identification component, a Vulnerability & Risk Assessment, and Hazard Mitigation Action Items.

PART 3
Part 3 contains the Multi-Hazard Goal and Action Items, which pertain to all five hazards contained in Part 2. Part 3 also contains the Plan Maintenance section, which details the formal process that will ensure that the Duarte Natural Hazard Mitigation Plan remains an active and relevant document.

PART 4
Part 4 provides the appendices including a List of Acronyms, a Hazard Mitigation Planning Overview from Southern California Edison and a Resource Directory.

The plan is structured in such a way that each part and /or section can be reviewed and revised separately. As new data becomes available, each section can be updated individually to stay current with new information. The ability to update individual

sections of the mitigation plan may also prove to be a cost saving measure for the city since the whole document will not need to be revised. Funding and staff resources can be allocated based on selected pieces in need of review. New information or revised mitigation actions can be easily incorporated, resulting in a natural hazard mitigation plan that remains current and relevant to the City of Duarte.

MAP

Plan Methodology

The City of Duarte Natural Hazard Mitigation Plan was developed over a 5 month time period. Eight city department and special divisions were involved in the development of the plan as follows:

- Public Safety Department
- Community Development Department
- Finance Department
- Planning Division
- Public Works Division
- Code Enforcement Division
- Crime Prevention Division
- Field Services Division

The Natural Hazard Mitigation Steering Committee convened every 3 to 4 weeks to guide development of the Plan. The Steering Committee played an integral role in developing the mission, goals, and action items for the mitigation plan. The Steering Committee consisted of ten city staff members plus representatives of public and private organizations as follows:

- City of Hope National Medical Center
- Duarte Chamber of Commerce
- Duarte Historical Society
- Southern California Edison Company
- Preferred Planning
- County of Los Angeles Library
- Duarte Mesa Association
- Neighborhood Watch

Two public workshops were held to gather comments and ideas from Duarte citizens. The first meeting provided a forum for gathering comments and ideas about mitigation planning. Prior hazard events and previous mitigation measures were discussed at this meeting. The second public workshop was an opportunity to review the mitigation goals and actions that had been drafted by the Mitigation Steering Committee and to receive public input on these goals. Further information on the Steering Committee meetings and the public workshops is contained in Section 4 “Public Participation”.

Information in the City of Duarte Natural Hazard Mitigation Plan is drawn from a number of sources. The format and content of the plan was developed utilizing the following guides:

- Building Support for Mitigation Planning (FEMA)
- Understanding Your Risks, Identifying Hazards & Estimating Loses (FEMA)

- Developing the Mitigation Plan (FEMA)
- Natural Hazard Mitigation Planning Toolkit (prepared by the Disaster Management Area Coordinators of Areas D, E and G)
- San Gabriel River Master Plan
- Lucas County Mitigation Plan
- Clackamas County Mitigation Plan

Data was compiled and collected from numerous sources on the five natural hazards: Earthquake, Wildfire, Flood, Windstorm, and Landslide. Research materials came from a number of State and Federal Agencies including the following:

- Building Seismic Safety Council
- California Department of Forestry and Fire Protection
- California Division of Mines and Geology
- California Department of Water Resources
- California Department of Conservation
- Federal Emergency Management Agency, Mitigation Division
- Governor's Office of Emergency Services
- Landslides Hazards Program, USGS
- Los Angeles County Fire Department
- Los Angeles County Public Works Department
- National Wildland/Urban Interface Fire Program
- National Flood Insurance Program (NFIP)
- National Oceanic/Atmospheric Administration (NOAA)
- National Weather Service
- Southern California Earthquake Center (SCEC)
- State Fire Marshal
- United States Geological Survey
- US Army Corps of Engineers

To determine the type and level of natural hazards that could affect the city of Duarte, the City of Duarte Natural Hazard Mitigation Steering Committee carefully researched natural events that had happened in the past and analyzed reoccurring factors. Historical records were studied to determine dates, magnitudes of hazard events, records of damage, and geographical locations of events. The Mitigation Steering Committee collected historical data from the following sources:

- San Gabriel Valley Tribune
- Pasadena Star Newspaper
- City of Duarte, City Clerk's Office
- Duarte Historical Museum
- Duarte Historical Society
- Los Angeles County Public Works Department
- Los Angeles County Fire Department
- Southern California Earthquake Center

- Personal interviews with city residents

Existing plans, city documents and other local sources of information were also used in the preparation of this plan. While many of the documents did not provide extensive details about natural hazards in Duarte, they did provide a starting point to explore additional information. By reviewing several key city documents, such as the city's General Plan, the Mitigation Steering Committee was also able to ensure that the Mitigation Plan would be consistent with existing city policies and programs. The following documents were studied and reviewed in preparation of the City of Duarte Natural Hazard Mitigation Plan:

City Documents	Other Documents
General Plan	San Gabriel River Master Plan
Emergency Preparedness Plan	Los Angeles County General Plan
Threat Assessment	Seismic Hazards in California (CGS)
City Budget	LA County Uniform Building Code
Capital Improvement Plan	LA County Uniform Fire Code
Hillside Development Overlay Zone	Census 2000
R-1D Residential Zone	
Title 16 Building & Construction Code	
Title 18 Municipal Code	

How Will The Plan Be Adopted And Implemented?

Plan Adoption

The Duarte Planning Commission will review the document at a regularly scheduled public meeting, will seek public input, and will make recommendations to the Duarte City Council.

The Duarte City Council will be responsible for adopting the City of Duarte Natural Hazard Mitigation Plan. The Duarte City Council, as the governing body, has the authority to promote sound public policy regarding natural hazards.

Coordinating Body

The City of Duarte Natural Hazard Mitigation Steering Committee will be responsible for coordinating implementation of the Plan action items and for undertaking the formal review process.

Convener

The Duarte City Council will adopt the Duarte Natural Hazard Mitigation Plan, and the City of Duarte Natural Hazard Mitigation Steering Committee will be responsible for the implementation of the Plan. The City Manager will serve as the **Convener** to facilitate

the Natural Hazard Mitigation Steering Committee meetings and will assign task such as updating.

Implementation Through Existing Programs

The City of Duarte addresses state mandated planning goals and legislative requirements through its General Plan, Zoning Codes, Capital Improvement Plans and Los Angeles County Uniform Building Code. The City of Duarte Natural Hazard Mitigation Plan provides a series of recommendations that are closely related to the goals and objectives of these existing planning programs. The City of Duarte will have the opportunity to implement recommended mitigation action items through existing programs and department procedures.

How Will The Plan Be Monitored And Evaluated?

The City of Duarte Natural Hazard Mitigation Plan will be evaluated on an annual basis to determine the effectiveness of mitigation actions and programs. The convener will be responsible for contacting the Natural Hazard Mitigation Steering Committee members and organizing the annual meeting.

The Plan Maintenance Section of this document (Section 12) provides details on the formal review process that will ensure that the City of Duarte Natural Hazard Mitigation Plan remains an active and relevant document.

Will The Public Continue To Be Involved?

The City of Duarte is committed to ensuring full public participation in the continual review and updates of the Natural Hazard Mitigation Plan. Copies of the Plan will be available at the City Clerk's Office, the Community Development Department and the Public Safety Offices. All updated and revised copies of the Natural Hazard Mitigation Plan will also be kept on file at the previously listed locations. Each plan that is available for public review will contain the address and phone number of the city Planning Division, responsible for keeping track of public comments on the Plan. In addition, the city website will be utilized to inform residents as to the time and date of the annual evaluation meetings on the Plan. The city website will also contain an email address and phone number to which people can direct their comments and concerns.

SECTION 2:

COMMUNITY PROFILE

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COMMUNITY PROFILE

Why Plan for Natural Hazards in the City of Duarte?

The City of Duarte is a small progressive city located at the base of the picturesque San Gabriel Mountains, approximately 15 miles northeast of Los Angeles. Duarte is bounded by the cities of Azusa on the east, Irwindale on the south, Monrovia on the west, and the City of Bradbury and the Angeles National Forest on the north. The Foothill Freeway (I-210) traverses Duarte from east to west and is a major transportation link for those traveling east to west into Los Angeles.

Incorporated in 1957, Duarte is a fully urbanized city with approximately 98 percent of its urbanized area developed. The total land area of the City is 6.8 square miles. Of this total area - 2,251 acres, or 52 percent, consists of undeveloped wilderness areas located in the San Gabriel Mountains.

As a fully urbanized community, natural hazards can greatly impact the citizens, the environment, and the economy of the City of Duarte. Earthquakes, wildfires, landslides, windstorms, and flooding have distressed this community in varying degrees. These natural hazards have impacted Duarte's residents and businesses with the financial and emotional costs of recovering after natural disasters. As the City becomes more populated, the costs of recovering from each natural disaster will increase. Recent wildfires in Southern California have reminded us in graphic detail of the high cost of natural disasters. The awareness of earthquakes in our region is another reminder of the need to implement programs that assist in protecting lives, property, and critical facilities. Recent reports from scientist of the U.S. Geological Survey and the Southern California Earthquake Center say that the Los Angeles Area could expect one earthquake every year of magnitude 5.0 or greater for the foreseeable future. Therefore, it is essential that the City of Duarte identify the risks associated with natural hazards and develops strategies to reduce risk and prevent loss from future natural hazard events.

Geography and the Environment

The City of Duarte is located in Los Angeles County in an area called The San Gabriel Valley. The area referred to as the San Gabriel Valley is so amorphous and its boundaries so difficult to identify that the U. S. Geological Survey does not recognize it as a separate entity. However, within Southern California the informal description is of a half-moon shaped valley squeezed between the San Gabriel and Verdugo Mountains, and the San Rafael, Montebello, Puente, and San Jose Hills.[1] The tributaries of the San Gabriel River drain the valley.

Duarte's topographical terrain is divided into three districts: the San Gabriel Mountain range of the Angels National Forest; the foothills and canyons of the San Gabriel

Mountains; and alluvial slopes of the mountains. The latter is the area that contains Duarte's urban development.
The City of Duarte presently has a total land area of 4,352 acres (6.8 square miles). Approximately, 1,078 acres are residential land uses and 1,303 acres are commercial/industrial land uses. The remaining 2,251 acres are wilderness areas included within the Angeles National Forest.

The Angeles National Forest consists of 693,667 acres of forest and chaparral in the San Gabriel Mountains. It was designated in 1892 by President Harrison as the first national forest in the state of California, and one of the earliest in the nation, its purpose being to protect the local watershed.

The northernmost section of the City is the mountainous country of the Angeles National Forest, which restricts any kind of urban development. The Foothills consist of steep wall canyons with few developable flat areas. As a result, 2,251 acres have been designated open space as the more suitable use for the area.

Urban development in the City of Duarte has been limited to the alluvial slope areas of the City. Single-family housing units are the predominant land use along the base of the Foothills. As the land begins to flatten out, then commercial land uses are available such as restaurants, service stations, and grocery stores. Neighborhood and regional shopping centers are located near the center of the town. Commercial, residential, and industrial uses are located along both sides of the Foothill Freeway.

The City of Duarte has two major physiographic regions that should be considered in planning for natural hazards: the San Gabriel River, and the San Gabriel Mountain range.

San Gabriel Mountain Range

Geographically, the San Gabriel Mountain Range is made up of two roughly parallel ranges. The northern, inland range is the longer and loftier range. It extends from Mt. Gleason eastward past the 9,000' summits of Waterman and Baden-Powell and climaxes near its eastern end in the only summit over 10,000 ' – Mt. San Antonio (Old Baldy). The southern, or front range, though neither as long nor as high, is equally rugged. Two of its summits- Strawberry and San Gabriel- exceed 6,000'.

Below the peaks is a complex of deep, shaded canyons, extending well up into the higher parts of the range. The range's major watershed is the San Gabriel River whose three main forks and countless tributaries drain fully 20 percent of the mountain precipitation.

The San Gabriel Mountain range is a fairly gentle range. Ridgelines are sinuous rather than jagged, summits rounded rather than angular, slopes tapered rather than sheer. The San Gabriels form a great roof over the Southern California coastal lowlands.[2]

The mountain areas north of Duarte contain rugged topography with few areas suitable for development. Most of the slopes in this area are steeper than 50 percent, which generally prohibit any kind of development. The City of Duarte is currently in negotiations with the State of California and land conservancies to preserve approximately 500 acres of rugged hillside areas.

San Gabriel River

The San Gabriel River is the central backbone of the San Gabriel River Watershed. The watershed for the San Gabriel River is one of several coastal watersheds in Southern California that drain hundreds of square miles of mountainous and urban lands to the Pacific Ocean. The character of the river changes dramatically during its 58-mile journey from Cogswell Dam (near the headwaters in San Gabriel Mountains) to its mouth at the Pacific Ocean. On its run to the sea, the San Gabriel River passes through 19 different cities.[3]

A network of dams and flood control measures controls the San Gabriel River. The natural water cycle and flow are significantly altered to protect the adjacent communities from flood damage and to better use local water resources for urban and agricultural water supplies.

The river environment for the San Gabriel River changes dramatically during the 58 – mile course. For this reason the River is divided into seven different reaches.

1. Headwaters. The Angeles National Forest at the base of the Cogswell Dam east to the confluence with the East Fork of the River.

2. San Gabriel Canyon. Where the main stem of the river joins the East Fork south to the mouth of the San Gabriel Canyon, just above the lasted developed land in the City of Azusa.

3. Upper San Gabriel Valley. From the mouth of the San Gabriel Canyon above Azusa to the base of the Santa Fe Dam in Irwindale.

4. Lower San Gabriel Valley. The base of the Santa Fe Dam to the base of the Whittier Narrows Dam.

5. Upper Coastal Plain. Whittier Narrows to where the river crosses Firestone Boulevard in Downey.

6. Lower Coastal Plain. Firestone Boulevard south to Coyote Creek confluence.

7. Zone of Tidal Influence. The final stretch of the river to the Pacific Ocean.

The City of Duarte is located in the Upper San Gabriel Valley reach. A network of dams in the San Gabriel Canyon and at the Headwaters controls water flows and provides

flood protection to the communities located in the Upper San Gabriel reach. Cogswell Dam is located in the Headwaters reach and two dams are located in the San Gabriel Canyon reach (Morris Dam and San Gabriel Dam).

Climate

The Climate of the City of Duarte is generally temperate and semi-arid with warm, dry summers and mild, moist winters. Nearly all precipitation occurs during the months of December through March. Precipitation during summer months is infrequent and rainless periods of several months are common. Since snowfall occurs in Southern California at elevations greater than Duarte's, snowfall is virtually non-existent.

January is the coldest month of the year and July is the warmest. At the Los Angeles civic center the 30-year average daily minimum temperature for January is 48 degrees. The average daily temperature for July is 84 degrees. Duarte's daytime temperatures are usually a little higher than downtown LA due to its location inland. The all-time low and high extremes of temperatures for the San Gabriel Valley area are about 21 and 112 respectively.[4]

Average temperature for Los Angeles (mean)

Spring	62 degrees
Summer	73 degrees
Fall	68 degrees
Winter	58 degrees

Precipitation (rainfall) in the Los Angeles area occurs primarily in the form of winter orographic rainfall associated with extra tropical cyclones of North Pacific origin. Major storms consist of one or more frontal systems. Occasionally, major storms will last 4 or more days. Major storms approach Southern California from the west or northwest with southerly winds, which continue until frontal passage. The San Gabriel Mountains lie directly across the path of the inflow of warm, moist air, and orographic effects greatly intensify precipitation.

The annual average for rainfall in Los Angeles County is 15.65 inches. In the San Gabriel Valley, the average rainfall is typically closer to 17.5 inches. The seasonal total for Duarte in 2001-2002 was 7.30 inches. The seasonal total for Duarte in 2000-2001 was 16.36.

The prevailing wind in the San Gabriel Valley is the sea breeze. This gentle onshore wind is normally strongest during late spring and summer afternoons. The speed of wind in Duarte is typically 10 to 15 miles per hour. Above Duarte, in the canyons of the San Gabriel Mountains the winds are typically 20 -25 miles per hour. Occasionally, a dry desert wind, called Santa Ana Winds, will blow from out of the northeast, most frequently during late fall and winter. The Santa Ana winds are usually low-humidity,

MAP

strong gusts that can exceed 70 miles per hour. These winds bring very high fire hazards.

Rainstorm-related winds are the next most common type of wind in Southern California. Rainstorm-related winds generally come from the southeast ahead of an approaching storm and they average 20-30 miles per hour. Strong gust up to 40 mph can also occur particularly in the San Gabriel Canyon.

Geology And Significant Geological Features

The San Gabriel Mountains are composed primarily of highly fractured igneous rock, with large areas of granitic rock formation being exposed. Faulting and deep weathering have produced porous zones in the rock formation; however, rock masses have produced a comparatively shallow soil mantle due to the steepness of slopes which accelerates erosion of the fine material.

Duarte is located in a seismically active region with a number of faults surrounding the area. The two principal seismic considerations for most cities in Southern California are damage to structures due to seismically induced ground shaking and surface rupture along active fault traces. Strong ground motions could have a major impact on the City of Duarte due to the proximity and earthquake potential of nearby active faults. The local geologic and topographic conditions of Duarte's location at the base of the San Gabriel Mountains could either amplify or attenuate the seismic waves.

Surface ruptures could also have a major impact on the City of Duarte. Surface rupture occurs during an earthquake when movement along an active fault breaks the ground surface. Two major faults, the *Sierra Madre Fault* and the *Duarte Fault* transverse the City. The Duarte fault is actually a "segment" of the Sierra Madre Fault.

Duarte Fault

The Duarte fault is a southern splay of the Sierra Madre-Cucamonga Fault Zone that crosses the City of Duarte in the northeastern section of the City. The fault extends through the San Gabriel River and into the City of Azusa based on vegetation lineaments observed on aerial photographs and geophysical evidence. Geologists from the California Department of Conservation, Geological Survey Division, are currently mapping the fault. Previous mapping of this fault indicate scarps within the older and younger alluvial fan deposits emanating from Bradbury, Spinks, and Monrovia Canyons north of the cities of Duarte and Azusa. Multiple groundwater barriers that are present north of Azusa seem to indicate the presence of an Upper Duarte fault, located a few thousand feet north of the Duarte fault. The studies currently underway should provide more information on this in the future.

The Upper Duarte and Duarte faults have not been zoned under the Alquist-Priolo Act. Nor is the Duarte Fault listed as an active fault with the California Geological Survey.

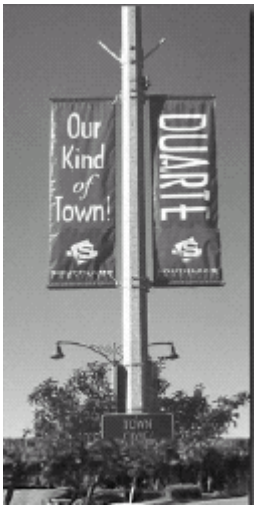
Sierra Madre-Cucamonga Fault Zone

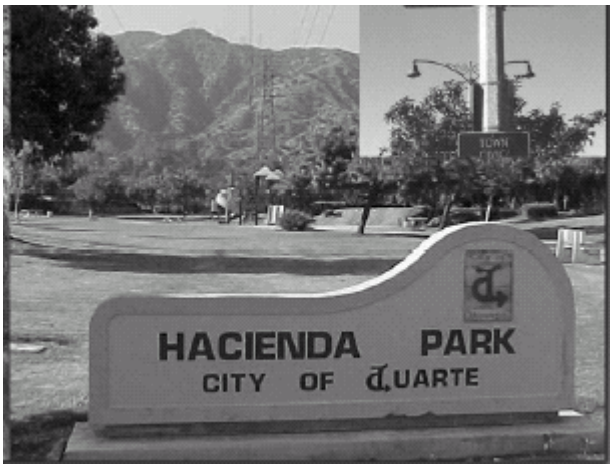
The Sierra Madre-Cucamonga Fault Zone includes several fault segments extending for over 86 miles along the southern margin of the San Gabriel Mountains. The two main portions of the Sierra Madre-Cucamonga Fault Zone include the Sierra Madre fault to the west and the Cucamonga fault to the east. The fault zone is inclined to the north, dipping below the San Gabriel Mountains and uplifting them above the Los Angeles Basin. The fault zone was responsible for the 1971 Mw 6.6 San Fernando earthquake on its westernmost segment near the town of Sylmar, California. The Sierra Madre fault passes through the northern portions of Pasadena, Arcadia, Monrovia, Duarte, Azusa, and portions of San Dimas. This fault segment has an estimated maximum moment magnitude of Mw 7.0.33.

Duarte As An Evolving Community

Duarte was incorporated as a general law/charter city in 1957. The city operates under a Council-City Manager form of government, with the five elected members of the City Council served by a City Manager and staff. The members of the City Council are elected at large for four-year terms.

The years since its incorporation have seen Duarte develop into a flourishing urban city. The 210 Freeway Automobile Complex boasts some the highest sales figures of new and used cars in the state and country. Although Duarte remains a primarily residential community, the city's proactive development efforts make it an ideal place to locate or expand a business. The city takes pride in the attractive and balanced commercial developments found throughout the community. Duarte's housing varies widely from affordable homes to expensive showplaces. Homebuyer's have a variety of options, which range from condominiums and townhouses to homes around the Rancho Duarte Golf Course and executive style homes on the Duarte Mesa with sweeping panoramic views. The Duarte Unified School District operates five elementary schools, one intermediate school, one high school and one alternative high school. The City of Duarte has 11 parks within the city boundaries and several facilities dedicated to recreational use, including a complete fitness center and two swimming pools. A year round program of recreational activities for people of all ages is provided by the City Parks and Recreation staff in the parks, the Senior Center and the Teen Center.[5]



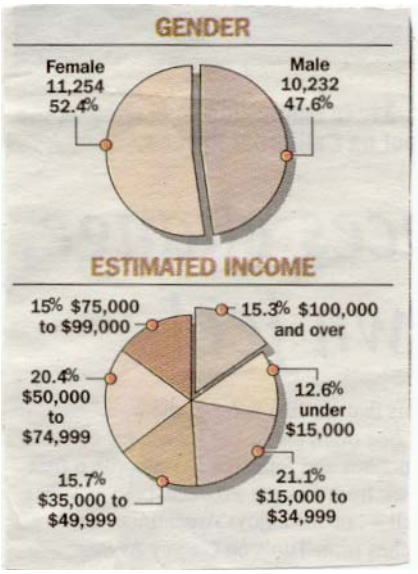


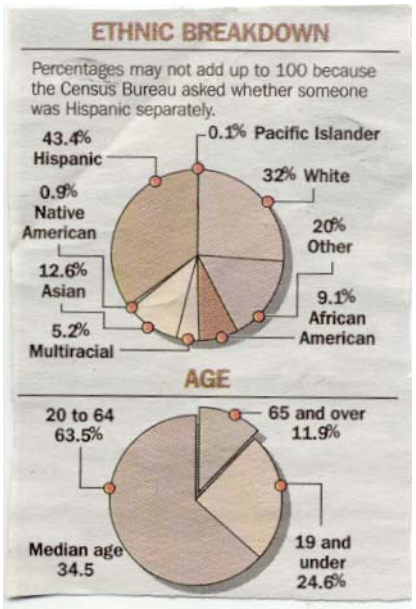
Population and Demographics

According to the 2000 U.S. Census, Duarte's population was 21,486 as of April 1, 2000. The population has steadily increased from its incorporation in 1957. In 1960, the population in Duarte was 13,962. In 1970, the population had grown to 14,981. By 1980 the population had grown by 12 percent for a total 16,766. The largest increase in population occurred between 1980 and 1990 with an increase of 23.4 percent. In 1990, the total population of Duarte was 20,688. Growth rates slowed between 1990 and 2000 due in part to lack of available land and a slow down in new construction.

1960	13,962
1970	14,981
1980	16,766
1990	20,688
2000	21,486

Population Density (2000 Census):	2,984.2 persons per square mile
Population over age 64 (2000 Census):	11.9% (1990 Census: 11.4%)
Population under age 18 (2000 Census):	28.2% (1990 Census: 28.5%)





The increase of people living in Duarte may create more exposure for the community to hazards. In particular, as the City becomes more crowded people seek out recreational opportunities in the wildness and canyon areas. This may increase the risk of wildfires in our city. It is not uncommon in Southern California to hear of a wildfire that was ignited by people participating in recreational activities in the wildlife/urban interface areas.

An increase in population levels also requires additional staffing for public safety personnel. More specifically, the amount of people living in a community directly impacts evacuation routes and evacuation plans. As population density increases in the City of Duarte, emergency personnel must reevaluate all emergency operation plans and makes changes accordingly.

Community Development & Housing

The City of Duarte encompasses approximately 4,352 acres of land. Approximately, 25 percent (1,077) of the total land area is devoted to residential uses. Light industrial activities account for 1.8 percent (79.5 acres) and commercial uses account for 2.9 percent (122.4) acres. Approximately 52 percent of the land area in Duarte is designated as Wilderness due to the Angeles Forest north of the cities urban area. Street and highways constitute a large percentage of the City at 11 percent or 478 acres. The remaining land uses are parks (1.3 percent), schools 1.7 percent, and hospitals 2.2 percent.

The unavailability of land in the San Gabriel Valley, including Duarte, results in land cost being very expensive. Duarte's suburban location to the City of Los Angeles, within easy driving distances into downtown Los Angeles, makes Duarte more desirable and consequently land cost are higher. Lastly, the price of raw land, environmental

requirements and necessary public improvements are all key factors affecting the cost of housing and commercial development. For example, the median home price in Duarte is $299,750. Homes of new construction are selling for $350,000 to $450,000.

The City of Duarte has been essentially built out for many years. The lack of available undeveloped land is a major constraint to the production of new housing. Two of the options available for housing production are infill development or tear down and rebuild development. The tear down and rebuild option becomes a market constraint because land cost mandates the need to build at a higher density. As to infill development, there are only a few vacant parcels remaining in the City.

As Duarte has grown so have its programs and recreation facilities. Duarte has a senior citizen center, a teen center, a community pool, a fitness center and 125 acres of parks. From Duarte's lush green Foothills to 125 acres of parks, trails, and community recreational facilities spread throughout the City, Duarte is a great place to call home.

Employment and Industry

A pro-business attitude, shared community vision and redevelopment have all played key roles in Duarte's dynamic growth and success over the past decade in attracting new business, expanding job opportunities and increasing residential, commercial and industrial property values. Recent figures indicated that sales tax has increased from $1.5 million to $3.2 million thanks to the vitality of Duarte's freeway-adjacent auto row and other major retailers including Staples, Target, and Wal-Mart. Another top sales generators in the City of Duarte are the car dealerships located adjacent to the Foothill (210) Freeway.

Duarte recently ranked fifth in the San Gabriel Valley in job creation with 2,314 new jobs, mainly in the retail and medical sectors. In addition, it ranked fourth in highest average pay at $32,451.

Industry	Number of Establishments
Manufacturing	47
Wholesale Trade	40
Retail Trade	50
Real Estate & Rental/Leasing	11
Professional, Scientific, & Technical	18
Administrative & Support	16
Health Care & Social Assistance	38
Accommodations & Food Services	32
Other Services (Auto Repair, Personal Care)	15
Wholesalers	36

Duarte's businesses are dependent on roads, emergency services, utilities, and communications. As the business community grows additional staffing will be needed for police and fire services. The greater the amount of people commuting to Duarte to work and shop, the greater the impact on roads and public services.
Evacuation routes and emergency operation plans will be directly impacted by larger numbers of business and industry employees. As the business community grows in the City of Duarte, emergency personnel must reevaluate all emergency operation plans and evacuation plans and make changes accordingly.

City of Health

The city motto for the City of Duarte is "City of Health". This motto was selected due to Duarte's outlook on health and due to the fact that two of the country's premier medical institutions were started in Duarte in the early part of the 20th century. In 1930, a group of Carmelite Sisters established the Santa Teresita Rest Home, known today as the Santa Teresita Hospital. From four small cottages, this medical facility developed into a fully accredited 283-bed hospital serving the San Gabriel Valley. In January of this year, the hospital closed its emergency room and cut back on many of its hospital services due to financial constraints. Currently, the hospital provides a 133 bed skilled nursing facility as well as an ancillary care unit to provide "a place of healing—for the body and the spirit".

In 1928, the Jewish Relief Association started a tuberculosis sanitarium on 40 acres of land in the southern section of the city. This later evolved into the world-renowned City of Hope Medical Center, a recognized leader in fighting cancer and other catastrophic diseases.

Today, the City of Hope includes 23 buildings dedicated to research and 13 to clinical research and treatment, all located on 112 acres of landscaped property with fountains and gardens (for further details on the 116 buildings located on the City of Hope Campus, see Appendix D at the end of this Hazard Mitigation Plan). The facility has more than 300 physicians and scientist and more than 2,500 employees, The latest effort to expand the City of Hope is the state-of-the-art, 144-bed Helford Clinical

Research Hospital which is expected to open later this year. More than 5,200 bone marrow transplants have been conducted at the hospital. In 2003, the City of Hope was recognized as one of America's best hospitals by U.S. News and World Report. In addition to its treatment facilities, at least 2.5 million is invested each week in research at the City of Hope.

Transportation and Commuting Patterns

Major east/west access in the City is provided by Huntington Drive, a major arterial with four travel lanes. Royal Oaks Drive and Central Avenue provide secondary east to west access across the City in the north and Duarte Road in the south.

Alternative modes of transportation include a railroad and several bus providers. The AT&SF Railroad traverses the City in an east to west direction just north of Duarte Road. At the present time, the line is not available for commuters. In the near future, the Metro Gold Line, a light rail line currently planned from Los Angeles to Montclair, may provide a commuter service.

The City operates its own bus system within the incorporated limits of the City. The transit system travels on most arterial and collector roads and passengers can make direct connections with the regional public transit system. In addition, Duarte is served by Foothill Transit, which connects the City with the surrounding region. Foothill Transit was established in 1988 and serves over 17 million passengers in the San Gabriel and Pomona Valleys annually. It is the second largest fixed route system in Los Angeles County, operating 299 buses and covering 327 square miles.

As daily transit rises, there is an increased risk that a natural hazard event will disrupt the commuting for thousands of Duarte residents and business persons. A severe rainstorm has the potential to disrupt the daily drive routines of Duarte residents and perhaps even more threatening is the possibility that a sizable earthquake could cause road blockages and overpass failures. Earthquakes, floods, windstorms, landslides, and wildfires all have the capability of disrupting automobile traffic and local transit systems.

MAP

ENDNOTES

1 Los Angeles A to Z, Pitt and Pitt, 1997

2 Trails of the Angeles, John Robinson, 1998

3 San Gabriel River Draft Master Plan, County of Los Angeles, 2004

4 Facts About Los Angeles, 2004

5 http://managementservices.maximus.com/exec_rec/

SECTION 3

MISSION STATEMENT & GOALS

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MISSION STATEMENT & GOALS

What is the Plan Mission?

The mission of the City of Duarte Natural Hazard Mitigation Plan is to establish and promote a comprehensive mitigation policy and program to protect citizens, employees, businesses, industries, facilities, infrastructure, property, and the environment from natural hazards. This can be achieved by documenting past hazard events, by understanding the risks posed by natural hazards, by increasing public awareness, and by identifying goals and activities to guide the city towards building a safer, more sustainable community.

What are the Plan Goals?

The plan goals describe the overall direction that the city government, community agencies, and Duarte citizens can take to minimize the undesired effects of natural hazards and to reduce the lost of life and property resulting from natural hazard events. The plan goals create the framework for implementing specific activities for each hazard event.

Goals

Protect Life and Property

- Identify natural and manmade hazards that threaten life and property in the City of Duarte.
- Implement programs and projects that assist in protecting lives by making infrastructure, critical facilities, and other property more resistant to losses from all hazards.
- Protect life and property by adopting state-of-the-art standards, codes, and construction procedures.
- Improve hazard assessment information to make recommendations for encouraging preventive measures for existing development in areas vulnerable to natural hazards.

Increase Public Awareness

- Increase public awareness of existing threats and the means to reduce these threats by conducting educational and outreach programs to all the various community groups in the City.
- Provide informational brochures, partnership opportunities, and funding resource information to assist in implementing mitigation activities.

Strengthen Partnerships

- Strengthen communication and coordinated participation among public agencies, residents, organizations, businesses and industries to aid in the implementation of mitigation measures.
- Encourage leadership within the public and the private sectors to promote and implement local hazard mitigation activities.

City Emergency Services

- Establish policy to ensure the importance of mitigation programs and projects for critical facilities, services, and infrastructure.
- Continue providing emergency services with training and equipment to address all identified hazards.
- Continue developing and strengthening coordination and cooperation among the various emergency service agencies.

Environmental

- Balance land use planning, natural resource planning and watershed management, with natural hazard mitigation measures to protect life, property, and the environment.
- Preserve existing natural systems and enhance man-made systems to promote natural hazard mitigation programs.

How are the Mitigation Activities Organized?

When a community has an understanding of the risks posed by natural hazard events, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from natural hazards. Specific actions can be considered and implemented that may reduce or lessen the impacts of natural hazards in the City of Duarte.

Goals, objectives, and actions are based on a community's values, identity, and culture. There are no wrong goals when it comes to mitigating the effects of hazards. However, hazard mitigation goals should be consistent with other community goals and city programs.

The City of Duarte Natural Hazard Mitigation Steering Committee has selected a full range of objectives for each prioritized hazard event (Earthquake, Wildfire, Flood, Windstorm and Landslide) In addition; the Steering Committee has identified Multi-Hazard Mitigation Objectives and Action Items. Multi-Hazard Action Items are identified in Section 11.

Furthermore, the Steering Committee has developed a list of mitigation items that will help the city achieve its goals and objective. When implemented these mitigation "action items" may reduce risk from natural hazards. Each action item includes a time estimate for implementation. *Short-term action items (ST)* are activities that city departments, residents, or organizations can implement with existing resources within one to two years. *Long-term action items (LT)* may require new or additional resources or may take longer time periods to implement (e.g. 3-5 years).

The action items are organized in a matrix contained at the end of this section. The matrix lists all the hazard specific action items contained in the mitigation plan.

The action items were developed utilizing public participation, government resources, data collection, and brainstorming sessions with various city departments. The matrix includes the following information for each action item:

- **Ideas for Implementation.** Each action item includes ideas for implementation and potential resources.

- **Coordinating Organization.** The coordinating organization is the city department, county agency, or other public agency, with regulatory responsibility to address specific natural hazards or that is willing to organize resources, oversee activity implementation, monitoring, and evaluation.

- **Timeline.** Action items include both short and long-term activities. Each action item includes an estimate of the timeline for implementation.

- **Plan Goals Addressed.** The plan goals addressed by each action item are included as a way to monitor and evaluate how well the mitigation plan is achieving its goals once implementation begins. FEMA has suggested grouping mitigation actions into seven broad categories. The seven categories are as follows:

    - **Prevention**
    - **Protect Life and Property**
    - **Public Education and Awareness**
    - **Natural Resource Protection**
    - **Emergency Services**
    - **Structural Projects**
    - **Partnership and Implementation**

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Multi-Hazard Mitigation Action Items										
Short-Term Multi-Hazard #1	Identify and pursue grant programs and funding opportunities from County, State, and Federal sources to implement mtigation goals and activities.	Natural Hazard Mitigation Steering Committee	On-going						✓	
Short-Term Multi-Hazard #2	Establish a formal role for the City of Duarte Natural Hazard Mitigation Steering Committee to develop a sustainable process for implementing, monitoring, and evaluating city-wide mitigation activities.	Natural Hazard Mitigation Steering Committee	On-going						✓	
Short-Term Multi-Hazard #3	Integrate the goals and actions items from the City of Duarte Natural Hazard Mitigation Plan into existing documents and programs where appropriate.	Natural Hazard Mitigation Steering Committee	On-going						✓	
Long-Term Multi-Hazard #1	Explore the possibilities of developing emergency access road/evacuation route for the Duarte Mesa area in the north section of the town.	Natural Hazard Mitigation Steering Committee	3-5 years		✓				✓	

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Long-Term Multi-Hazard #2	Develop, enhance and implement education programs aimed at mitigating naturals hazards, reducing risks to citizens, public agencies, private property owners, businesses, and schools.	Natural Hazard Mitigation Steering Committee	On-going				✓		✓	

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Earthquake Mitigation Action Items										
Short-Term Earthquakes #1	Integrate new information on the Duarte Fault as it becomes availiable into the City's General Plan and other city planning maps/documents.	City Planning Department	2-3 years	✓		✓				
Short-Term Earthquakes #2	Develop public education program related to earthquake hazard insurance.	City Administraton Department	2-3 years				✓			
Short-Term Earthquakes #3	Review Federal, State, County, and City Guidelines on seismic safety standards and construction codes on an annual basis to reduce earthquake hazards to new buildings and infrastructure.	Building Department and Planning Department	Annually	✓						
Long-Term Earthquakes #1	Conduct inventory of emergency facilities/shelters and update facilities to provide safe shelters for the community.	Building Department and Planning Department	4-6 years	✓		✓				
Long-Term Earthquakes #2	Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.	Housing Department and Administration	3-5 years	✓		✓				
Long-Term Earthquakes #3	Explore possibilities of developing emergency access road/secondary evacuation route across the San Gabriel River.	Public Works Department	3-5 years		✓				✓	

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Long-Term Earthquakes #4	Encourage reduction of nonstructural earthquakes hazards in homes, schools, businesses, and government offices.	City Administraton Department	3-5 years				✓			

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Wildfire Mitigation Action Items										
Short-Term Wildfires #1	Augment emergency services to increase the efficiency of wildfire response	City of Duarte Public Safety Department and Los Angeles County Fire Department	2 years							✓
Short-Term Wildfires #2	Identify altermative firefighting water sources and coordinate with Los Angeles County Fire Department on inventory of alternative sources.	City of Duarte Field Services Division, City of Duarte Community Delopment Department and Los Angeles County Fire Department	3 years							✓
Short-Term Wildfires #3	Increase communication and coordination between county fire personal, city planners, contractors and property owners to address risks and mitigation measures that are available in wildland/urban interface areas of the city.	City Planning Department and Los Angeles County Fire Department	1-3 years			✓	✓			
Long-Term Wildfires #1	Enhance outreach and education programs aimed at mitigating wildfires hazards.	Public Safety Department and Neighborhood Watch Captains	2-4 years			✓	✓			
Long-Term Wildfires # 2	Develop outreach program and recovery activities for responding to community during and immediately following a wildfire.	City Public Safety Department	2-5 years			✓	✓			

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Long-Term Wildfires #3	Support programs for the expansion or improvements of firefighting water sources and water storage facilities.	Duarte City Council	3-5 years			✓			✓	✓

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Flood Mitigation Action Items										
Short-Term Flood #1	Determine existing flood warning systems for San Gabrial River and San Gabriel Canyon Dams and establish city procedures to handle early warnings.	Public Works Department	2-4 years			✓				✓
Short-Term Flood #2	Develop program for capping sewer inlets during major storms and flood ecents to prevent water surges in sewer lines.	Public Works Department	2-4 years	✓	✓					
Short-Term Flood #3	Continue public education program on sandbag techniques and expand to include other flood protection measures.	Field Services Department	2-4 years			✓				
Long-Term Flood #1	Upon completion of a Flood Hazard Study or Mapping by the Federal Emergency Management Agency (FEMA), implement prope floodplain management policies.	Community Development Department	5-7 years	✓		✓				
Long-Term Flood #2	Identify areas thata are subject to urban flooding and develop programs to minimize or eliminate the flooding.	Public Works Department	5-7 years	✓	✓					

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Windstorm Mitigation Action Items										
Short-Term Windstorm #1	Identify trees that could be a problem in a windstorm event and implement measures to prevent trees from causing damage to property, public infrastructure and threatening lives.	Field Services Department and Administration	2 years	✓					✓	
Short-Term Windstorm #2	Expand Debris Managament Program for community clean-up after windstorm events.	Field Services Department and Administration	2 years			✓				✓
Long-Term Windstorm #1	Develop program and seek grant funding to install permanent back-up power units for powering signalized intersections in the event of an electrical failure.	Administration	3-4 years		✓	✓				
Long-Term Windstorm #2	Collect windstorm risk analysis data including failure rates, frequency of events, and locations around the city that have the highest incidence of property damage from wind events.	Public Safety	6-10 years	✓		✓				
Long-Term Windstorm #3	Increase public awareness of windstorm mitigation activities in order to protect life and property before, during and after a windstorm.	Administration	3-5 years				✓			

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Long-Term Windstorm #4	Encourage utility companies and land developers to use underground utility methods where possible to reduce power outages from windstorms.	Community Development Department	6-10 years	✓	✓					

Windstorm Mitigation Action Items

Long-Term Windstorm #5	Review the Los Angeles County Uniform Building Code and all other applicable City development codes with the Los Angeles Building and Safety Department to update wind safety standards and construction codes to reduce windstorm hazards to new buildings and infrastructure.	Community Development Department	6-10 years	✓	✓					

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed						
				Prevention	Structural	Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Landslide Mitigation Action Items										
Short-Term Landslide #1	Increase public awareness of Earthquake-Induced Landslide Hazard Areas as delineated on State of California Seismic Hazard Zones Official Map.	Planning Department	2 years				✓			
Short-Term Landslide #2	Identify safe evacuation routes in high-risk debris flow and landslide areas.	Field Services								✓
Long-Term Landslide #1	Review existing soil stability construction practices and determine if additional measures are needed.	Community Development Department	3-5 years	✓		✓				
Long-Term Landslide #2	Continue public education program on sandbag techniques and expand to include other landslide protection measures.	Field Services Department	3-5 years				✓			

SECTION 4

PUBLIC PROCESS

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PUBLIC PROCESS

Public participation is a key component to the strategic planning process. Public participation offers citizens the chance to voice their ideas, interests, and opinions which ensures the opportunity for citizens to be involved in the planning process. The Federal Emergency Management Agency also requires public input during the development of natural disaster mitigation plans.

To integrate a cross-section of citizen input through the planning process, the City of Duarte's disaster mitigation plan developed a public participation process through four components: (1) developed a project steering committee comprised of knowledgeable individuals representative of the community; (2) implemented a city-wide disaster assessment survey requesting citizens to prioritize disasters and identify possible consequences; (3) conducted informational presentations to local community groups to increase awareness of mitigation efforts; and (4) conducted public workshops to identify common concerns and ideas regarding hazard mitigation efforts and identify likely mitigation plans.

STEERING COMMITTEE

The City of Duarte's Hazard Mitigation Steering Committee consists of representatives from various city departments. For the development of this plan, the committee invited private organizations and businesses that serve or do business in the city. Steering committee members have an understanding of how the community is structured and how residents, businesses and the environment may be affected by natural hazard events. The steering committee guided the development of the plan, and assisted in developing plan goals and action items, and sharing local expertise to create a more comprehensive plan.

Natural Hazard Mitigation Steering Committee

<u>City Staff</u>
Don Anderson, Director of Safety Coordination
Gina Casillas, Planning Intern
Evelyn DeJesus, Deputy Finance Director
Steve Esbenshade, Engineering Division Manager
Jason Golding, Associate Planner
Abby Lai, Crime Prevention Specialist
John Mack, Code Enforcement Manager
Bill Ornelas, Field Services Division Manager
Eric Vilander, Public Works Technician
Troy Wittenbrock, Field Services Supervisor

<u>Organizations and Agencies</u>
Duarte Historical Society
Duarte Mesa Association
Nasr Gergis, City of Hope National Medical Center

Pui-Ching Ho, Community Library Manager
Laura Nash, Preferred Planning
Neighborhood Watch
John Steelesmith, Southern Calfornia Edison
Jan Wight, Duarte Chamber of Commerce

<u>Project Managers</u>
Don Anderson, Director of Safety Coordination
Ed Cox, Director of Community Development

- -

Meeting 1: February 4, 2004 2:00pm

Attendance: Don Anderson, John Mack, Jason Golding, Abby Lai

Committee discussed strategies and tasks required to complete plan. A timeline was created to include a schedule of upcoming meetings involving the City Council, community organizations and local residents. In addition, a list of community organizations expected to participate in upcoming meetings and in the assessment survey was compiled.

Meeting 2: February 18, 2004 4:00pm

Attendance: Don Anderson, John Mack, Jason Golding, Abby Lai

Committee discussed the potential to use consultants to work with staff in the creation of this plan. Preparations for future meetings with community organizations and residents were confirmed. An assessment survey draft will be created and reviewed at the next committee meeting.

Meeting 3: March 2, 2004 9:00am

Attendance: Don Anderson, Jason Golding, Abby Lai

Committee discussed the necessary steps in obtaining the City Council's approval in creating and implementing this Disaster Mitigation Plan. The committee will be pursuing the aid of a consultant to gather data, coordinate community involvement, analyze the hazard assessment, identify possible mitigation activities and assemble the plan. Plans for upcoming public meetings were confirmed.

Meeting 5: March 10, 2004 2:00pm

Attendance: Don Anderson, John Mack, Abby Lai, Laura Nash

The committee discussed plans for the upcoming public meeting in detail outlining the details of the power-point presentation and marketing efforts that were made to increase public participation.

Meeting 4: March 16, 2004 – 10:00 am

Attendance: Don Anderson, John Mack, Jason Golding, Abby Lai, Laura Nash, Evelyn de Jesus, Bill Ornelas, Steve Esbenshade; Others present: John Steelesmith – Southern California Edison, Nasr Gergis – City of Hope, Jan Wight – Duarte Chamber of Commerce, PuiChing Ho – Duarte Public Library

The committee explained the details and requirements of creating a hazard mitigation plan. The importance of having such a plan was stressed in relation to receiving future funding in the event of a disaster and to receive funds to advance mitigation efforts. After the presentation, those present were asked for their organization's support by completing a Disaster Assessment Survey and remaining involved throughout the planning process.

Meeting 6: April 13, 2004 10:00am

Attendance: Don Anderson, John Mack, Abby Lai, Laura Nash

Committee reviewed the results of the assessment survey submitted by citizens and businesses/utilities. Given the results of the survey and knowledge possessed by the committee, the hazards were prioritized and discussed in further detail to provide direction in gathering historical data.

Meeting 7: May 5, 2004 – 10:00am

Attendance: Don Anderson, Gina Casillas, Evelyn De Jesus, Steve Esbenshade, Jason Golding, Abby Lai, John Mack, Laura Nash, Eric Vilander, Troy Wittenbrock

Committee identified the most prevalent hazards in consideration of historic events and the results of the community assessment survey. Profiles for these hazards were reviewed and will need further attention to complete. Critical infrastructure and facilities were assessed for vulnerabilities. A timetable was approved and further meeting dates were established.

Meeting 8: May 25, 2004 – 2:00pm

Attendance: Don Anderson, Evelyn De Jesus, Steve Esbenshade, Abby Lai, John Mack, Laura Nash, Bill Ornelas, Eric Vilander, Troy Wittenbrock

Committee conducted an overview of the progress made thus far in the creation of the plan. The subject of wildfires and earthquakes were discussed in detail and mitigation goals/activities for these topics were discussed.

Meeting 9: June 3, 2004 – 10:00am

Attendance: Don Anderson, Gina Casillas, Steve Esbenshade, Jason Golding, Abby Lai, John Mack, Laura Nash, Bill Ornelas, Eric Vilander, Troy Wittenbrock

Committee conducted an overview of the progress made thus far in the creation of the plan. The subject of floods, landslides and dam failure were discussed in detail and mitigation goals/activities for these topics were discussed.

Meeting 10: June 8, 2004 – 10:00am

Attendance: Don Anderson, Abby Lai, John Mack, Laura Nash

Committee briefly reviewed the history of major disasters that have impacted the city. Mitigation plans were discussed and preparations for the June 15th public meeting were discussed.

DISASTER ASSESSMENT SURVEY

The disaster assessment survey provided the community's input in identifying and prioritizing potential natural disasters that threaten the City of Duarte. The information provides added direction in the creation of the Disaster Mitigation Plan.

Survey Structure

Two surveys were designed for use: (1) one for citizens; and (2) another for use by businesses and other organizations. Both surveys were similarly structured in two main sections comprised of a rank order system for prioritizing the potential harm from various natural hazards and a series of open-ended questions allowing the participants to express concerns and suggest mitigation ideas.

Examples of the survey are provided on pages 7-11 of this chapter.

Distribution of Surveys

The surveys were distributed to the citizens and organizations of Duarte in four ways: (1) the Duarte Chamber of Commerce sent surveys to local business members; (2) all major utilities, hospitals, large business organizations and the school district were mailed surveys; (3) the Neighborhood Watch Program distributed surveys through a network of block captains reaching over 75% of the households in the city; and (4) the Duarte Senior Center distributed surveys to senior citizens visiting the center.

Results

Over 140 completed surveys were submitted by citizens and tabulated. Approximately one dozen surveys were submitted by business and community organizations. The survey showed citizens to be most concerned about fires and earthquakes, and least concerned about winter storms, dam failure and landslides. Most mitigation efforts that were suggested dealt with earthquake and fire related concepts that were considered in the mitigation planning.

INFORMATIONAL PRESENTATIONS

Informational presentations, conducted by steering committee member Don Anderson, were intended to raise awareness and involvement among the business community and among community leaders. Support from these groups enhanced the distribution and return of completed disaster assessment surveys and subsequently, increased input regarding mitigation ideas, ultimately resulting in a more comprehensive mitigation plan.

Meeting 1: March 24, 2004 7:00pm – Neighborhood Watch Meeting

Attendance: Don Anderson and Lt. Steve Biagini; Lou Arespeu, H.P. Baks, Will Dahl, Adriana Indo, Martha Knoll, Carol Kutter, J. Lehmann, Ellen Metz, Martha Moffitt, Joe A. Ramos,Tony Ramos, Chris Russo, Gerald Rosweld, Alice Sparks, Maria Theel and Shirley Tidwell

The benefits of the creation and implementation of a Disaster Mitigation Plan was shared with approximately 15 residents during a neighborhood meeting.

Residents were also invited to become involved in the planning process of this plan.

Meeting 2: April 8, 2004 6:30pm – Neighborhood Watch Area Coordinator's Meeting

Attendance: Don Anderson, Linda Acosta, Beverly Firth, Margaret Fleis, Gwen Gagnon, Nancy Hunt, Oscar Morales, Pat Or and Samuel Saldana
Committee member Don Anderson thanked Neighborhood Watch Area Coordinators for their efforts in distributing the Disaster Assessment Survey to the community. Their efforts resulted in over 150 surveys completed and returned. Area Coordinators also learned of how the community will benefit from the implementation of this plan and coordinators were invited to become involved in the planning process of this plan.

Meeting 3: April 20, 2004 – 7:30am – Duarte Chamber of Commerce Breakfast Mixer

Attendance: Alicia George, Amy Reed, Beverly Young, Bill Baca, Brenda McPheeters, Chet Beeton, Jeff Beeton, Cynthia Vasquez, Debbie Gewertz, Diana Burckhard, Glen Polk, Jay Gomez, Jan Wight, Jennifer Quan, John Steelsmith, Joyce Smith, June Schaffer, Kevin Tran, Kevin Nguyen, Bryan Lee, Loretta Vigil, Norma Delerma, Orlin Pilapil, Pat Johnson, Patriciat Plunket, Pierre Poponnian, Rona Lunde and Ruben Cesena
Committee member Don Anderson discussed the city's role in creating a Disaster Mitigation Plan. Local businesses learned how this plan will better protect the entire community as this mitigation plan will help to protect the livelihood of businesses in the event of a major disaster.

PUBLIC MEETINGS

The City of Duarte coordinated two public meetings inviting citizens to gather ideas and opinions about the mitigation plan.

Meeting 1: March 16, 2004 – 7:00pm

The first public meeting explained the details and requirements of creating a hazard mitigation plan. The importance of having such a plan was stressed in relation to receiving future funding in the event of a disaster and to receive funds to advance mitigation efforts. Those present were asked for their support through this process as we continue toward identifying hazards, assessing risks and developing a mitigation plan.

Invitation Process

Inviting citizens to this public meeting involved mailing information letters and flyers to 150 Neighborhood Watch Block Captains, running meeting announcements on Duarte's Local Access Cable Channel, printing announcements in the local publications and distributing meeting flyers at city hall, the public library and other civic facilities.

Results

The meeting began with a 20-minute power-point presentation that reviewed past major disasters, the purpose of a mitigation plan, federal requirements for a plan and how to begin creating a plan. After the presentation, those present were asked for further support by providing their insights by completing a Disaster Assessment Survey and to help in the distribution of surveys to aid in obtaining results that are representative of the community.

Meeting 2: June 15, 2004 – 7:00pm

The second public meeting was intended to allow citizens the opportunity to evaluate the mitigation goals and ideas proposed by the steering committee. Citizens were able to ask questions for further clarification and asked to provide feedback.

Invitation Process

Inviting citizens to this public meeting involved mailing information letters and flyers to 150 Neighborhood Watch Block Captains and 80 others that expressed interest through the disaster assessment surveys, running meeting announcements on Duarte's Local Access Cable Channel, printing announcements in the local publications and distributing meeting flyers at city hall, the public library and other civic facilities and mailed to others that expressed interest through their assessment survey.

Results

The meeting began with a 20-minute power-point presentation that reviewed details and requirements of the plan. The presentation further provided a short history of earthquakes, wildfires, dam failure, floods, and landslides that have impacted the City of Duarte. Each potential disaster was followed by a summarized list of mitigation goals and activities proposed by the steering committee. Meeting attendants also received a complete draft of mitigation goals and activities and were encouraged to provide feedback during the coming weeks.

SECTION 5

RISK ASSESSMENT

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RISK ASSESSMENT

Federal Requirements

The Disaster Management Act of 2000 prescribes that government agencies assess their vulnerability and estimate potential loses during the preparation of a Hazard Mitigation plan. This requirement is referred to as a Risk Assessment. A risk assessment is intended to provide information that will help communities identify and prioritize mitigation activities that will reduce losses from the identified hazards.

Risk Assessment

Risk Assessment is the process of determining the areas of greatest need in a community by evaluating which populations and facilities are most vulnerable to natural hazards and to what extent injuries and damages may occur. Conducting a risk assessment can provide information on the locations of hazards, the value of existing land and property in hazard locations, and which areas are most vulnerable to damage from hazards.

There are five stages in the completion of a risk assessment: identifying hazards, profiling hazard events, identifying assets, estimating potential losses, and analyzing development trends. Each of the stages is discussed below with a brief description of how the City of Duarte meets those criteria.

HAZARD IDENTIFICATION

The primary steps in hazard identification are to review past occurrences of natural hazard events and to list the hazards that may occur in a community. To accomplish this task the City of Duarte reviewed historical records obtained from the City Clerk's Office and from local newspaper sources. Steering Committee members also visited the Duarte Historical Museum to review their archives and contacted the Duarte Historical Society for further information. Lastly, Steering Committee members met with individual city departments to discuss past hazard events such as the 1980 Stables Fire, the 1997 windstorm, and 1994 Northridge earthquake. Statistical data, photographs, and other relevant information were collected at each of these meetings. Based on the information collected as well as information obtained from surveys that were distributed throughout the community, the Natural Hazard Mitigation Steering Committee selected five natural hazards as follows: Earthquakes, Wildfires, Floods, Windstorms, and Landslides.

PROFILING HAZARD EVENTS

Upon creating a list of potential hazards, the next step was to determine "How bad can it get?" In order to profile hazard events, the causes and characteristics of each hazard must be determined. Each of the five selected hazard types has very different characteristics. An earthquake will affect Duarte in a different way than a wildfire.

Based on the conclusion that the characteristics of each hazard type needed to be discussed in detail, a section of the plan was dedicated to each hazard type. The characteristics of earthquakes are discussed in the chapter on earthquakes and the characteristics of landslides are discussed in the landslide chapter. In addition, each chapter or "section" contains a full description of the history of hazard specific events. The sections are as follows:

Section 6	Earthquake
Section 7	Wildfire
Section 8	Flood
Section 9	Windstorm
Section 10	Landslide

Contained in each of these hazard specific sections, is a description of what part of Duarte's population, infrastructure and environment has been historically vulnerable to each hazard type. This is particularly valuable because each hazard event has different effects depending on it magnitude, duration, or intensity. For example, no two wildfires will impact Duarte in the same way twice because the wildfire is driven by distinct wind and fuel conditions.

IDENTIFYING ASSETS

The process of identifying assets entails combining hazard identification with an inventory of the property and population exposed. In the Community Issues portion of each hazard section, information is provided on the critical facilities that may be exposed to the hazard type. For example, Section 6 "Earthquakes" identifies many critical facilities that could be susceptible to earthquakes. The facilities are as follows:

Dams (Sawpit, Cogswell, San Gabriel and Morris Dam)
Buildings
Businesses
Bridges
Freeway overpasses
Damage to lifelines (gas lines, electricity and phone lines)
Disruption of Critical Services

Critical facilities are of particular concern because these entities provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the city and fulfill important public safety, emergency response, and/or disaster recovery function. The critical facilities have been mapped and are illustrated on the maps contained at the end of this chapter.

ESTIMATING POTENTIAL LOSSES

A risk assessment should include the extent of injury and damage that may result from a hazard event of a given intensity. Where data was available, the City of Duarte estimated potential losses utilizing a number of resources.

Locations of potential hazards were determined utilizing maps from the City's General Plan Public Safety Element. Existing maps that were extracted from the General Plan and utilized for vulnerability assessment include the Fire Hazard Area Map, Flood Inundation Areas Map, Seismic Hazard Management Map and Evacuation Routes and Emergency Faculties Map. Property improvement values were estimated utilizing the last equalized Los Angeles County Tax Assessor Roles. Based on this information each hazard section provides information on vulnerable areas in the city. The population that lives above Royal Oaks Drive near the foothills potentially may be exposed to more hazard events (e.g. landslides, liquefaction, and dam failure induced floods) than the population that lives in the southern sections of the city.

ANALYZING DEVELOPMENT TRENDS

The City of Duarte Community Profile Section of this Natural Hazard Mitigation Plan (Section 2) provides a description of the development trends in the city including geography and environment, population and demographics, community development and housing, employment and industry, and transportation and commuting. The City is currently updating the Housing Element for the City of Duarte and where available this information has been included in Section 2. The City will be updating the remaining chapters of the General Plan very soon. When the General Plan update is completed then additional information on development trends will be incorporated into the City of Duarte Natural Hazard Mitigation Plan.

List of Hazard Mitigation Plan Maps

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3	Street Map	2
4	Critical Facilities	5
5	Essential Facilities	5
6	Evacuation Routes	5
7	Southern California Earthquake Fault Map	6
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Map #	Type of Map	Section of Plan
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11	Duarte Fault Map	6
12	Duarte Seismic Hazard Management Zones	6
13	30-yr Probability Map of Exceedance for 0.2g	6
14	Wildfire Risk Areas	7
15	San Gabriel River Map	8
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Section 6:

EARTHQUAKE

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Why Are Earthquakes a Threat to the City of Duarte?

Earthquakes have been observed in Southern California throughout recorded history. Sometimes earthquakes occur in this region as frequently as thirty times in one day. There are hundreds of sensitive monitoring stations, located throughout Southern California, that record between 2,000 and 10,000 earthquakes per year with magnitudes greater than about M 1.0. In the last decade, Southern California has had more than 200,000 earthquakes. A few were damaging but most were not even felt.

Two of the largest quakes to hit California were the Fort Tejon quake in 1857 and the Owens Valley quake in 1872. It was estimated that the magnitude of the Fort Tejon quake was 8.0 and it shook the village of Los Angeles 40 miles away. The Owens Valley quake had an estimated magnitude of 7.8 and it was also felt in Los Angeles, over 200 miles away. While these earthquakes were two of the largest in California, the damage incurred from them was not as great as the 1994 Northridge earthquake. This is due, in part to the difference in population density. As the population of Southern California grows, the potential for greater damage from a large earthquake grows.

The Northridge earthquake struck Southern California at 4:31 A.M. on January 17, 1994. It registered 6.7 on the Richter Scale. The temblor caused at least 61 deaths and 6,500 injuries. More than 1,500 people were seriously injured. In the following days and weeks, thousands of aftershocks occurred in the San Fernando Valley causing additional damage to affected structures. Thousands of homes and businesses were without electricity; tens of thousands had no gas; and nearly 50,000 had little or no water. The quake destroyed or seriously damaged more than 1,000 buildings throughout the Los Angeles Basin and left 20,000 people homeless. While not destroyed, nearly 11,000 structures were moderately damaged. Freeway overpasses collapsed creating traffic disruptions and commuter havoc on the freeway system. Extensive damage was caused by ground shaking, but earthquake triggered liquefaction and dozens of fires also caused additional severe damage. With the estimated damage bill running as high as $20 billion, the Northridge earthquake was one of the costliest natural disasters in American history.[1]

The City of Duarte is located in a seismically active region with a number of faults surrounding the area. These faults are indicated on Map 7 of this Section. A few of the active faults – the Sierra Madre and the San Andreas- are capable of affecting the city. Potentially active faults in the immediate vicinity are the Duarte Fault (a southern splay of the Sierra Madre fault) and the Raymond Hills fault.

Past seismic events indicate that the City of Duarte has been free of major damaging earthquakes for at least 125 years. However, a number of historic earthquakes have affected the city in varying degrees from nonstructural damage (toppling of building contents) to minor structural damage (cracks in swimming pools).

HISTORIC EARTHQUAKES THAT HAVE AFFECTED THE CITY OF DUARTE

Date	Fault or Location	Estimated Richter Magnitude
1855	Newport-Inglewood	6.0
1857	San Andreas	8.9
1883	San Gabriel Mountains	6.0
1920	Newport-Inglewood	5.5
1925	Santa Barbara	6.3
1933	Newport – Inglewood (Long Beach)	6.3
1941	Torrance-Gardena	6.5
1941	Santa Barbara	6.0
1971	San Fernando	6.4
1987	Whittier Narrows	5.9
1994	Northridge	6.7

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up and the rocks slips suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that we feel during an earthquake. An earthquake occurs when plates grind and scrape against each other. In California there are two plates, the Pacific Plate and the North American Plate. The Pacific Plate consists of most of the Pacific Ocean floor and the California Coast line. The North American Plate comprises most the North American Continent and parts of the Atlantic Ocean floor. The primary boundary between these two plates is the San Andreas Fault. The San Andreas Fault is more than 650 miles long and extends to depths of at least 10 miles. [2]

Talk of a “Big One” (an earthquake exceeding 8.0 on the Richter scale) has been heard for many years. This prediction is based on the long history of seismic events in Southern California and the existence of the San Andreas Fault. The San Andreas Fault runs from the Mexican border to a point offshore, west of San Francisco. This long, dangerous fault zone dissects northern Los Angeles County from northwest to southeast. “Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 130 year intervals on the southern San Andreas Fault. As the last large earthquake on the southern San Andreas occurred in 1857, that section of the fault is considered a likely location for an earthquake within the next few decades.”[3]

But San Andreas is only one of dozens of known earthquake faults that criss-cross Southern California. Some of the better-known faults include the Newport-Inglewood, Whittier, Chatsworth, Elsinore, Hollywood, Los Alamitos, and Palos Verdes faults. Beyond the known faults, there are a potentially large number of “blind” faults that underlie the surface of Southern California. One such blind fault was involved in the Whittier Narrows earthquake in October 1987.

Although the most famous of the faults, the San Andreas, is capable of producing an earthquake with a magnitude of 8+ on the Richter scale, some of the “lesser” faults have the potential to inflict greater damage on the urban core of the Los Angeles Basin. Seismologists believe that a 6.0 earthquake on the Newport-Inglewood would result in far more death and destruction than a “great” quake on the San Andreas, because the San Andreas is relatively remote from the urban centers of Southern California.

The science of earthquake prediction is ever changing and caution should be used in giving too much credence to predictions that are based solely on past patterns. However, in 1992, a panel of earthquake scientists released a report called “Future Seismic Hazards in Southern California”. This report stated that based on the 1992 Landers quake centered in a sparsely populated desert area, the statistical probability of a major quake in Southern California had been revised upward. The report asserted that a 5 to 12 percent possibility of a massive quake existed yearly. [4]

Furthermore, the USGS Earthquake Hazards Program predicts that within the next 30 years the probability is 60% that an earthquake measuring greater than 6.7 will occur in Southern California.

History of Earthquake Events in Southern California

Since seismologists started recording and measuring earthquakes, there have been tens of thousands of recorded earthquakes in Southern California, most with a magnitude below three. In the last decade Southern California has had more than 200,000 earthquakes. A few of these quakes were damaging but most were not even felt. No community in Southern California is beyond the reach of a damaging earthquake. The following table describes the significant historical earthquake events that have affected Southern California.

Table 6.1 Earthquake Events in the Southern California Region

Southern California Region Earthquakes with a Magnitude 5.0 or Greater			
1769	Los Angeles Basin	1916	Tejon Pass Region
1800	San Diego Region	1918	San Jacinto
1812	Wrightwood	1923	San Bernardino Region
1812	Santa Barbara Channel	1925	Santa Barbara
1827	Los Angeles Region	1933	Long Beach
1855	Los Angeles Region	1941	Carpenteria
1857	Great Fort Tejon Earthquake	1952	Kern County
1858	San Bernardino Region	1954	W. of Wheeler Ridge

1862	San Diego Region	1971	San Fernando
1892	San Jacinto or Elsinore Fault	1973	Point Mugu
1893	Pico Canyon	1986	North Palm Springs
1894	Lytle Creek Region	1987	Whittier Narrows
1894	E. of San Diego	1992	Landers
1899	Lytle Creek Region	1992	Big Bear
1899	San Jacinto and Hemet	1994	Northridge
1907	San Bernardino Region	1999	Hector Mine
1910	Glen Ivy Hot Springs		

Source:
http://geology.about.com/gi/dynamic/offsite.htm?site=http%3A%2F%2Fpasadena.wr.usgs.gov%2Finfo%2Fcahist_eqs.html

The seismic risk is much more severe today than in the past because the population at risk is in the millions, rather than a few hundred or a few thousand persons.

Earthquake Related Hazards

Ground shaking, landslides, liquefaction, and amplification are the specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and the type of earthquake.

Ground Shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Earthquake Induced Landslides

Earthquake induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in Southern California have a high likelihood of encountering such risks, especially in areas with steep slopes.

Liquefaction
Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Many communities in Southern California are built on ancient river bottoms and have sandy soil. In some cases this ground may be subject to liquefaction, depending on the depth of the water table.

Amplification
Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.[5] Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Earthquake Characteristics and Terminology

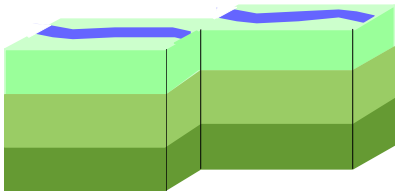
Causes and Characteristics of Earthquakes in Southern California

The earthquakes of California are caused by the movement of huge blocks of the earth's crust. Southern California straddles the boundary between the Pacific and the North American plates. These large sections of the earth's crust are moving past each other. The Pacific Plate is moving northwest, scraping past North America at a rate of about 1-¾ inches per year.[6]

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. The friction across the surface of the fault holds the rocks together so they do not slip immediately when pushed sideways. Eventually enough stress builds up and the rocks slip suddenly, releasing energy in waves that travel through the rock to cause the shaking that we feel during an earthquake.

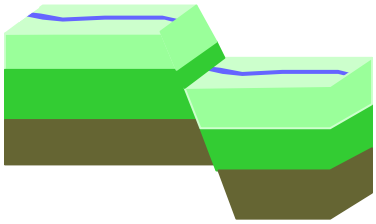
A fault is a thin zone of crushed rock between two blocks of rock, and can be any length, from centimeters to thousands of kilometers. When an earthquake occurs on one of these faults the rock on one side of the fault slips with respect to the other.

EARTHQUAKE FAULTS
A fault is a break in the Earth's crust along which blocks of the crust slide relative to one another due to tectonic forces. The blocks of crust on each side of the fault are called fault blocks. If a fault is not vertical, it is useful to distinguish between its two sides- the hanging wall and the footwall.



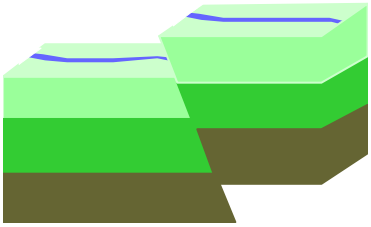
Normal Fault

On a normal fault, the hanging wall moves down and the footwall moves up. Normal faults usually occur when tectonic forces cause tension that pulls rocks apart.



Reverse Fault

On a reverse fault, the hanging wall moves up and the footwall moves down. Reverse faults usually happen when tectonic forces cause compression that pushes rocks together.

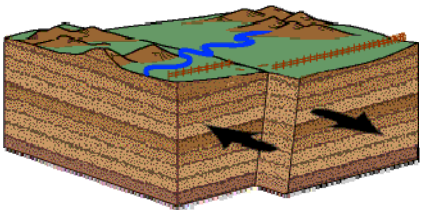


Thrust Fault

A thrust fault is a special category of reverse faults, in which the fault plane lies at a low angle to the earth's surface.

Strike-slip Fault

Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observers perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the shift is called a left lateral fault.



Dip-slip Fault

Dip-slip faults are slanted fractures where the blocks mostly shift vertically. If the earth above an inclined fault moves down, the fault is called a normal fault, but when the rock above the fault moves up, the fault is called a reverse fault. Thrust faults have a reverse fault with a dip of 45 ° or less.

Earthquake Terminology

Active Fault. A fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.

Aftershocks. Aftershocks refer to smaller earthquakes that occur right after another earthquake (or mainshock) in the same region. Aftershocks can continue over a period of weeks, months, or years. In general, the larger the mainshock, the larger and more numerous the aftershocks, and the longer they will continue.

Earthquake Magnitude. Earthquake magnitude refers to the size of the earthquake and is a function of its energy release. Magnitude is an attribute of the earthquake itself, whereas ground motion intensity refers to the severity of shaking in the affected region. Earthquake magnitude is measured on many different scales, e.g., Richter (M_R), Local (M_L), Moment (M_w), Body Wave Magnitudes (m_b), Surface Wave Magnitude (M_s), etc. Richter Magnitude is most commonly known to the public for historical reasons.

It is much easier to calculate immediately after an earthquake, but is less accurate especially for large magnitudes.

Earthquake recurrence. Refers to how often earthquakes of different magnitudes occur in time. There are many models devised to predict earthquake recurrence in the future based on historical records, geological evidence and judgment.

Epicenter. Epicenter refers to the earthquake's "point" source location on the earth's surface given in longitude and latitude (no depth).

Fault. A break in the Earth along which movement occurs. Sudden movement along a fault produces earthquakes. Slow movement produces a seismic creep.

Fault Rupture. Seismic energy builds up along the faults as the tectonic plates move with respect to each other. The relative motion is "locked" along the faults due to friction and rock interlock. Once the energy built up is large enough, an earthquake occurs due to the sudden slippage of rocks along the faults, thus releasing part of its energy. The longer the time between earthquake occurrences on the same fault, the higher the potential of a larger one.

Focus. That point within the Earth from which originates the first motion of an earthquake and its elastic waves.

Focal zone. The rupture zone of an earthquake. In the case of a great earthquake, the focal zone may extend several hundred kilometers in length.

Foreshock. A small tremor that commonly precedes a larger earthquake or main shock by seconds to weeks and that originates at or near the focus of the larger earthquake.

Hypocenter. The hypocenter is the point within the earth where an earthquake rupture starts. The epicenter is the point directly above it at the surface of the Earth.

Intensity: Intensity is the rating of the effects of an earthquake at a particular place based on the observations of the affected areas, using a descriptive scale like Modified Mercalli Scale.

Liquefaction. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soils ability to support weight.

Mainshock. The largest in a series of earthquakes occurring closely in time and space. The mainshock may be preceded by foreshocks or followed by aftershocks.

Modified Mercalli Intensity Scale: The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction. Although numerous intensity scales have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale.

P (Primary) waves: P waves are pressure or primary seismic waves, trigger recording instruments first before the arrival of S waves as they travel faster.

Peak Ground Acceleration (PGA). A measure of the ground motion severity experienced at a site due to an earthquake. A PGA of 0.2g means that the maximum

horizontal acceleration is 20% of the earth's gravity. Since force is proportional to acceleration, that would mean that the earthquake generated horizontal forces is equivalent to 20% of the structures weight at its base.

Plates. Pieces of crust and brittle uppermost mantle, perhaps 100 kilometers thick and hundreds or thousands of kilometers wide, that covers the Earth's surface. The plates move very slowly over, or possibly with, a viscous layer in the mantle at rates of a few centimeters per year.

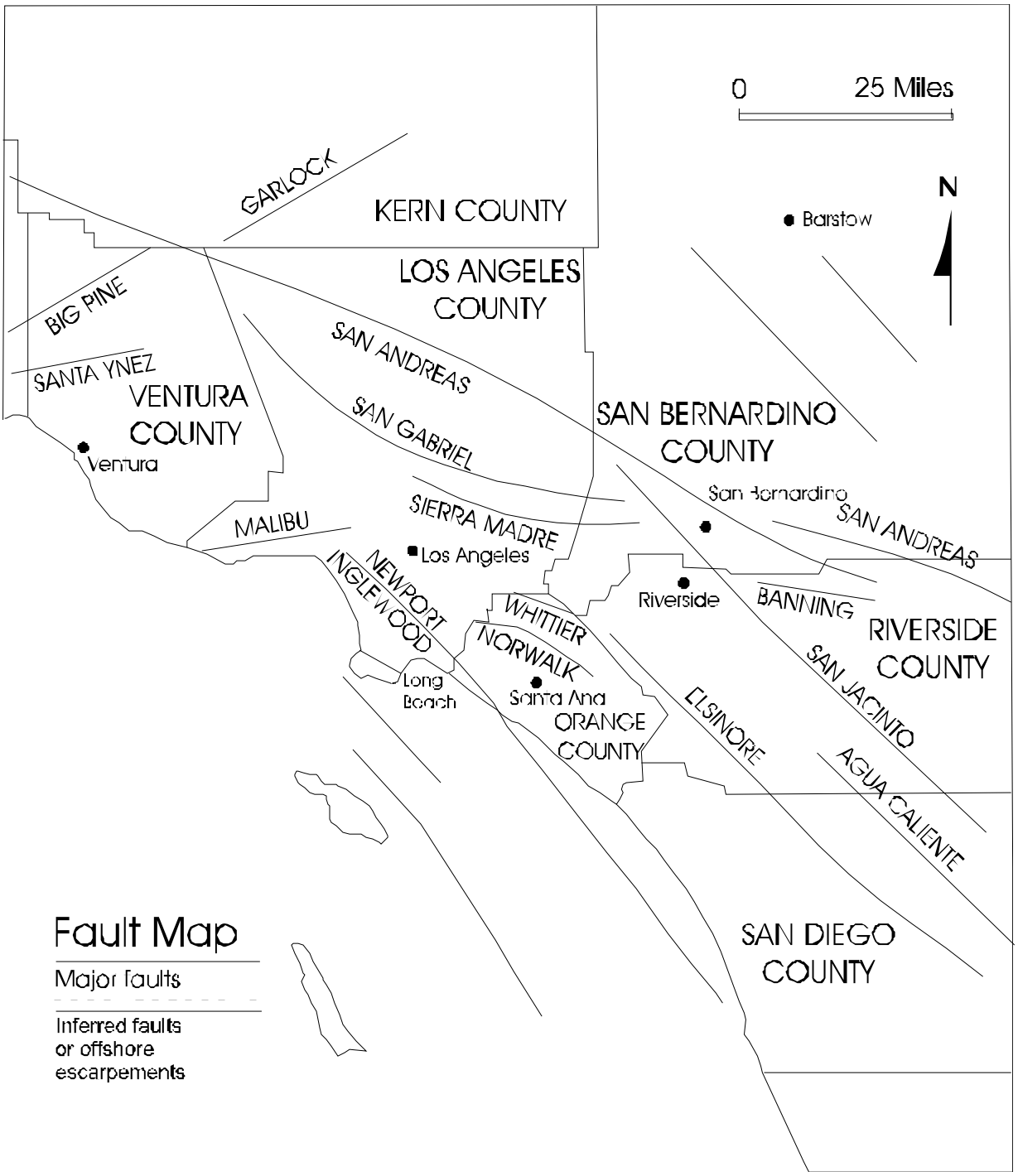
Plate Tectonics. A widely accepted theory that relates most of the geologic features near the Earth's surface to the movement and interaction of relatively thin rock plates. The theory predicts that most earthquakes occur when plates move past each other.

Richter Scale. The Richter magnitude scale was developed in 1935 by Charles F. Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter scale, magnitude is expressed in whole numbers and decimal fractions. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value. *(USGS National Earthquake Information Center, 1998)*

S Waves. S waves are shear or secondary seismic waves that arrive after P wave. The lag between the P and S waves is what seismologists use to estimate how distant the earthquake was.

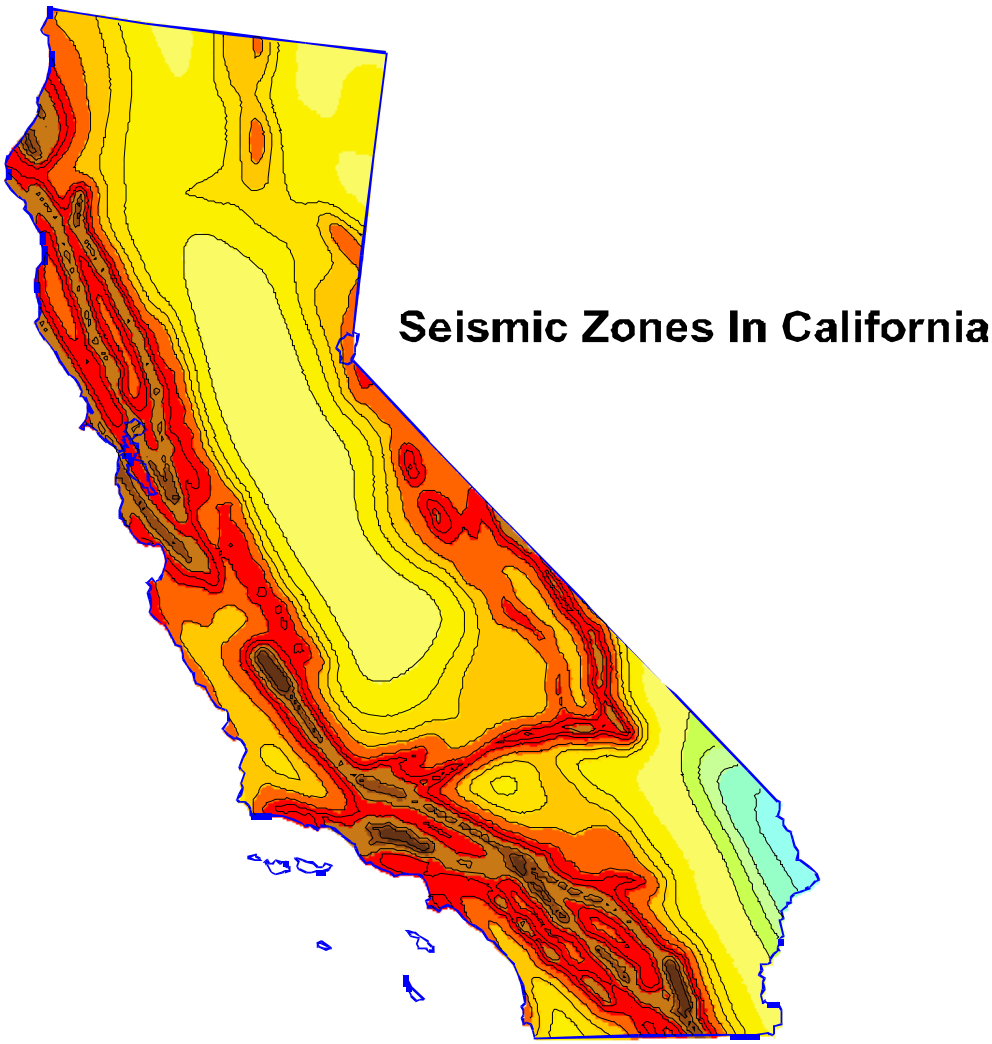
Seismograph. A seismograph is a sensitive instrument that can detect, amplify, and record ground vibrations too small to be perceived by human beings.

Southern California Earthquake Fault Map



Map 7
Section 6 - Earthquakes
Duarte Natural Hazard Mitigation Plan

Seismic Zones in California
Map 2
Section 6 – Earthquakes
Duarte Natural Hazard Mitigation Plan



Darker Shaded Areas indicate Greater Potential Shaking

Source: USGS Website

Earthquake Hazard Assessment

Hazard Identification

For decades, partnerships have flourished between the USGS, Cal Tech, the California Geological Survey and universities to share research and educational efforts with Californians. Tremendous earthquake mapping and mitigation efforts have been made in California in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, and local government agencies and private organizations support earthquake risk reduction, and have made significant contributions in reducing the adverse impacts of earthquakes.

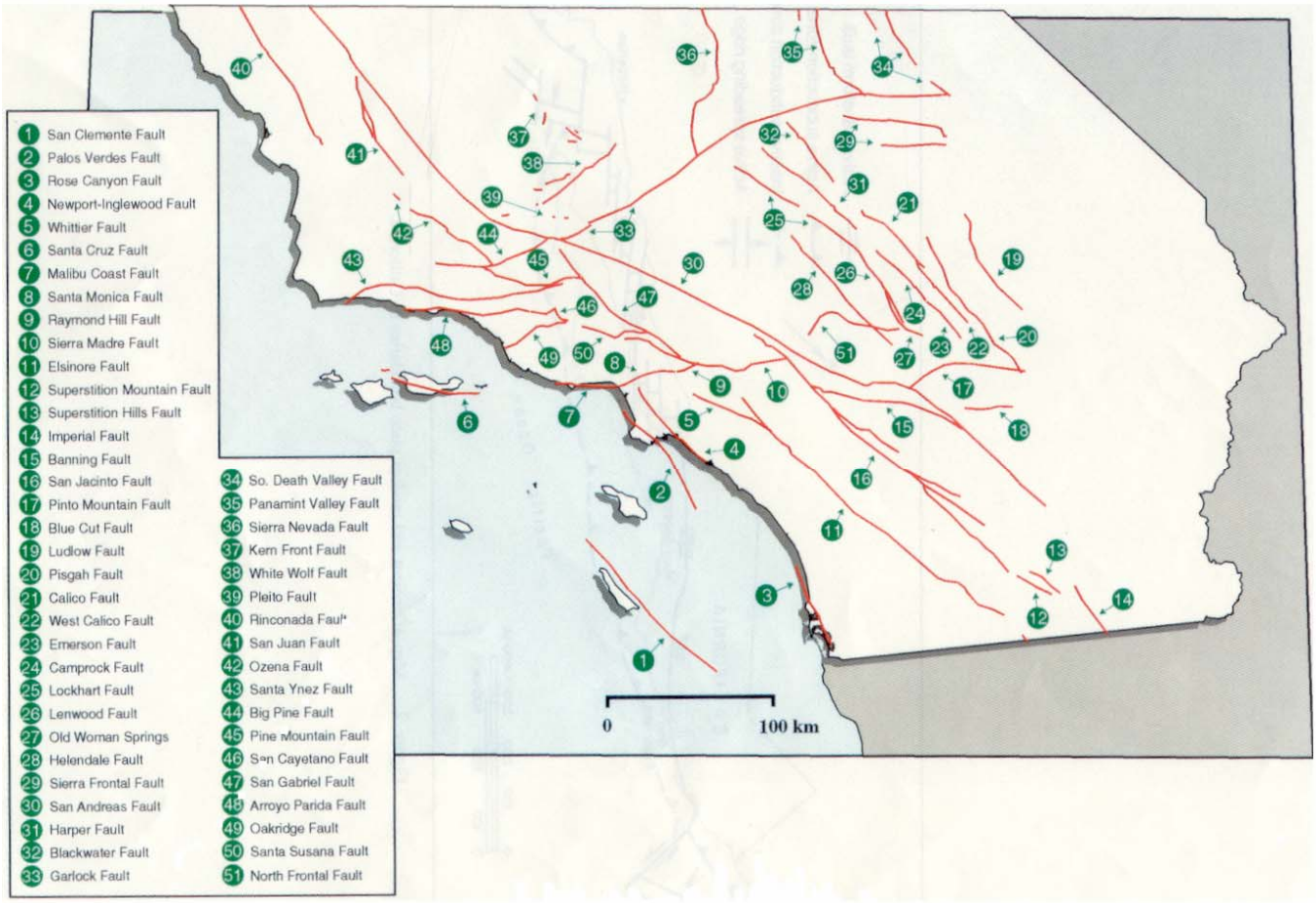
These organizations, in partnership with other state and federal agencies, have undertaken a rigorous program in California to identify seismic hazards and risks including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in California through the State Division of Mines and Geology. Map 8 illustrates Seismic Zones in California.

Southern California has more than 200 faults that are long enough to produce earthquakes greater than 6.0 on the Richter scale. Many of these faults can be detected at the earth's surface; other faults are buried beneath the sediments of the Los Angeles basin and the inland valleys. These faults result from the complications caused by the bend in the San Andreas Fault and together produce about half of the major earthquakes.

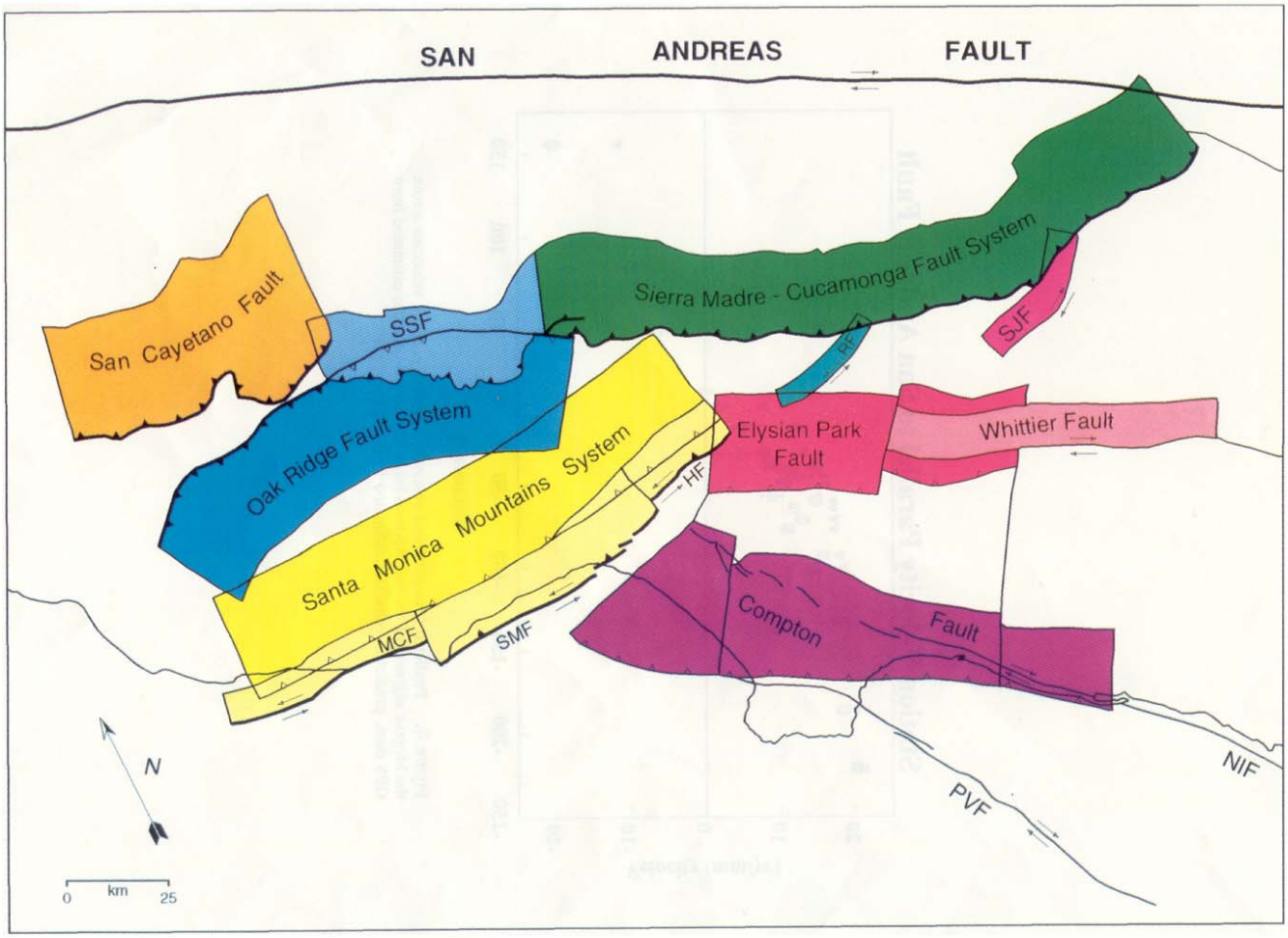
Earthquake Faults That Could Impact The City of Duarte.

Sierra Madre Fault Zone (includes Duarte Fault)
Length: the zone is about 55 km long; total length of main fault segments is about 75km.
Most Recent Major Rupture: Holocene
Slip Rate: between 0.36 and 4 mm/yr
Interval Between Surface Ruptures: several thousand years
Probable Magnitudes: 6.0 – 7.0

Raymond Fault
Length: 26 km
Most Recent Major Rupture: Holocene
Slip Rate: 0.10 and 0.22 mm/yr
Interval Between Major Ruptures: roughly 4,500 years
Probable Magnitudes: 6.0 – 7.0



Map 9 Major active surface faults in Southern California



Map 10. Exposed faults and buried thrust ramps in the greater Los Angeles basin.

Source: Working Group on California Earthquake Probabilities

Newport-Inglewood Fault
Length: 75 km
Last Major Rupture: March 10, 1933
Slip Rate: 0.6 mm/yr
Interval between Major Ruptures: unknown
Probable Magnitudes: Mw 6.0 – 7.2
Notes: Although this fault is located more than 20 miles from Duarte, it expected to be capable of a maximum credible earthquake of Richter magnitude 7.0.

Whittier Fault
Length: about 40 km
Last Major Rupture: Holocene
Slip Rate: between 2.5 and 3.0 mm/yr
Interval between Major Ruptures: unknown
Probable Magnitudes: Mw 6.0 – 7.2
Notes: According to geologist, the Whittier Fault could produce a maximum credible earthquake of Richter magnitude 7.5. An earthquake of this magnitude could have an impact on the City of Duarte.

San Andreas Fault
Length: 1200 km
Last Major Rupture: 1857 Mojave segment, 1906 Northern segment
Slip Rate: about 20 to 35 mm per year
Interval Between Major Ruptures: average of about 140 years on the Mojave segment. Recurrence interval varies greatly, from under 20 years (at Parkfield only) to over 300 years.
Probable Magnitudes: 6.8 – 8.0

Vulnerability & Risk Assessment

The term “vulnerability” describes how exposed or susceptible to damage an asset is. Consequently, a “vulnerability assessment” is the extent of injury and damage that may result from a hazard event of a given intensity in a given area. Risk analysis is the estimated impact that an earthquake will have on people, services, facilities, and structures in a community.

Factors included in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region.

The effects of earthquakes can span a very large area. An earthquake on the western end of Los Angeles basin could, very easily, be felt on the eastern end of the basin. The amount of damage that can result from an earthquake can vary depending on the magnitude of the quake, the type of tectonic plate motion that produced the quake and the location of the earthquake.

The list of assets that could be damaged in a major earthquake is almost endless but the prime assets that are at risk from earthquake damage are: public utilities, dams, bridges, critical facilities such as police and fire stations, housing stock, old buildings and sewer, water, and natural gas pipelines.

Three of the principal seismic considerations for the City of Duarte are surface rupture along active fault traces, damage to structures due to seismically induced ground shaking and liquefaction.

Surface Rupture

Surface rupture occurs during an earthquake when movement along an active fault breaks the ground surface. The Duarte General Plan, adopted in 1989, identifies three faults that should be considered capable of generating surface rupture: the Sierra Madre Fault, the Duarte Fault (a southern splay of the Sierra Madre fault) and the Raymond Fault (Map 11) The *Sierra Madre Fault* and the *Duarte Fault* transverse the city. The *Raymond Fault*, could have an impact on the City of Duarte although it is located outside of the city limits in the cities of Arcadia and Monrovia.

SIERRA MADRE FAULT

The Sierra Madre Fault extends for approximately 85 km along the base of the San Gabriel Mountains as a northeast-dipping reverse fault. The Sierra Madre Fault is a long complex zone of mechanically related thrust and reverse faults that are located along the base of the San Gabriel Mountains from the San Fernando Pass on the west to the Cajon Pass on the east. In general the Sierra Madre fault zone marks the southern margin of uplift of the San Gabriel Mountains. On the basis of general geologic mapping and trenching, Crook et al. (1987) concluded that major earthquakes have not occurred on this fault for several thousand years, and possibly for as long as 11,000 years.

The slip rate on the Sierra Madre fault zone appears to be low, as low as 1mm/yr or less. Specifically, the slip rate has been notated by the Southern California Earthquake Center as “between .36 and 4 mm/yr.” Two studies of the central and eastern portions of the Sierra Madre fault zone have indicated that recurrence intervals between large events (M7) seem to be long, perhaps 7 -8 k.y. or longer.

The Sierra Madre Fault is often divided into five main segments, labeled with the letters A through E. The map below shows these segments. (Courtesy of The Southern California Earthquake Data Center).

DUARTE FAULT

Segment D of the Sierra Madre Fault is known as the Duarte Fault or Duarte Branch, because of its location near the City of Duarte. The Duarte Branch is designated as a potentially active fault. The Duarte branch of the Sierra Madre fault zone forms a buried, 2.5-km-high, moderately north dipping buttress between the sedimentary and volcanic rocks of the San Gabriel Valley and the igneous and metamorphic rocks of the San Gabriel Mountains. A moderately north dipping, tabular low-velocity zone extends to at least 5 km depth in basement rocks from the base of this scarp and is interpreted as the deep continuation of the Duarte fault. There is little surface evidence of the Duarte fault because of the active deposition by the San Gabriel River in this location. (Crook et. Al., 1987)

Multiple groundwater barriers present north of Azusa indicate the presence of an Upper Duarte fault, which has an inferred trace a few thousand feet north of the Duarte fault. The Upper Duarte Fault and the Duarte Fault should be thought of in terms of a zone rather than a single fault trace. The City of Duarte has identified a “hazard zone” that consists of 1/8 mile on either side of the projected active traces of each fault.

The Duarte Fault Zone has not been zoned under the Alquist-Priolo Act because the timing of the latest movement has not been determined. Although no major earthquakes have occurred on this fault for several thousand years, it has been noted by the Southern California Earthquake Center that the “buttress-like northern margin of the San Gabriel Valley is potentially a reflecting boundary for seismic energy that might be trapped in the San Gabriel basin during a future earthquake.” Studies are currently underway at the California Department of Conservation to study the Sierra Madre Fault and the Duarte Branch. This study was verified in a telephone conversation on April 21, 2004 with geologist Jerome Trieman of the California Department of Conservation, Geological Survey Division. More information on the Duarte Branch will be available in the near future.

RAYMOND FAULT

The Raymond Fault extends across the Los Angeles Basin from the Los Angeles River to the foot of the San Gabriel Mountains in Monrovia. Its trace is accurate, convex to the south, and trends roughly eastwest at the western portion. This fault has been delineated as an Earthquake Fault Zone under the Alquist-Priolo Act. Geomorphic features along the surface trace of the Raymond Fault indicate it is predominately a left lateral strike-slip fault. Seismic evidence and aftershock analyses indicate that the 1988 Pasadena earthquake (Mw 4.9) occurred on the Raymond Fault. This fault is capable of producing a 6.5 magnitude earthquake and it has a slip-rate of 1.5 mm/yr.

Alquist-Priolo Earthquake Fault Zones

The City of Duarte is not located within a Special Studies zone or an Earthquake Fault Zone as established by the Alquist-Priolo Earthquake Fault Zoning Act. The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. The California Department of Conservation has stated that surface rupture is the most easily avoided seismic hazard.

Although the City of Duarte has not been listed as an Alquist-Priolo Earthquake Fault Zone city, the City has considered the capabilities of the Sierra Madre Fault and the Duarte Branch of the Sierra Madre Fault in generating surface ruptures. A “hazard” zone has been identified consisting of 1/8 mile on either side of the most projected active traces of each fault. “Restricted Use” areas have been delineated on City base maps and zoning maps to regulate new construction in these areas. City staff has used the hazard management zone as a guide to direct development. The hazard management zone has been thought of as a special area requiring future geological investigation to determine the exact location and lateral extent of potential ground rupture.

A risk assessment will need to be conducted when studies are completed by the Geological Survey Division of the California Department of Conservation and additional information is available as to the exact locations of the Duarte and Lower Duarte Faults. However, to give an indicator on population and structural distributions, a estimate of the number of residential units that are located near the Duarte and Lower Duarte Faults is provided below. The conceptual locations of these faults was drawn from the Seismic Hazard Maps contained in the 1989 Duarte General Plan. Based on this Seismic Hazard Map, the total number of residential units that could be impacted by surface rupture is estimated at 2,117. The current improvement value for these residential units is estimated at 223 million dollars.

MAP

Risk Assessment – Surface Rupture

Fault Zone	Number of Residential Units	Estimated Improvement Value
Lower Duarte Fault	809	$ 80 million
Duarte Fault	863	$ 85 million
Sierra Madre Fault	445	$ 58 million

Ground Shaking

The City of Duarte is likely to be subjected to strong ground shaking based on its location in a seismically active region. The intensity of the ground shaking would depend upon the magnitude of an earthquake as well as faulting mechanism and the distance from the seismic source (focus). To measure the ground motion severity that the City of Duarte could experience due to an earthquake, the estimated level of Peak Ground Acceleration (PGA) has been considered.

Peak Ground Acceleration

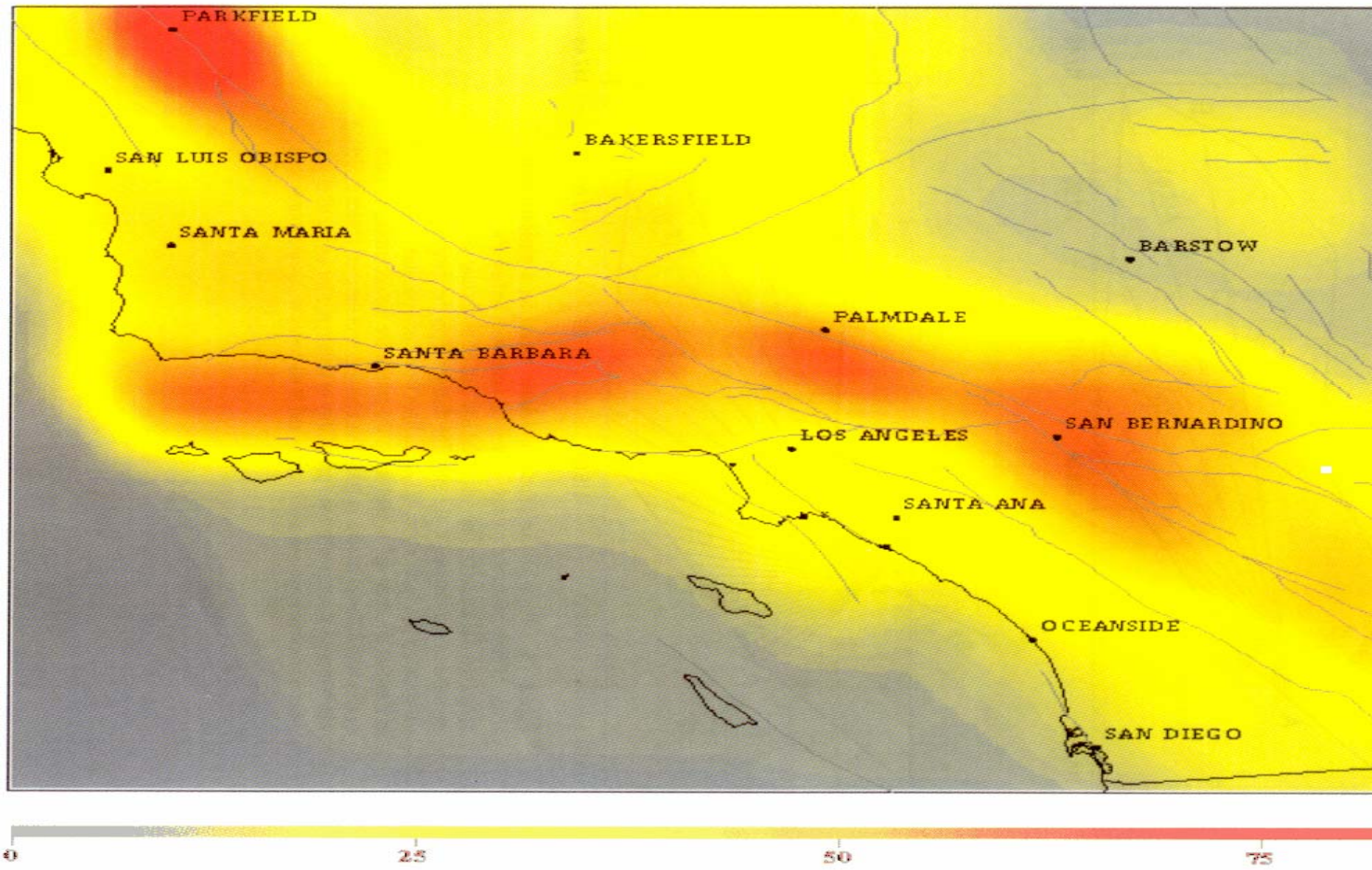
Peak Ground Acceleration (PGA) is a measure of the strength of ground movements. The PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (g). The Earthquake Hazards Program that is operated by the USGS has identified the City of Duarte as follows:

Location: 34.1383 Lat. -117.9635 Long
Distance to Nearest Grid Point: 5.4251
Nearest Grid Point 34.1 Lat. -118.0 Long

Probabilistic ground motion values, in %g, at the Nearest Grid point are:

	10%PE in 50 yr	5%PE in 50 yr	2%PE in 50 yr.
PGA	57.139790	74.137878	98.206917
0.2 sec SA	127.341904	169.338898	217.080505
0.3 sec SA	123.978203	160.67.3294	199.220901
1.0 sec SA	46.828430	63.314930	84.74629

30-Year Probability of Exceedance for 0.2 g



Map 13. Map showing the 30-yr probability of the peak ground acceleration exceeding 0.2 g assuming a rock site.

Source: Seismic Hazards in Southern California: Probable Earthquakes, 1994 to 2024

Explanation of Terms

Probability of Exceedance or PE The USGS computer calculates the ground motion effect (peak acceleration) at the site for all the earthquake locations and magnitudes believed possible in the vicinity of the site. Each of these magnitude-location pairs is believed to happen at some average probability per year. Small ground motions are relatively likely, large ground motions are very unlikely.

Beginning with the largest ground motions and proceeding to smaller, USGS adds up probabilities until they arrive at a total probability corresponding to a given probability, P, in a particular period of time, T. The corresponding ground motion (peak acceleration) is said to have a P probability of exceedance (PE) in T years.

Spectral acceleration" or SA The PGA (peak acceleration) is what is experienced by a particle on the ground. SA is approximately what is experienced by a building, as modeled by a particle on a mass less vertical rod having the same natural period of vibration as the building.

Liquefaction

The Seismic Hazards Mapping Act was passed in 1990 following the Loma Prieta earthquake to reduce threats to public health and safety, protect lives and to minimize property damage from earthquakes. The Seismic Hazards Mapping Act requires that the State Geologist identify and map areas susceptible to liquefaction, earthquake induced landslides, and other ground failures. The State Department of Conservation operates the Seismic Mapping Program for California. Extensive information is available at their website: http://gmw.consrv.ca.gov/shmp/index.htm.

Shaking from an earthquake is usually highest in areas near faults. However, how intense a structure shakes depends upon the kind of building, the underlying rock type and thickness, the depth and force of the quake and other factors. The areas most likely to be damaged include those with high groundwater and sand layers below the ground and steep slopes with weak rock prone to landslides.

The Seismic Hazard Zones for the City of Duarte were mapped in 1999 and can be found on the *Azusa Quadrangle* Map. The largest area in the city that may be subject to occurrence of liquefaction is located near the San Gabriel River. The area includes Encanto Parkway on the east and continues to the west as far as Los Lomas Road. The subject area is north of Huntington Drive and continues into the Fish Canyon area. A smaller residential area that may be subject to liquefaction is the located north of Sunnydale Drive and west of Los Lomas Road.

Based on the Seismic Hazard Zone maps produced by the California Department of Conservation, the total number of residential units that could be impacted by liquefaction is estimated at 1,294. The current improvement value for these residential units is estimated at 123.8 million dollars.

Risk Assessment- Liquifaction

Total Number of Residential Units	Estimated Improvement Value

1.294	$123.8 million

Earthquake Induced Landslides

The Azusa Quadrangle Official Map of Seismic Hazard Zones indicates that the foothill areas above the developed city are subject to earthquake-induced landslides. This wilderness area north of the existing urban development constitutes the largest land use area within the city's boundaries totaling 2,251 acres of land. The northernmost portion of this area lies within the Angeles National Forest, which covers 1,913 acres of land. The remaining area is rugged mountainous topography unsuitable for urban development.

Within the urbanized area of the city there are several undeveloped slopes that could be subject to earthquake-induced landslides. The proximity of these slopes to residential developments could, potentially, cause exposure to landslides for residents living in these hillside areas. The areas are as follows:

- North of Brookridge Road near Mountain Crest Road
- North of Greenbank Road
- West of Las Lomas Road, north of Willowglen Drive
- North of Crestview Court
- Northwest of Westvale Road
- Northeast of High Mesa Drive
- East of Tall Pine Drive
- Northwest of Spinks Canyon Road

The above list is only a general indicator of locations of Seismic Hazard Zones that are subject to landslides. Specific locations should be determined by reviewing the Official Map that has been produced by the California Department of Conservation.

Based on the Seismic Hazard Zone maps produced by the California Department of Conservation, the total number of residential units that could be impacted by earthquake-induced landslides is estimated at 26 units. The current improvement value for these residential units is estimated at 4.08 million dollars.

Risk Assessment – Earthquake-Induced Landslides

Total Number of Residential Units	Estimated Improvement Value
26 units	$ 4.08 million

The Seismic Hazard Zone Maps indicate "Zones of Required Investigation". This means that developers and property owners that are located in these zones must evaluate the level of liquefaction and landslide hazard and make necessary design changes to a project before obtaining a construction permit. For new structures, the investigations must demonstrate that the site is suitable or can be made suitable for most proposed buildings. Geologists evaluate the potential for ground failure at each site. Engineers then design and locate the structures and buildings to reduce the damage from future earthquake shaking.

Community Earthquake Issues

Damages caused by earthquakes in Southern California can be viewed from several worst case scenarios, depending on which fault might rupture, and which communities are in proximity to the fault. Damage will not be limited to immediately adjoining communities. Depending on the hypocenter of the earthquake, seismic waves may be transmitted through the ground to unsuspecting communities. In the Northridge 1994 earthquake, Santa Monica suffered extensive damage, even though there was a range of mountains between it and the origin of the earthquake.

Damages from a large earthquake almost anywhere in Southern California are likely to run into the billions of dollars. Freeway overpasses may be damaged, utility poles may fall over and buildings may become structurally unsound. Although building codes in Los Angeles County are some of the most stringent in the world, older existing buildings were built under much less rigid seismic codes than are in place today.

The California State Seismic Safety Commission recently recommended that 8,700 unreinforced masonry buildings undergo mandatory retrofitting within five years. The commission's recommendation, detailed in its final report on the San Simeon earthquake, could mark a significant change in state policy on seismic retrofitting. Current policy does not mandate retrofitting of older masonry buildings though such structures have long been considered by seismologists as the most sensitive to earthquake damage.

Two people died and 47 were injured when an unreinforced structure in Paso Robles collapsed on them during a magnitude-6.5 quake in December of 2003. The commission determined only nine of 53 such buildings in downtown Paso Robles had been retrofitted and that damage and injuries would have been much less severe had they been.

Los Angeles County, which has the largest number of the structures in question, has retrofitted to some degree or demolished 85 percent of such buildings. Orange County has retrofitted 61 percent of more than 700 buildings and San Francisco has upgraded 59 percent of more than 2,000.

The City of Duarte has only one unreinforced masonry structure. This structure is located at the southwest corner of Highland Avenue and Royal Oaks Drive. The structure has been used for a variety of retail businesses ranging from a grocery market to its present usage as a carpet store.

What is Susceptible to Earthquakes?

Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, schools, and lifelines (highways and utility lines) suffer damage in earthquakes and can cause death or injury to humans.

The welfare of homes, major businesses, and public infrastructure is very important. Addressing the reliability of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by the City.

DAMS

There are a total of 103 dams in Los Angeles County, owned by 23 agencies or organizations, ranging from the Federal government to Home Owner Associations.[7] These dams hold billions of gallons of water in reservoirs. Releases of water from the major reservoirs are designed to protect Southern California from floodwaters and to store domestic water. Seismic activity can compromise the dam structures, and the resultant flooding could cause catastrophic flooding. Following the 1971 Sylmar earthquake the Lower Van Norman Dam showed signs of structural compromise, and tens of thousands of persons had to be evacuated until the dam could be drained. The dam has never been refilled.

There are four dams in the Los Angeles network that could have a direct impact on the City of Duarte:

> **Sawpit Reservoir:** Sawpit Reservoir is located in the City of Monrovia. It was constructed by the Los Angeles County Flood Control District in 1927 in Sawpit Canyon. Sawpit Canyon drains the southern slopes of Monrovia Peak. The reservoir has a 157' crest height and it holds 10 acres of water.
>
> **Cogswell Dam**: Cogswell Dam and Reservoir is owned by the Los Angeles County Flood Control District and is operated by the Department of Power and Water. It was completed in April of 1934 at a cost of $3.1 million. It is a rock-filled structure with a concrete cutoff wall and rises 255 feet above the original stream bottom. Used both for flood control and water conservation, Cogswell Dam is located 22 miles north of the cities of Azusa and Duarte in San Gabriel Canyon.
>
> **San Gabriel Dam**: San Gabriel Dam and Reservoir is also owned by the Los Angeles County Flood Control District and operated by Department of Power and Water. Construction of this dam began in 1932 and finished in 1939 at a cost of 17 million. It is a compacted, earth-filled and rock-filled dam with a concrete its crest. San Gabriel Dam is located 7 miles north of the cities of Azusa and Duarte.
>
> **Morris Dam**: Morris Dam and Reservoir was built by the City of Pasadena in 1934 at a cost of 7.6 million. It was later relinquished to the Metropolitan Water District (MWD) of Southern California. In 1955, it was transferred to the Department of Water and Power. Morris Dam is a concrete, partially arched gravity structure. It is 800 feet long and rises 245 feet above the original streambed. Morris Dam is located just a few miles below the San Gabriel Dam and its primary use is water conservation.

Detailed information on each of these dams is included in Section 8 of this report (Flood chapter) as well as information on flood inundation in the event of dam failure.

BUILDINGS

The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people. Lives are at risk and the cost to clean up the damages is great. In most California communities, including the City of Duarte, many buildings were built before 1993 when building codes were not as strict. In addition, retrofitting is not required except under certain conditions and can be expensive. Therefore, the number of buildings at risk remains high. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of unreinforced masonry buildings.

INFRASTRUCTURE AND COMMUNICATION

Residents in the City of Duarte commute frequently by automobiles and public transportation such as buses and light rail. An earthquake can greatly damage bridges and roads, hampering emergency response efforts and the normal movement of people and goods. Damaged infrastructure strongly affects the economy of the community because it disconnects people from work, school, and essential services. Damaged infrastructure can also separates businesses from their customers and suppliers, thereby affecting the economy of a community.

BRIDGE AND FREEWAY OVERPASS DAMAGE

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link. Such is the case for Duarte with the San Gabriel River Bridge.
The San Gabriel River Bridge is one of the most important emergency access/evacuation routes for the City of Duarte. The bridge is not located within the city boundaries of Duarte but it is located at the eastern border of the city and provides for ingress and egress out of the City and across the river. The City of Azusa is currently working to upgrade this bridge. The freeway overpasses in the City of Duarte are state owned by Cal Trans. In recent years, Cal Trans has retrofitted the overpasses on the Foothill (210) Freeway.

DAMAGE TO LIFELINES

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, and electricity and communication networks. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. Lifelines need to be usable after earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

DISRUPTION OF CRITICAL SERVICES

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. Most of the critical facilities in the City of Duarte are housed in fairly modern buildings. However, since they were built prior to 1993 they do not meet current seismic codes.

BUSINESSES

Seismic activity can cause great loss to businesses, both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to large and small shop owners who may have difficulty recovering from their losses. Forty percent of businesses do not reopen after a disaster and another twenty-five percent fail within one year according to the Federal Emergency Management Agency (FEMA). Similar statistics from the United States Small Business Administration indicate that over ninety percent of businesses fail within two years after being struck by a disaster.

INDIVIDUAL PREPAREDNESS

Because the potential for earthquake occurrences and earthquake related property damage is relatively high in the City of Duarte, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property, as well as being earthquake insured, and anchoring buildings to foundations are just a few steps individuals can take to prepare for an earthquake.

DEATH AND INJURY

Death and injury can occur both inside and outside of buildings due to collapsed buildings falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life.

FIRE

Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to extinguish fires is less likely. Furthermore, major incidents will demand a larger share of resources, and initially smaller fires and problems will receive little or insufficient resources in the initial hours after a major earthquake event. Loss of electricity may cause a loss of water pressure in some communities, further hampering fire fighting ability.

DEBRIS

After damage to a variety of structures, much time is spent cleaning up glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing a strong debris management strategy is essential in post-disaster recovery.

Existing Mitigation Activities

In California, each earthquake is followed by revisions and improvements in the Building Codes. The 1933 Long Beach earthquake resulted in the Field Act, affecting school construction. The 1971 Sylmar earthquake brought another set of increased structural standards. Similar re-evaluations occurred after the 1989 Loma Prieta and 1994 Northridge earthquakes. These code changes have resulted in stronger and more earthquake resistant structures.

Existing mitigation activities include current mitigation programs and activities that are being implemented by city, county, regional, state, and federal agencies.

Local Mitigation Programs

New Building Programs

The City of Duarte Building and Safety Division is responsible for the review of construction plans and for the performance of various building inspection activities including dissemination of Building Permits. This department protects the public welfare by regulating and controlling the design, construction, and quality of materials, use and occupancy, location and maintenance of all buildings and structures within the City of Duarte. The City of Duarte contracts with the County of Los Angeles for building inspection services and structural plan checking. As a contract city with the Los Angeles County Building and Safety Department, Duarte has adopted, by reference, the Los Angeles County Uniform Building Code. The Uniform Building Code was first enacted by the International Conference of Building Officials (ICBO) on October 18-21, 1927. Revised editions of this code have been published approximately every 3 years since that time. The Uniform Building Code contains several sections that address earthquake hazards as follows:

1605, 1 (Distribution of Horizontal Sheer);
1605. 2 (Stability against Overturning);
1626 (Seismic);
1605. 3 (Anchorage); and
1632, 1633, 1633. 9 deal with specific earthquake hazards.

In addition, the City of Duarte Planning Division, maintains the City Zoning Maps that delineate “Restricted Use” areas along the Duarte and Sierra Madre fault zones. Construction proposals are reviewed utilizing these maps and restrictive zones.

Furthermore, any new developments proposed for sites located within the Zones of Required Investigation as delineated by the State Department of Conservation must demonstrate that the site can be made suitable for the proposed development.

State Mitigation Programs

California is painfully aware of the threats it faces from earthquakes. Dating back to the 19th century, Californians have been killed, injured, and lost property as a result of earthquakes. As the State's population continues to grow, and urban areas become even more densely built up, the risk will continue to increase. For decades the Legislature has passed laws to strengthen the built environment and protect the citizens. The following table provides a sampling of some of the 200 plus laws in the State's codes.

Partial List of the Over 200 California Laws on Earthquake Safety	
Government Code Section 8870-8870.95	Creates Seismic Safety Commission.
Government Code Section 8876.1-8876.10	Established the California Center for Earthquake Engineering Research.
Public Resources Code Section 2800-2804.6	Authorized a prototype earthquake prediction system along the cental San Andreas fault near the City of Parkfield.
Public Resources Code Section 2810-2815	Continued the Southern California Earthquake Preparedness Project and the Bay Area Regional Earthquake Preparedness Project.
Health and Safety Code Section 16100-16110	The Seismic Safety Commission and State Architect will develop a state policy on acceptable levels of earthquake risk for new and existing state-owned buildings.
Government Code Section 8871-8871.5	Established the California Earthquake Hazards Reduction Act of 1986.
Health and Safety Code Section 130000-130025	Defined earthquake performance standards for hospitals.
Public Resources Code Section 2805-2808	Established the California Earthquake Education Project.
Government Code Section 8899.10-8899.16	Established the Earthquake Research Evaluation Conference.
Public Resources Code Section 2621-2630 2621.	Established the Alquist-Priolo Earthquake Fault Zoning Act.
Government Code Section 8878.50-8878.52 8878.50.	Created the Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990.
Education Code Section 35295-35297 35295.	Established emergency procedure systems in kindergarten through grade 12 in all the public or private schools.
Health and Safety Code Section 19160-19169	Established standards for seismic retrofitting of unreinforced masonry buildings.
Health and Safety Code Section 1596.80-1596.879	Required all child day care facilities to include an Earthquake Preparedness Checklist as an attachment to their disaster plan.
Source: http://www.leginfo.ca.gov/calaw.html	

The Alfred E. Alquist Hospital Seismic Safety Act ("Hospital Act") was enacted in 1973 in response to the moderate Magnitude 6.6 Sylmar Earthquake in 1971 when four major hospital campuses were severely damaged and evacuated. Two hospital buildings collapsed killing forty seven people. Three others were killed in another hospital that nearly collapsed.

When the Hospital Act was passed in 1973, the State anticipated that, based on the regular and timely replacement of aging hospital facilities, the majority of hospital buildings would be in compliance with the Act's standards within 25 years.

However, hospital buildings were not, and are not, being replaced at that anticipated rate. In fact, the great majority of the State's urgent care facilities are now more than 40 years old.

The moderate Magnitude 6.7 Northridge Earthquake in 1994 caused $3 billion in hospital-related damage and evacuations. Twelve hospital buildings constructed before the Act were cited (red tagged) as unsafe for occupancy after the earthquake. Those hospitals that had been built in accordance with the 1973 Hospital Act were very successful in resisting structural damage.
However, nonstructural damage (for example, plumbing and ceiling systems) was still extensive in those post-1973 buildings.

Senate Bill 1953 ("SB 1953"), enacted in 1994 after the Northridge Earthquake, expanded the scope of the 1973 Hospital Act. Under SB 1953, all hospitals are required, as of January 1, 2008, to survive earthquakes without collapsing or posing the threat of significant loss of life. The 1994 Act further mandates that all existing hospitals be seismically evaluated, and retrofitted, if needed, by 2030, so that they are in substantial compliance with the Act (which requires that the hospital buildings be reasonably capable of providing services to the public after disasters). SB 1953 applies to all urgent care facilities (including those built prior to the 1973 Hospital Act) and affects approximately 2,500 buildings on 475 campuses.

National Programs

USGS

The U.S. Geological Survey program serves the Nation as an independent fact-finding agency that collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems. The USGS is working to improve its earthquake monitoring and reporting capabilities through the Advanced National Seismic System. In the past three years the USGS has installed approximately 300 new earthquake-monitoring instruments in the San Francisco, Seattle, Salt Lake City, Anchorage, Reno, Las Vegas, and Memphis areas. Full implementation of ANSS will result in 6000 new instruments on the ground and in structures. Once in place, the ANSS will provide emergency response personnel with real-time (within 5-10 minutes of an event) information on the intensity and distribution of ground shaking that can be used to guide emergency response efforts. Similarly, information on building "shaking" will equip engineers with the data they need to improve building designs in the future.

In addition, the USGS conducts the Earthquake Information and Seismograph Networks program. This project provides rapid earthquake information on felt earthquakes in the U.S. and significant earthquakes worldwide to federal and state government agencies, the national and international scientific communities, news media, and the general public.

FEMA

The National Earthquake Hazards Reduction Program was established in 1977, under the authority of the Earthquake Hazards Reduction Act of 1977, enacted as Public Law 95-124.

The purpose of the National Earthquake Hazards Reduction Program (NEHRP) is to reduce the risks of life and property from future earthquakes. FEMA serves as lead agency among the four primary NEHRP federal partners, responsible for planning and coordinating the Program.

Other Programs

Earthquake research and education activities are conducted at several major universities in the Southern California region, including Cal Tech, USC, UCLA, UCSB, UCI, and UCSB. The local clearinghouse for earthquake information is the Southern California Earthquake Center located at the University of Southern California, Los Angeles, CA 90089, Telephone: (213) 740-5843, Fax: (213) 740-0011, Email: SCEinfo@usc.edu, Website: http://www.scec.org. The Southern California Earthquake Center (SCEC) is a community of scientists and specialists who actively coordinate research on earthquake hazards at nine core institutions, and communicate earthquake information to the public. SCEC is a National Science Foundation (NSF) Science and Technology Center and is co-funded by the United States Geological Survey (USGS).

In addition, Los Angeles County along with other Southern California counties, sponsors the Emergency Survival Program (ESP), an educational program for learning how to prepare for earthquakes and other disasters. Many school districts have very active emergency preparedness programs that include earthquake drills and periodic disaster response team exercises.

Earthquake Mitigation Action Items

When a community has an understanding of the risks posed by earthquakes, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from an earthquake. Specific actions have been considered by the steering committee through the aid of public participation that may reduce or lessen the impacts of earthquakes in the City of Duarte.

ST - Short Term
LT – Long Term
EQ – Earthquake

ST-EQ #1
Integrate new information on the Duarte Fault as it becomes available into the City's General Plan and other city planning maps/documents.

Ideas for Implementation
1.1 Coordinate with the California Department of Conservation on obtaining new data and maps related to the Duarte Fault.

1.2 Update the City's General Plan Public Safety Element with new mapping information on the Duarte Fault.

1.3 Update all current zoning maps and development guidelines to address all new information received from the California Department of Conservation related to earthquake fault zones.

Coordinating Organization: City Planning Department
Timeline: 2 years
Plan Goals Addressed: Prevention, Protect Property

ST-EQ #2
Develop public education program related to earthquake hazard insurance.

Ideas for Implementation
2.1 Utilizing the City's newsletter, produce articles that will provide information to Duarte residents on the availability of earthquake insurance.

2.2 Coordinate with insurance companies to produce brochure or public information leaflet related to the availability of earthquake insurance that can be distributed at community events and placed in government buildings.

Coordinating Organization: City Administration Department
Timeline: 2 years
Plan Goals Addressed: Public Education and Awareness

ST EQ #3
Review Federal, State, County, and City Guidelines on seismic safety standards and construction codes on an annual basis to reduce earthquake hazards to new buildings and infrastructure.

Ideas for Implementation
3.1 Review all code amendments and modifications of the Los Angeles County Uniform Building Code with the Los Angeles County Building and Safety Department.
3.2 Review all recommendations of the California State Seismic Safety Commission pertaining to the construction of new buildings and infrastructure.
3.3 Review the guidelines of the National Earthquake Hazards Reduction Program (NEHRP) and consider changes to Duarte's plan checking program for new construction based on these guidelines.
3.4 Review the Development Standards on the City of Duarte Hillside Overlay Zone to incorporate all new information related to earthquake fault zones.

Coordinating Organization: City Planning Department, and Building and Safety Division.
Timeline: Annually
Plan Goals Addressed: Prevention

LT-EQ #1
Conduct inventory of emergency facilities/shelters and update facilities to provide safe shelters for the community.

Ideas for Implementation
1.1 Conduct an inventory of each emergency facility and ensure that each facility has alternative emergency power source.
1.2 Encourage seismic strength evaluations for each emergency facility.
1.3 Update City's evacuation route map and distribute it to appropriate city departments.

Coordinating Organization: Building Department and Planning Department
Timeline: 3-6 years
Plan Goals Addressed: Structural, Protect Life and Property

LT-EQ #2
Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.

Ideas for Implementation
2.1 Provide information for property owners, businesses and organizations on sources of funds (loans, grants, etc.) for retrofitting.
2.2 Explore options for including seismic retrofitting in existing programs such as home improvement programs.

Coordinating Organization: Housing Department and Administration
Timeline: 3-5 years
Plan Goals Addressed: Protect Life and Property, Prevention

LT-EQ #3
Explore possibilities of developing emergency access road/secondary evacuation route across the San Gabriel River.

Ideas for Implementation
3.1 Meet with the Army Corps of Engineers and all related government agencies regarding the possibility of establishing an emergency access road/ secondary evacuation route across the San Gabriel River that would be secondary to the existing bridge across the river.
3.2 Obtain updates from the City of Azusa regarding the retrofitting of the bridge across the San Gabriel River.

Coordinating Organization: Public Works Department
Timeline: 3-5 years
Plan Goals Addressed: Structural Projects, Partnership and Implementation

LT-EQ #4
Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.

Ideas for Implementation

5.1 Provide information to the community on securing bookcases, furniture, water heaters, and other objects that can cause injuries or block exits.

5.2 Obtain public information brochures produced by FEMA and state agencies related to earthquake safety and make brochures available to the public at City Hall, Teen Center, and Senior Citizen Center.

Coordinating Organization: City Administration Department
Timeline: 3-5 years
Plan Goals Addressed: Public Education and Awareness

Earthquake Resource Directory

Local and Regional Resources

Los Angeles County Public Works Department
900 S. Fremont Avenue
Alhambra, CA 91803
(626) 458-5100

Southern California Earthquake Center (SCEC)
3651 Trousdale Parkway Suite 169
Los Angeles, CA 90089-0742
Ph: 213-740-5843

Notes: The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.

State Resources

California Department of Transportation (CalTrans)
120 S. Spring Street
Los Angeles, CA 90012
Ph: 213-897-3656
http://www.dot.ca.gov/

California Resources Agency
1416 Ninth Street Suite 1311
Sacramento, CA 95814
Ph: 916-653-5656
http://resources.ca.gov/

California Division of Mines and Geology (DMG)
801 K Street
Sacramento, CA 95814
Ph: 916-445-1825
www.consrv.ca.gov/cgs/index.htm

California Department of Conservation: Southern California Regional Office
655 S. Hope Street
Los Angeles, CA 90017-2321
Ph: 213-239-0878
www.consrv.ca.gov

Governor's Office of Emergency Services (OES)
P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911
www.oes.ca.gov

Federal Resources

Building Seismic Safety Council (BSSC)
1090 Vermont Ave., NW
Suite 700
Washington, DC 20005
Ph: 202-289-7800
www.bssconline.org

Federal Emergency Management Agency, Region IX
1111 Broadway
Suite 1200
Oakland, CA 94607
Ph: 510-627-7100
www.fema.gov

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600
www.fema.gov/fima/planhowto.shtm

United States Geological Survey
345 Middlefield Road
Menlo Park, CA 94025
Ph: 650-853-8300
http://www.usgs.gov/

Western States Seismic Policy Council (WSSPC)
125 California Avenue
Suite D201, #1
Palo Alto, CA 94306
Ph: 650-330-1101
www.wsspc.org/home.html

Publications

Putting Down Roots in Earthquake Country, prepared by the Department of Interior, USGS and the Southern California Earthquake Center (SCEC) in cooperation with the Federal Emergency Management Agency, 1995.
Contact: Southern California Earthquake Center
Address: University of Southern California
University Park, Los Angeles, CA 90089.
Phone: (213) 740-1560

Land Use Planning for Earthquake Hazard Mitigation: Handbook for Planners
Wolfe, Myer R. et. al., (1986) University of Colorado, Institute of Behavioral Science, National Science Foundation.

This handbook provides techniques that planners and others can utilize to help mitigate for seismic hazards. It provides information on the effects of earthquakes, sources on risk assessment, and effects of earthquakes on the built environment. The handbook also gives examples on application and implementation of planning techniques to be used by local communities.
Contact: Natural Hazards Research and Applications Information Center
Address: University of Colorado, 482 UCB,
Boulder, CO 80309-0482
Phone: (303) 492-6818
Fax: (303) 492-2151
Website: http://www,colorado.edu/UCB/Research/IBS/hazards

Public Assistance Debris Management Guide, FEMA (July 2000).
The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing. and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The "Public Assistance Debris Management Guide" is available in hard copy or on the FEMA website.

End Notes

[1] Los Angeles A to Z, An Encyclopedia of the City and County, Pitt and Pitt, University of California Press, 1997.

[2] USGS Earthquake Hazard Program

[3] http/pubs.usgs.gov/gip.earthq/safault.html

[4] Future Seismic Hazards in Southern California, Phase I: Implications of the 1992 Landers Earthquake Sequence, *Southern California Earthquake Center Report,* 42p., 1992

[5] Planning for Natural Hazards: The California Technical Resource Guide, Department of Land Conservation and Development (July 2000)

[6] Putting Down Roots in Earthquake Country, USGS and the Southern California Earthquake Center, 1995

[7] Source: Los Angeles County Public Works Department, March 2004

SECTION 7

WILDFIRES

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Why are Wildfires a Threat to Southern California?

After deadly firestorms roared through Southern California in October of 2003, federal and state officials approved more than $218 million to help residents, business owners, local government agencies and non-profit organizations recover from the wildfires and prepare for future disasters. To date, more than 40,500 residents and business owners have registered for aid since the fires swept through Los Angeles, Riverside, San Bernardino, San Diego and Ventura counties.[1]

For thousands of years, fires have been a natural part of the ecosystem in Southern California. However, wildfires present a substantial hazard to life and property in communities built within or adjacent to hillsides and mountainous areas. There is a huge potential for losses due to wildland/urban interface fires in Southern California. According to the California Division of Forestry (CDF), there were over seven thousand reportable fires in California in 2003, with over one million acres burned.[2] According to CDF statistics, in the October, 2003 Firestorms, over 4,800 homes were destroyed and 22 lives were lost.[3]

The 2003 Southern California Fires

The most destructive wildfire season in California history occurred in the fall of 2003. In a ten-day period, 12 separate fires raged across Southern California in Los Angeles, Riverside, San Bernardino, San Diego and Ventura counties. The massive "Cedar" fire in San Diego County alone consumed 2,800 homes and burned over a quarter of a million acres.

Table 8-1. October 2003 Firestorm Statistics

County	Fire Name	Date Began	Acres Burned	Homes Lost	Homes Damaged	Lives Lost
Riverside	Pass	10/21/03	2,397	3	7	0
Los Angeles	Padua	10/21/03	10,446	59	0	0
San Bernardino	Grand Prix	10/21/03	69,894	136	71	0
San Diego	Roblar 2	10/21/03	8,592	0	0	0
Ventura	Piru	10/23/03	63,991	8	0	0
Los Angeles	Verdale	10/24/03	8,650	1	0	0
Ventura	Simi	10/25/03	108,204	300	11	0
San Diego	Cedar	10/25/03	273,246	2,820	63	14
San Bernardino	Old	10/25/03	91,281	1,003	7	6
San Diego	Otay / Mine	10/26/03	46,000	6	11	0
Riverside	Mountain	10/26/03	10,000	61	0	0
San Diego	Paradise	10/26/03	56,700	415	15	2
Total Losses			749,401	4,812	185	22

Source: http://www.fire.ca.gov/php/fire_er_content/downloads/2003LargeFires.pdf

Historic Fires in Southern California

Fire shapes and regulates the functions of ecosystems. It has dominated California's landscape for as long as there has been vegetation to burn. Even without people, the state's volatile combination of climate, terrain, and vegetation produces one of the most combustible natural fire environments on earth. But the addition of more than 30 million people coupled with changes in land management during the twentieth century has created a dynamic fire environment that clearly challenges the ability of land management and fire protection agencies to achieve ecosystem management while providing the increased levels of fire protection demanded by the public for natural resources, life, and property.[4]

Table 8-2. Large Historic Fires in California 1961-2003
20 Largest California Wildland Fires (Structures Destroyed)

	Fire Name	Date	County	Acres	Structures	Deaths
1	Tunnel	October 1991	Alameda	1,600	2,900	25
2	Cedar	October 2003	San Diego	273,246	2,820	14
3	Old	October 2003	San Bernardino	91,281	1,003	6
4	Jones	October 1999	Shasta	26,200	954	1
5	Paint	June 1990	Santa Barbara	4,900	641	1
6	Fountain	August 1992	Shasta	63,960	636	0
7	City of Berkeley	September 1923	Alameda	130	584	0
8	Bel Air	November 1961	Los Angeles	6,090	484	0
9	Laguna Fire	October 1993	Orange	14,437	441	0
10	Paradise	October 2003	San Diego	56,700	415	2
11	Laguna	September 1970	San Diego	175,425	382	5
12	Panorama	November 1980	San Bernardino	23,600	325	4
13	Topanga	November 1993	Los Angeles	18,000	323	3
14	49er	September 1988	Nevada	33,700	312	0
15	Simi	October 2003	Ventura	108,204	300	0
16	Sycamore	July 1977	Santa Barbara	805	234	0
17	Canyon	September 1999	Shasta	2,580	230	0
18	Kannan	October 1978	Los Angeles	25,385	224	0
19	Kinneloa	October 1993	Los Angeles	5,485	196	1
19	Grand Prix	October 2003	San Bernardino	59,448	196	0

20	Old Gulch	August 1992	Calaveras	17,386	170	0

http://www.fire.ca.gov/FireEmergencyResponse/HistoricalStatistics/PDF/20LSTRUCTURES.pdf

"Structures" is meant to include all loss - homes and outbuildings, etc.

Historic Wildfires in the City of Duarte

Duarte's location at the base of the San Gabriel Mountains creates an urban/wildland interface that makes Duarte more susceptible to wildfires than cities that do not border the foothills. When surveys were mailed out to Duarte residents and businesses in preparation of this Natural Hazard Mitigation Plan, many residents expressed their concern that wildfires pose the "highest threat " to their home. This was particularly true of residents living north of Royal Oaks Drive who reside closest to urban/wildland interface areas. Several of the surveys expressed a concern that Duarte could experience another fire like the Stable Fire that occurred 1980.

1953 Duarte Fire

This fire originated between Spinks Canyon and Maddock Canyon in wildland area. A total of 561 acres burned in this fire. Of the 561 acres that burned, 256 acres were considered within the "Duarte area". Duarte did not incorporate as a city until four years later, in 1957.

1958 Norum Fire

This fire burned in the foothills north of Monrovia, Duarte, Bradbury, and Azusa. A total of 6,440 acres burned in the Norum Fire. Of the 6,440 acres, 2,505 acres of land were within Duarte's boundaries. (Mostly wilderness areas).

1980 Stable Fire

On November, 16, 1980 a "fire storm' that had been fanned by Santa Ana Wind conditions swept down from the foothills and destroyed 35 homes in the City of Duarte and 14 homes in the City of Bradbury. Reports indicated that the fire had moved from the City of Azusa, east of the San Gabriel River to the Duarte and Bradbury homes in 8 to 10 minutes, due to a strong shift in winds.

Immediately after the fire, city and county personnel began taking measures to deal with the devastation. A Disaster Assistance Center was established at City Hall and Federal and State agencies were contacted for help. The Los Angeles County Fire District set up a mobile command center and the City set up an emergency shelter. In the weeks that followed the fire, the City established several programs to deal with possible floods and mudslides that could occur due to the bare slopes where all vegetation had been burned off. Mud diversion structures were constructed, 50,000 sandbags were distributed, and parking was restricted on streets with potential slides. Since the Stable

Fire occurred during California's rainy season, "Storm Watch" flyers were also issued to residents in Duarte's hillside areas. The Disaster Center at City Hall monitored weather reports and storm situations and kept residents informed of these situations. City staff was also prepared to mobilize personnel and equipment if needed to clear mud flows from the public streets and parkways. As quickly as possible, several temporary debris basins were constructed and existing debris basins were cleared and reinforced with sandbags.

Wildfire Terminology & Characteristics

What is a Wildfire?

A *wildfire* is an uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly. Wildfires are usually signaled by dense smoke that fills the area for miles around.[6]

A *wildland* fire is a wildfire in an area in which development is essentially nonexistent, except for roads, railroads, power lines, and similar facilities.

Terminology

Air Tanker: A fixed-wing aircraft equipped to drop fire retardants or suppressants.

Backfire: A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire and/or change the direction of force of the fire's convection column.

Bambi Bucket: A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.

Brush: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

Brush Fire: A fire burning in vegetation that is predominantly shrubs, brush and scrub growth.

Bucket Drops: The dropping of fire retardants or suppressants from specially designed buckets slung below a helicopter.

Buffer Zones: An area of reduced vegetation that separates wildlands from vulnerable residential or business developments. This barrier is similar to a greenbelt in that it is usually used for another purpose such as agriculture, recreation areas, parks, or golf courses.

Control Line: All built or natural fire barriers and treated fire edge used to control a fire.

Defensible Space: An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, "defensible space" is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation.

Fire Break: A natural or constructed barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Fire Cache: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.

Fire Crew: An organized group of firefighters under the leadership of a crew leader or other designated official.

Fire Front: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter.

Fire Perimeter: The entire outer edge or boundary of a fire.

Fire Season: 1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resource values sufficient to warrant organized fire management activities. 2) A legally enacted time during which burning activities are regulated by state or local authority.

Fire Storm: Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirls.

Fire Weather: Weather conditions that influence fire ignition, behavior and suppression.

Flash Fuels: Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, that ignite readily and are consumed rapidly when dry. Also called fine fuels.

Ground Fuel: All combustible materials below the surface litter, including duff, tree or shrub roots, punchy wood, peat, and sawdust that normally support a glowing combustion without flame.

National Fire Danger Rating System (NFDRS): A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

Peak Fire Season: That period of the fire season during which fires are expected to ignite most readily, to burn with greater than average intensity, and to create damages at an unacceptable level.

Prevention: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards.

Project Fire: A fire of such size or complexity that a large organization and prolonged activity is required to suppress it.

Suppression: All the work of extinguishing or containing a fire, beginning with its discovery.

Surface Fuels: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity.

Underburn: A fire that consumes surface fuels but not trees or shrubs. (See Surface Fuels.)

Wildland Fire: Any nonstructure fire, other than prescribed fire, that occurs in the wildland.

Wildland Urban Interface: The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

Wildfire Characteristics

The presence of fire in the landscape has been one of the major evolutionary factors in determining the composition and flora throughout the state and around the world. Natural causes of fire range from lightning, sparks from falling rocks, volcanic activity, and the spontaneous combustion of plant materials and other organic matter (Barbour, Burk & Pitts, 1980).

Man has also played a role in the pattern of fires in the landscape, dating back as far as 30,000 years ago with the arrival of the first Americans. Early Spanish explorers and missionaries documented the use of fire by Native Americans who used fire clear areas for the germination of oaks for the production of acorns, and to create and maintain grasslands for hunting. Later, European settlers used fire to clear brush so land could be used for agricultural purposes.

Various plant species depend on fire as a means to reproduce, while others have adapted to survive in the presence of fire. In the case of the Coast Live Oaks, stump sprouting, or the generation of new growth from burnt trunks, occurs following a blaze.

It is man's desire to be near the Coast Live Oaks and California chaparral that prompts him to build near wildland areas. Over six million California residents live in wildland areas, with another four million along the wildland/urban interface. (Planning, 1995) While the urban/wildland interface is a wonderful place to live from an aesthetic point of view, millions of dollars are spent every year in fire suppression and flood control.

The Interface

One challenge Southern California faces regarding the wildfire hazard is from the increasing number of houses being built on the urban/wildland interface. Every year the growing population has expanded further and further into the hills and mountains, including forest lands. The increased "interface" between urban/suburban areas and the open spaces created by this expansion has produced a significant increase in threats to life and property from fires and has pushed existing fire protection systems beyond original or current design and capability.

Property owners in the interface are not aware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their own property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

Scene From FIRE SIEGE 2003

Fuel

Fuel is the material that feeds a fire and is a key factor in wildfire behavior. Fuel is classified by volume and by type. Volume is described in terms of "fuel loading", or the amount of available vegetative fuel.

The type of fuel also influences wildfire. Chaparral is a primary fuel of Southern California wildfires. Chaparral habitat ranges in elevation from near sea level to over 5,000' in Southern California. Chaparral communities experience long dry summers and receive most of their annual precipitation from winter rains. Although chaparral is often considered as a single species, there are two distinct types; hard chaparral and soft chaparral. Within these two types are dozens of different plants, each with its own particular characteristics.

Fire has been important in the life cycle of chaparral communities for over 2 million years; however, the true nature of the "fire cycle" has been subject to interpretation. In a period of 750 years, it is generally thought that fire occurs once every 65 years in coastal drainages and once every 30 to 35 years inland." [7]

> "The vegetation of chaparral communities has evolved to a point it requires fire to spawn regeneration. Many species invite fire through the production of plant materials with large surface-to-volume ratios, volatile oils and through periodic die-back of vegetation. These species have further adapted to possess special reproductive mechanisms following fire. Several species produce vast quantities of seeds which lie dormant until fire triggers the parent plant which produces these seeds defends itself from fire by a thick layer of bark which allows enough of the plant to survive so that the plant can crown sprout following the blaze. In general, chaparral community plants have adapted to fire through the following methods; a) fire induced flowering; b) bud production and sprouting subsequent to fire; c) in-soil seed storage and fire stimulated germination; and d) on plant seed storage and fire stimulated dispersal." [8]

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire's ability to spread.

Topography

Topography influences the movement of air, thereby directing a fire course. For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces up slope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

Weather

Weather patterns combined with certain geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible.[9] High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The so-called "Santa Ana" winds, which are heated by compression as they flow down to Southern California from Utah, create a particularly high risk, as they can rapidly spread what might otherwise be a small fire.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term drought is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance.

Unusually dry winters, or significantly less rainfall than normal, can lead to relatively drier conditions and leave reservoirs and water tables lower. Drought leads to problems with irrigation and may contribute to additional fires, or additional difficulties in fighting fires.

Development

Growth and development in scrubland and forested areas is increasing the number of human-made structures in Southern California interface areas. Wildfire has an effect on development, yet development can also influence wildfire. Owners often prefer homes that are private, have scenic views, are nestled in vegetation and use natural materials. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and fire fighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.

Wildfire Hazard Assessment

Wildfire Hazard Identification

Wildfire hazard areas are commonly identified in regions of the wildland/urban interface. Ranges of the wildfire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control such as the surrounding fuel load, weather, topography, and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather and topography.

The following table illustrates a rating system to identify wildfire hazard risk (with a score of 3 equaling the most danger and a score of 1 equaling the least danger.)

Sample Hazard Identification Rating System

Category	Indicator	Rating
Roads and Signage	Steep; narrow; poorly signed	3
	One or two of the above	2
	Meets all requirements	1
Water Supply	None, except domestic	3
	Hydrant, tank, or pool over 500 feet away	2
	Hydrant, tank, or pool within 500 feet	1
Location of the Structure	Top of steep slope with brush/grass below	3

	Mid-slope with clearance	2
	Level with lawn, or watered groundcover	1
Exterior Construction	Combustible roofing, open eaves, Combustible siding	3
	One or two of the above	2
	Non-combustible roof, boxed eaves, non-combustible siding	1

In order to determine the "base hazard factor" of specific wildfire hazard sites and interface regions, several factors must be taken into account. Categories used to assess the base hazard factor include:

Topographic location, characteristics and fuels;
Site/building construction and design;
Site/region fuel profile (landscaping);
Defensible space;
Accessibility;
Fire protection response; and
Water availability.

The City of Duarte has taken a similar approach to identifying fire hazard risk utilizing four main determinants. The four determinants are: (1) human proximity; (2) vegetative cover; (3) slope; and (4) access. Utilizing these criteria, the city has been divided into three Fire Hazard Areas. The risk of widespread fire in the southern urbanized portions of the city is rated low. The risk of fire increases as access becomes more limited north of Royal Oaks Drive and the vegetation becomes less cultivated. Map 14 indicates the High Fire Hazard Areas north of Royal Oaks near the foothills. An Extreme Fire Hazard Risk has been identified for Duarte Mesa due to the topography, limited access, and dry vegetation (primarily chaparral).

A summary of those factors that constitute each category of fire hazard risk is listed below.

FIRE HAZARD RISK

Extreme Risk

Vegetation: Chamise chaparral
Proximity: Fronting developed areas/wildland interface
Access: Limited, topography extremely variable
Slope: Steep (40 + percent)

High Risk

Vegetation: Woodland-grass
Proximity: Areas fronting developments to back country.

MAP

Access:	Somewhat limited
Slope:	Moderate (20 to 40 percent)

Low Risk

Vegetation:	Cultivated/ urban-barren areas
Proximity:	Developed areas
Access:	Available
Slope:	Flat

Each of these hazard risk categories is shown on the Fire Hazard Areas Map shown on Page 11.

Vulnerability and Risk

The environmental setting and foothill topography of Duarte lends the city to a range of fire hazards from wild fires to urban fires. Wildland fires in undeveloped areas ignite accumulated brush, woody material and chaparral. As experienced in the past, these kinds of fires can burn large areas and cause considerable damage to structures, watershed, and natural habitat for animals.

Urban fires usually originate from sources such as substandard electrical wiring, faulty heating systems, children playing with matches, and the improper use of flammable liquids.

Fire protection and fire prevention services are provided by the Los Angeles County Fire Department. A total of 57 cities contract with the Los Angeles County Fire Department which staffs a total of 163 engine companies, 31 truck companies, 79 paramedic units, and numerous other pieces of specialized apparatus. The Los Angeles County Fire Department operates 157 fire stations and answers over 234,000 emergency calls annually.[10]

The Los Angeles County Fire Department is credited with the creation of the nation's second Fire Fighter Paramedic Program and the nation's first 911 Emergency Calling System. Throughout its history, the Department has emerged as a leader in the fire service on local, regional and national levels, growing to become the nation's second largest fire protection agency.[11]

The primary fire station for the City of Duarte is located at 1105 Highland Avenue. The station is equipped with two engine companies, one patrol vehicle, and one water tender. Eight firefighters staff the station and one paramedic is assigned to Engine 44.

Vulnerability and Risk Assessment is the second step of the fire-hazard assessment. A vulnerability/risk assessment should indicate an inventory of property that will be

impacted by wildfires. It is by understanding the population and property exposed to natural hazards that we can reduce risk and prevent loss from future events.

To determine the inventory of property that would be impacted by wildfires, city staff collected information on individual properties from the last equalized Los Angeles County Tax Assessor Roles. Utilizing the boundaries for High Fire Danger Areas and Extreme Fire Danger Areas, city staff determined the total number of residential units that would be at risk in each of these fire danger areas. Then the improvement value for each property was computed and results of this computation are listed below.

HIGH FIRE DANGER AREA

Number of Residential Units	Estimated Improvement Value
586 units	$ 68.8 million

EXTREME

FIRE DANGER AREA

Number of Residential Units	Estimated Improvement Value
126 units	$ 21.8 million

Community Wildfire Issues

Each year, wildfires burn hundreds of homes and other structures in or adjacent to forests and rangelands. And even before the last flames have flickered out, some owners begin thinking about rebuilding homes on the very sites scorched by fire. This situation is not new or confined to a particular area; nor is the proposed remedies new or applicable only to a particular area.

Southern California epitomizes the problem of protecting homes from recurring wildfires. Several conditions contribute to a fire protection problem that is as severe as to be found anywhere. Vegetation, ranging from heavy stands of grass to brush to hardwoods or conifers, thrives in the Mediterranean climate there. Other conditions contributing to the high fire hazard are the large population, mountainous topography, and an increasingly affluent, mobile society encroaching into wildlands.[12]

What Is Susceptible to Wildfire?

Growth and Development in the Interface

The hills and mountainous areas of Southern California are considered to be interface areas. The development of homes and other structures is increasingly encroaching into

the wildlands and is expanding the wildland/urban interface. The interface neighborhoods are characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation and natural fuels.

In the event of a wildfire, vegetation, structures and other flammables can merge into unwieldy and unpredictable events. Factors important to the fighting of such fires include access, firebreaks, and proximity of water sources, distance from a fire station and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires shows that many structures are destroyed or damaged for one or more of the following reasons:

Combustible roofing material;
Wood construction;
Structures with no defensible space;
Fire department with poor access to structures;
Subdivisions located in heavy natural fuel types;
Structures located on steep slopes covered with flammable vegetation;
Limited water supply; and
Winds over 30 miles per hour.

In the case of the Duarte Stable Fire in 1980, a least three of these factors were present; including high winds, poor access, and combustible roofing material. As an outcome of the Stable Fire, the City of Duarte has implemented stronger standards including the prohibiting of wood shingle roofs in the northern section of town.

Road Access

Road access is a major issue for all emergency service providers. As development encroaches into hillside areas, the number of houses without adequate turn-around space is increasing. Firefighters are often challenged by narrow roads and limited access.

California Dept. of Forestry & Fire Protection

Water Supply

Water is still the most effective tool for fighting wildland fire when and where it can be obtained in sufficient quantity. It is really the only effective tool for fighting home and most other structural fires. Therefore, a large, dependable source of water above that required for normal daily domestic purposes must be provided for at the time a subdivision or individual homesite is planned and developed (Alger 1971, County Sup. Assoc. Calif. 1966, Nat. Fire Prot. Assoc. 1974).

The amount of water reserved for firefighting purposes and the size and type of delivery system provided depend on (a) the degree of wildfire hazard involved (fire hazard severity classification); and (b) the type and location of the occupancy (home, mobile home, apartments, etc.).

Interface Fire Education Programs and Enforcement

Fire protection in urban/wildland interface areas may rely heavily more on the landowner's personal initiative to take measures to protect his or her own property. Therefore, public education and awareness may play a greater role in interface areas. In those areas with strict fire codes, property owners who resist maintaining the minimum brush clearances may be cited for failure to clear brush.

Structural Design and Construction

Because of the behavior of wildland fires, how a building is designed and constructed is the most important factor in providing fire safety for a home or other structure. Properly built homes can survive a destructive fire even if many of the other protective measures listed above are absent. The architect and building contractor, therefore, are key figures in providing safety.

In addition building inspectors and city leaders need to be knowledgeable and be able to exert pressure that will guarantee adherence to fire safe practices in design and construction.

The Need for Mitigation Programs

Continued development into the interface areas will have growing impacts on the wildland/urban interface. Periodically, the historical losses from wildfires in Southern California have been catastrophic, with deadly and expensive fires going back decades. The continued growth and development increases the public need for natural hazards mitigation planning in Southern California.

Wildfire Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by the City of Duarte as well as county, regional, state, and federal agencies

Local Programs

In 1981, immediately following the devastating Stable Fire, the City of Duarte adopted a Hillside Overlay District to provide regulations for the hillside areas in the city. The intent of the Hillside Overlay District was to "regulate use, development, and alteration of land in hillside areas so that essential natural characteristics such as land form, vegetation, and wildlife communities, scenic qualities, and open space were protected and maintained". The hillside ordinance also requires that the development of homes in the hillside areas provide maximum safety with respect to fire hazards, exposure to geological and geotechnical hazards, drainage, and erosion.

One section of the Hillside Overlay District is entitled **Fire Prevention Standards**. This code sections mandates that water mains and water systems be sized to provide sufficient water to meet the firefighting requirements of the area involved. In addition, the distance between any residence and a fire hydrant shall not be more than two hundred fifty feet and hydrants shall be connected directly to water mains by not smaller than a six-inch pipe.

The Fire Prevention Standards of the Hillside Overlay Zone also prescribe the following construction standards:

(A) **All new roofs shall be Class A or equal as determined by the community development director.**

(B) Any cantilevered construction including stairs, balconies, porches and open structure under buildings shall be protected from below with a surface of one-hour fire retardant construction.

(C) All openings to enclosed under-floor areas shall be covered with wire mesh of one-quarter inch size.

(D) All eaves shall be fully boxed in with exterior stucco or its equivalent. Any necessary vents shall be covered with one-quarter inch mesh or its equivalent.

The Fire Prevention Standards of the Hillside Overlay Zone also restricts native brush within thirty feet of any building. The fire department has the authority to require a greater clear area where it deems necessary and to approve the required planting.

One of the main development policies of the hillside ordinance is to "provide for safe circulation of vehicular traffic to and from the hillside area and to provide access for emergency vehicles necessary to serve the hillside area". In addition, the hillside ordinance establishes a maximum land coverage formula for each parcel based on the average slope. For example if the average slope is 25 percent, then the maximum land coverage is 30 percent. This development standard can be an essential element in fighting fires. Basically, steep terrain complicates fire suppression in three ways. First,

steep slopes, canyons and ridges complicate and intensify the effects of wind. Second, in the absence of wind, fires race much faster up a steep slope than they do on the level. It is difficult, slow and dangerous to fight fire on steep, rocky side hills. The combined effects of terrain and wind often create smoke and air turbulence conditions, which preclude the use of aircraft. Hillside roads make access and response time slow and difficult for firefighters and for heavy fire trucks and other equipment.

Adequate access around the perimeter of a home is another essential element in fighting fires. This factor was taken in to consideration when the City adopted new zoning codes for the Duarte Mesa Area (R-1D zone) following the Stable Fire. Specifically, side yard setbacks were increased to a minimum of 8 feet in width rather than the standard 5-foot setbacks mandated in the flatter sections of the city. This provision allows for greater access by firefighting personnel. At the time of the revisions to the R1-D zone the heights of the homes in The Duarte Mesa area were restricted to a maximum height of 18 feet.

County Fire Programs

The City of Duarte contracts with the Los Angeles County Fire Department for fire protection and fire prevention services. As stated earlier, the County Fire Department has a total of 163 engine companies, 31 truck companies, 79 paramedic units, and numerous other pieces of specialized apparatus. The County also provides Fire Prevention Services, Forestry Services, Emergency Medical Services and an Urban Search and Rescue Program.

The Los Angeles County Fire Department is proud to have recently retrofitted more than 100 fire engines with fire retardant foam capability. This can be a life-saving measure in foothill areas where existing water tanks are not functioning or are inaccessible.

For many years the Los Angeles County Fire Station in Duarte has maintained a Fire Hazard Advisory sign in front of their station at 1105 Highland Avenue, Duarte. The sign advises local residents and the business community about fire hazards risk utilizing a three-tier system: High Fire Danger, Moderate Fire Danger and Low Fire Danger.

All of the fire service providers in the County of Los Angeles are dedicated to fire prevention and use their resources to educate the public to reduce the threat of the fire hazard, especially in the wildland/urban interface. Fire prevention professionals throughout the county have taken the lead in providing many useful and educational services to Southern California residents, such as:

Home fire safety inspection;
Assistance developing home fire escape plans;
Business Inspections;
Citizen Emergency Response Team (CERT) training;
Fire cause determination;
Counseling for juvenile fire-setters;
Teaching fire prevention in schools;
Coordinating educational programs;
Providing standards to hospitals and schools; and
Answering citizens' questions regarding fire hazards.

State Programs

As a contract city with the Los Angeles County Fire Department, Duarte has adopted, by reference, the California Fire Code. This code establishes the clearance of brush, the maintenance of high fire hazard areas and the maintenance of effective firebreaks with the Los Angeles County Fire Department.

The California Department of Forestry and Fire Protection (CDF) is dedicated to the fire protection and stewardship of over 31 million acres of California's privately owned wildlands. In addition, the Department provides varied emergency services in 35 of the State's 58 counties via contracts with local governments.

The Department of Forestry and Fire Protection responds with firefighters, fire engines, and aircraft to an average 6,300 wildland fires each year. Those fires burn an average of nearly 144,000 acres annually.

Federal Programs

The role of the federal land managing agencies in the wildland /urban interface is reducing fuel hazards on the lands they administer; cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships and relationships with property owners, local protection agencies, states and other stakeholders in wildland/urban interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.

Federal Emergency Management Agency (FEMA) Programs

FEMA is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland /urban interface is to encourage comprehensive

disaster preparedness plans and programs, increase the capability of state and local governments and provide for a greater understanding of FEMA programs at the federal, state and local levels.[13]

Fire Suppression Assistance Grants

Fire Suppression Assistance Grants may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property and encourage the development and implementation of viable multi-hazard mitigation measures and provide training to clarify FEMA's programs. The grant may include funds for equipment, supplies and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. FEMA's US Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues and the USFA's National Fire Academy provides training programs.

Hazard Mitigation Grant Program

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

National Wildland/Urban Interface Fire Protection Program

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association (WGA) can act as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface.
The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

U.S. Forest Service

The U. S. Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on forestlands. The USFS is a cooperating agency and, while it has little to no jurisdiction in the lower valleys, it has an interest in preventing fires in the interface, as fires often burn up the hills and into the higher elevation US forest lands.

Other Mitigation Programs and Activities

Prescribed Burning

The health and condition of a forest will determine the magnitude of wildfire. If fuels - slash, dry or dead vegetation, fallen limbs and branches - are allowed to accumulate over long periods of time without being methodically cleared, fire can move more quickly

and destroy everything in its path. The results are more catastrophic than if the fuels are periodically eliminated. Prescribed burning is the most efficient method to get rid of these fuels. In California during 2003, various fire agencies conducted over 200 prescribed fires and burned over 33,000 acres to reduce the wildland fire hazard.[3]

Firewise

Firewise is a program developed within the National Wildland/ Urban Interface Fire Protection Program and it is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower planners and decision makers at the local level. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the general public about hazard evaluation and policy implementation techniques. Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos and conferences. The interactive home page allows users to ask fire protection experts questions and to register for new information as it becomes available (www.firewise.org).

FireFree Program

FireFree is a unique private/public program for interface wildfire mitigation involving partnerships between an insurance company and local government agencies. It is an example of an effective non-regulatory approach to hazard mitigation. Originating in Bend, Oregon, the program was developed in response to the city's "Skeleton Fire" of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and structures. Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort. Bend's pilot program included:

1. A short video production featuring local citizens as actors, made available at local video stores, libraries and fire stations;
2. Two citywide yard debris removal events;
3. A 3D-minute program on a model Fire Free home, aired on a local cable television station; and
4. Distribution of brochures, featuring a property owner evaluation checklist and a listing of fire-resistant indigenous plants.

Wildfire Mitigation Action Items

When a community has an understanding of the risks posed by wildfires, it is essential that local decision makers, residents, and business leaders, seek measures to reduce or minimize the loss of life and property damage resulting from fires. Specific actions have been considered by the steering committee through the aid of public participation that may reduce risk and lessen the severity of wildfires in the City of Duarte.

ST – Short Term
LT – Long Term
WF- Wildfire

ST-WF #1
AUGMENT EMERGENCY SERVICES TO INCREASE THE EFFICIENCY OF WILDFIRE RESPONSE.

Ideas for Implementation:

1.1 Coordinate with Los Angeles County Fire Department (through contract services) to replace out-of-date apparatus and equipment on a scheduled basis.

1.2 Continue to support "mutual assistance" agreements between the fire departments of local cities, Los Angeles County, and the U.S. Government.

1.3 Provide city equipment to the Los Angeles County Fire Department to fight fires including water trucks, city trucks, and tools.

1.4 Increase the number of portable generators that are available for emergency power. Specifically, to provide back-up power system, in the event of an electrical power failure, to pump water supply into water tanks for fire suppression.

Coordinating Organization: City of Duarte Public Safety Department and Los Angeles County Fire Department.
Timeline: 2 years
Plan Goals Addressed: Emergency Services

ST-WF #2
IDENTIFY ALTERNATIVE FIREFIGHTING WATER SOURCES AND COORDINATE WITH LOS ANGELES COUNTY FIRE DEPARTMENT ON INVENTORY OF ALTERNATE SOURCES.

Ideas for Implementation

2.1 Identify all swimming pools via curb markers to be used for emergency pumping.

2.2 Establish policy for keeping city water trucks filled with 2,000 gallons of water for supplementary fire support.

2.3 Advocate the installation of water cannons and other high-pressured sprinklers in greenbelt areas adjacent to urban-wildland areas.

2.4 Identify additional water sources within the city and outside the city that may be available for fire fighting.

Coordinating Organization: City of Duarte Field Services Division, City of Duarte Community Development Department and Los Angeles County Fire Department.
Timeline: 3 years
Plan Goals Addressed: Emergency Services

ST-WF #3
INCREASE COMMUNICATION AND COORDINATION BETWEEN COUNTY FIRE PERSONNEL, CITY PLANNERS, CONTRACTORS AND PROPERTY OWNERS TO ADDRESS RISKS AND MITIGATION MEASURES THAT ARE AVAILABLE IN WILDLAND/URBAN INTERFACE AREAS OF THE CITY.

Ideas for Implementation

3.1 Continue fire inspections and brush clearance programs sponsored by the Los Angeles County Fire Department.

3.2 Provide development standards and zoning handouts to property owners and contractors that describe the fire prevention measures contained within the Hillside Overlay Zone including unobstructed fire protection equipment access easements, Class A roof materials, fire hydrant locations, and water main minimum requirements.

3.3 Update the development standards of the Hillside Overlay Zone with new fire prevention measures as needed to address the construction of new buildings and infrastructure.

Coordinating Organization: City Planning Department and Los Angeles County Fire Department
Timeline: 1-3 years
Plan Goals Addressed: Prevention, Protect Life and Property, Public Awareness

LT-WF #1
ENHANCE OUTREACH AND EDUCATION PROGRAMS AIMED AT MITIGATING WILDFIRE HAZARDS.

Ideas for Implementation

1.1 Produce public information brochures that encourage residents to plant fire-resistant landscaping, to clear dry brush, and to consider fire-resistant building materials.

1.2 Publish fire prevention articles in city newsletter related to fire evacuation, fire escape plans, and fire safety.

1.3 Hold neighborhood meetings in interface neighborhoods to educate the residents on fire prevention methods.

Coordinating Organization: Public Safety Department and Neighborhood Watch Captains.
Timeline: 2-4 years
Plan Goals Addressed: Protect Life and Property, Public Awareness

LT-WF #2
DEVELOP OUTREACH PROGRAM AND RECOVERY ACTIVITIES FOR RESPONDING TO COMMUNITY DURING AND IMMEDIATELY FOLLOWING A WILDFIRE.

Ideas for Implementation

2.1 Provide emergency hot line at City Hall with pre-recorded message to inform public of wildfire response and recovery activities. List of emergency centers provided on recording.

2.2 Upon activating the emergency centers, place public information on the city web site and on the public access channel on cable television.

2.3 Obtain grant monies or funding to purchase two message boards to be placed in strategic locations in the city to alert the public to wildfire hazards.

2.4 Develop bulletin board on the city's web site for sharing information and for informing those who are out of the area of current activities and recovery efforts.

Coordinating Organization: City Public Safety Department
Timeline: 2-5 years
Plan Goals Addressed: Protect Life and Property, Public Awareness

LT-WF#3
Support programs for the expansion or improvement of firefighting water sources and water storage facilities.

Ideas for Implementation

3.1 Explore funding sources and advocate with Cal-American Water Company to install fire-resistant electrical pump systems or to install back-up power generators at each water tank to ensure adequate fire suppression.

3.2 Coordinate and advocate with the U.S. Forest Service to install portable tanks filled with water or flame retardant chemical in strategic locations in the forest areas north of Duarte.

Coordinating Organization: Duarte City Council
Timeline: 3-5 years
Plan Goals Addressed: Protect Life and Property, Emergency Services, Partnership and Implementation

Wildfire Resource Directory

County Resources

Los Angeles County Fire Department
1320 N. Eastern Ave.
Los Angeles, CA., 90063
Telephone: 323.881.2411
http://www.lacofd.org/default.htm

State Resources

California Division of Forestry & Fire Protection
1416 9th Street
PO Box 944246
Sacramento California 94244-2460
(916) 653-5123
http://www.fire.ca.gov/php/index.php

Office of the State Fire Marshal (OSFM)
1131 "S" Street
Sacramento, CA 95814
PO Box 944246
Sacramento, CA 94244-2460
Tel. (916) 445-8200
Fax. (916) 445-8509

Federal Resources and Programs

National Fire Protection Association (NFPA)
This is the principal federal agency involved in the National Wildland/Urban Interface Fire Protection Initiative. NFPA has information on the Initiatives programs and documents.
Public Fire Protection Division
1 Battery March Park.
P.O. Box 9101
Quincy, MA 02269-9101
Phone: (617) 770-3000

National Interagency Fire Center (NIFC)
The NIFC in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations. These agencies include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, Fish and Wildlife Service, National Park Service, National Weather Service and Office of Aircraft

National Interagency Fire Center
3833 S. Development Ave.
Boise, Idaho 83705
208-387-5512
http://www.nifc, gov/

United States Fire Administration (USFA) of the Federal Emergency Management Agency (FEMA)
As an entity of the Federal Emergency Management Agency, the mission of the USFA is to reduce life and economic losses due to fire and related emergencies through leadership, advocacy, coordination and support.
USFA, Planning Branch, Mitigation Directorate
16825 S. Seton Ave.
Emmitsburg, MD 21727
(301) 447-1000
http://www.fema.gov/hazards/fires/wildfires.shtm - Wildfire Mitigation
http://www.usfa.fema.gov/index.htm - U.S. Fire Administration

Additional Resources

Firewise - The National Wildland/Urban Interface Fire program
Firewise maintains a Website designed for people who live in wildfire prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos and conferences.
Firewise
1 Battery March Park.
P.O. Box 9101
Quincy, MA 02269-9101
Phone: (617) 770-3000
http://www.firewise.org/

Federal Wildland Fire Policy, Wildland/Urban Interface Protection
This is a report describing federal policy and interface fire. Areas of needed improvement are identified and addressed through recommended goals and actions.
http://www.fs.fed.us/land/wdfire7c.htm

Publications

National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire, National Wildland/Urban Interface Fire Protection Program, (1991), National Fire Protection Association, Washington, D.

This document, developed by the NFPA Forest and Rural Fire Protection Committee, provides criteria for fire agencies, land use planners, architects, developers and local governments to use in the development of areas that may be threatened by wildfire. To obtain this resource:
National Fire Protection Association Publications
(800) 344-3555
http://www.nfpa.org or http://www.firewise.org

An International Collection of Wildland- Urban Interface Resource Materials
(Information Report NOR- 344). Hirsch, K., Pinedo, M., & Greenlee, J. (1996). Edmonton, Alberta: Canadian Forest Service.
This is a comprehensive bibliography of interface wildfire materials. Over 2,000 resources are included, grouped under the categories of general and technical reports, newspaper articles and public education materials. The citation format allows the reader to obtain most items through a library or directly from the publisher. The bibliography is available in hard copy or diskette at no cost. It is also available in downloadable PDF form.
Canadian Forest Service, Northern Forestry Centre, I-Zone Series
Phone: (780) 435-7210
http://www.prefire.ucfpl.ucop.edu/uwibib.htm

Wildland/Urban Interface Fire Hazard Assessment Methodology.
National Wildland/Urban Interface Fire Protection Program, (1998).
NFPA, Washington, D.C.
Firewise (NFPA Public Fire Protection Division)
Phone: (617) 984-7486
http://www.firewise.org

Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility.
National Wildland/Urban Interface Fire Protection Program, (1998). Washington, D.
Firewise (NFPA Public Fire Protection Division)
Phone: (617) 984-7486
http://www.firewise, org

Wildfire Endnotes

[1] More Than $218 Million Approved for Southern California Wildfire Recovery, March 2004, California Office of Emergency Services.

[2] http://www.fire.ca.gov/php/2003fireseasonstats_v2.asp

[3] http://www.fire.ca.gov/php/fire_er_content/downloads/2003Large Fires.pdf

[4] Fire Management for California Ecosystems, August 28, 1995, California Department of Forestry and Fire Protection.

[5] http://www.fire.ca.gov/fireemerg. (see page 2)

[6] Understanding Your Risk, Identifying Hazards and Estimating Your Losses, August 2001, Federal Emergency Management Agency.

[7] http://www.coastal.ca.gov/fire/ucsbfire.html

[8] Ibid

[9] Planning for Natural Hazards: The Oregon Technical Resource Guide, (July 2000), Department of Land Conservation and Development

[10] http://www.lacofd.org

[11] Ibid

12 Protecting Residences From Wildfires by Howard E. Moore
(General Technical Report PSW-50)
WEB SITE: http://www.fs.fed.us/psw/publications/documents/gtr-050/

13 Source: National Interagency Fire Center, Boise ID and California Division of Forestry, Riverside Fire Lab

SECTION 8:

FLOOD & DAM FAILURE

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Why are Floods and Dam Failure a Threat to the City of Duarte?

Through historic times the Los Angeles area has been periodically pounded by heavy rains and inundated by floods. Some of the heaviest rains ever recorded on the west coast of North America occurred near Los Angeles as a result of the high transverse orographic barrier catching a moist subtropical airflow. Historical references highlight eight major floods across the coastal plain in the Los Angeles area between 1815 and 1876. From 1884 to 1938, nine more floods wreaked havoc. In the latter half of the twentieth century, enormous public work projects were completed, which served to mitigate flood damage in the Los Angeles area.

If not for the successful flood control system, the City of Duarte could experience major flood events based on its location at the base of the San Gabriel Mountains. The peaks of the San Gabriel Mountains range in height from 9,000 ft. elevation down to 6,000 ft. elevation. Below the peaks is a complex environment of deep canyons, slopes and tributaries. The range's major watershed is the San Gabriel River with three main forks and countless tributaries draining fully 20 percent of the mountain's precipitation. The San Gabriel River runs in a north/south direction near the east boundary of the City of Duarte.

The San Gabriel River is the central backbone of the San Gabriel River Watershed. The watershed for the San Gabriel River is one of several coastal watersheds in Southern California that drain hundreds of square miles of mountainous and urban lands to the Pacific Ocean. The San Gabriel River changes dramatically from its origination high in the San Gabriel Mountains, through 58 miles of carefully controlled spillways and reservoirs through urbanized cities, to its mouth at the Pacific Ocean. On its run to the sea, the San Gabriel River passes through 19 different cities. [1]

The San Gabriel River is controlled by a network of dams and flood control measures. This network of carefully planned dams has protected the City of Duarte from any serious flooding events. The natural water cycle and flow are significantly altered to protect the adjacent communities from flood damage and to better use local water resources for urban and agricultural water supplies. The network of dams and flood control measures have been very effective in controlling flood waters in Los Angeles County however, a major earthquake could cause sudden failure of one of these dams resulting in major damage.

MAP

Dam Failures in Southern California			
Sheffield	Santa Barbara	1925	Earthquake slide
Puddingstone	Pomona	1926	Overtopping during construction
Lake Hemet	Palm Springs	1927	Overtopping
Saint Francis	San Francisquito Canyon	1928	Sudden failure at full capacity through foundation, 426 deaths
Cogswell	Monrovia	1934	Breaching of concrete cover
Baldwin Hills	Los Angeles	1963	Leak through embankment turned into washout, 3 deaths
http://cee.engr.ucdavis.edu/faculty/lund/dams/Dam_History_Page/Failures.htm			

While dam failures are infrequent in Southern California, one of the most remembered dam failures occurred on December 14, 1963. The 155-foot high Baldwin Hills dam gave way and sent 360 million gallons of water in a fifty-foot high wall cascading onto the community below, killing five persons, destroying 277 homes, and damaging 50 million (1963 dollars) of dollars in property.

Luckily, early warning and prompt action by dam personnel and the police prevented more lives from being lost. The Baldwin Hills dam was built in 1950, and during construction geologists found that two faults ran through the reservoir and the earthen dam. One of the faults was thought to be active, so special drains were constructed underneath the reservoir to allow water, which might percolate through the fault to exit safely. The dam was built near a large oil field, and the extraction of the oil caused the ground to subside. This caused slippage between the two faults. The slippage was minimal (only a couple of centimeters), but it was enough to rupture the lining of the reservoir. The special drains quickly clogged up with sand and water, and the 65 million gallons of water quickly cut an opening under and through the dam itself. [2]

The failure of the Baldwin Hills Dam caused the State of California Legislature to amend the State Water Code. The statutes governing dam safety in California, place the supervision of the safety of non-federal dams and reservoirs under the jurisdiction of the Department of Water Resources' Division of Safety of Dams. The Division of Safety of Dams reviews plans and specifications for the construction of new dams or for the enlargement, alteration, repair, or removal of existing dams. Professional engineers and geologists from the Division supervise the maintenance and operations of all dams as well as evaluate each project to enlarge, alter, repair or remove any existing dams.

Flooding from the San Gabriel River and dam failure inundation are not the only flood issues that Duarte must be concerned with. Portions of the City are prone to urban flooding, also referred to as ponding. While urban flooding is not a major problem in the City of Duarte it is one that requires on-going maintenance of existing storm drains and flood control channels. Debris accumulation in storm drains and flood control channels is one of the largest maintenance problems for the City. Low-lying areas of the City are particularly susceptible to urban flooding. The following areas are considered at risk due to urban flooding:

- Huntington Drive, north side, west of Buena Vista Street
- Encanto Parkway, north of Huntington Drive (City of Azusa jurisdiction)
- Encanto Parkway near Fish Canyon Road
- Central Avenue, north side, east of Santo Domingo Avenue
- Buena Vista Street, east side, south of Galen Street.
- Vineyard Avenue south of Royal Oaks

These urban flooding areas are considered to be a hazard only to their specific location and are not expected to threaten or endanger the lives of persons in the surrounding areas. [3]

History of Flooding and Flood Protection in Los Angeles County

1884

In February and March of 1884 almost 26 inches of rain fell in Los Angeles. The 1883-84 rainfall season was the wettest in recorded history, with 38.18 inches recorded downtown. Fifty houses were washed away in the flooding that occurred, several people were killed, and there was extensive property damage.

1914

The heavy rains of January 25-26, 1914 were followed by a second and larger storm three weeks later. Large areas of the basin were flooded by the Los Angeles River. The disastrous flood of 1914 caused over 10 million dollars in property and it led directly to the establishment of the Los Angeles County Flood Control District in 1915. The District was formed to control and conserve flood, storms, and other wastewaters.

Flood destruction and loss of life awakened the growing population of the Los Angeles Basin to the need for flood control. In 1915, Congress authorized the U.S. Army Corps of Engineers to work on the Los Angeles River problem.

1933

Beginning December 31, 1933 and continuing into New Year's Day 1934, very heavy rains caused destructive flooding and mudslides across Los Angeles County from Malibu to Covina. Fourteen weather stations in the Los Angeles area reported record maximum two-day rainfalls, with two locations recording 1,000-year events. A rain gauge located on the slopes below Mount Wilson recorded almost fifteen inches of rain on New Year's Day. In all, the flooding left more than forty persons dead in the City of La Canada and destroyed or damaged 500 homes.

The 1938 flood reinforced the need for flood control systems.

1938

After 4 days of rain, a countywide flood occurred that is recorded as a 50-year storm. Leading up to the March rains, Los Angeles had received about ten inches of rain in February. On March 2nd, with the ground already saturated, five to seven inches of rain fell across the basin. Rainfall in the surrounding mountains was much heavier. Mountain gauges recorded ten inches or more of rain, with a few receiving up to 18 inches. Stream flows recorded by gauging stations within the San Gabriel Mountain watershed were phenomenal. The Red Cross calls this the 5th largest flood in history (at that time) with 113 lives lost, and $40 million in damage. The public demands action and the Army Corps of Engineers begin channelizing the Los Angeles River with 10,000 workers applying 3,000,000 barrels of concrete by hand.[4]

1943

In 1943, it rained extremely hard on January 22nd and 23rd. The greatest 24-hour rainfall in California history occurred in this storm when 26.12 inches fell at Hoegees, below Mount Wilson. Fifteen weather stations in the transverse ranges received storm totals exceeding twenty inches. This storm was reported as a one hundred-year event. Goodridge (1998) stated that the area encompassing a 100-year or more return period covered 11,000 square miles, and extended from Santa Barbara County to Riverside County.

1969

Southern California received heavy precipitation through the 1968-69 season, particularly during January and February, when almost 23 inches of rain fell at downtown Los Angeles. A low-pressure trough had anchored off the southern California coast, setting up a steady-state subtropical moisture flow across the district. During this event, almost three hundred rain gauges recorded the highest-ever 60-day rainfall totals.

Flood control projects completed before 1968 mitigated property damage in Los Angeles. When the 1969 rains finally ended, Frank G. Bonelli of the Los Angeles County Board of Supervisors stated, "The overall flood control system prevented one of the worst catastrophes in the history of Los Angeles." To the north, across Santa Barbara County and San Luis Obispo County, losses and damage from these heavy rains had been much more severe.

1980

In the month of February 1980, thirteen inches of rain fell after an abnormally wet January. The Los Angeles River slightly overflowed the levees at the lower end of the river at Wardlow Road. The 129,000 cfs river gauge measurement at that location was the highest recorded since records began in 1928. This 40-year flood event broke through a barrier that was supposed to withstand a 100-year flood, which caused the Corps of Engineers to re-evaluate flood protection for the lower Los Angeles River.

1983

Heavy rains were well handled by the complex system of drainages, catchments, and bridges built by the Corps of Engineers within the Los Angeles area. A low-latitude Pacific storm moved into southern California at the end of February and first of March 1983, with total-period rainfall ranging from about 7 inches in the valley areas to 20-25 inches in the upper San Gabriel Canyon watershed. The heaviest rainfall occurred with the passage of a strong occluded cold front during the morning of March 1st, with peak intensities well in excess of 1 inch per hour in a number of areas. Several stations in the watershed recorded from 4 to 8 inches on March 1st. Although more than 20 inches of rain fell in the upper San Gabriel Canyon, Duarte did not experience any major flooding due to the existing flood control system.

1995

On January 4, 1995 a storm caused record rainfalls in the south portion of the Los Angeles basin near the City of Carson. (The City of Duarte is located in the north portion of the Los Angeles basin. Duarte only received a ½ inch of rain while Carson received 3.4 inches of rain.) The storm caused about six million dollars in damage, with two hundred structures flooded and one hundred vehicles abandoned.

Flood control facilities operated at peak capacity at many locations for short periods of time during the event, but the Los Angeles River did not approach capacity because intense rainfall occurred over only a relatively small portion of the lower drainage basin.

1998

In 1998, another strong storm produced the wettest February of all time at downtown Los Angeles, with 13.68 inches recorded during the month. Over nineteen inches fell at Montebello Fire Station, just east of the downtown weather station. In the Los Angeles metropolitan area, seasonal rainfall records were established at six key area stations, including Chatsworth with an incredible 44.19 inches. For the entire 1997-98 rainfall season, precipitation over the whole district averaged a whopping **230% of normal**. With such huge numbers, it was somewhat surprising to note that **the only flooding reported was of the urban and small stream variety**—more nuisance than disaster.

Several reasons are offered to explain the lack of problems associated with this very heavy rainfall season:

- One was the ample warning, of the strong probability of heavy winter rains, which was provided by the National Weather Service and the media. This prompted extra vigilance in the removal of debris from storm basins and flood channels.

- Secondly, adequate long-term flood control measures by the U.S. Army Corps of Engineers and their partners were largely completed and in place.

Construction Projects to Control Flooding

San Gabriel River

In 1917 and again in 1924 successful bond issues financed construction of 14 dams which were built to impound San Gabriel Mountains storm waters until they could be released in a controlled manner. Between 1917 and 1937, the San Gabriel River was not only engineered through a series of dams and levees to provide water and flood protection but the river channel was also made deeper and narrower. This flood protection allowed safe urban development near the San Gabriel River.[5]

Figure 1-1. The San Gabriel River offers spectacular views as it travels through the Angeles National Forest in Reach 2.

the river—reflecting the consensu
over 130 independently sponsore
identified by the 19 cities along t
the public agencies and commun
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underway or proposed, enabling t
being done and what remains to l

The Plan also provides suggestior
as well as how to design a projec
principles. This includes perform
use to assess potential projects a
their progress in meeting the goa
includes five Concept Design Stu
approach applied at the project l
sponsors can use to guide their o

This framework is meant to guide
encouraging them to join with th
agencies, non-profit groups, busi
and other stakeholders in designi

One of the first dams constructed was Sawpit Reservoir located just north of the City of Monrovia.

> **Sawpit Reservoir:** Sawpit Reservoir was constructed by the Los Angeles County Flood Control District in 1927 in Sawpit Canyon. Sawpit Canyon drains the southern slopes of Monrovia Peak. The reservoir has a 157' crest height and it holds 10 acres of water.[6]

Three major dams in the upper watershed of the San Gabriel River also provide flood protection for the City of Duarte. Two of these dams, Cogswell Dam and San Gabriel Dam, were built in San Gabriel Canyon between 1934 and 1937 respectively. A third dam, known as Morris Dam was constructed in 1934 by the City of Pasadena.[7]

> **Cogswell Dam**: Cogswell Dam and Reservoir is owned by the Los Angeles County Flood Control District and is operated by the Department of Power and Water. It was completed in April of 1934 at a cost of $3.1 million. It is a rock-filled structure with a concrete cutoff wall and rises 255 feet above the original stream bottom. Used both for flood control and water conservation, Cogswell Dam is located 22 miles north of the cities of Azusa and Duarte in San Gabriel Canyon.

> **San Gabriel Dam**: San Gabriel Dam and Reservoir is also owned by the Los Angeles County Flood Control District and operated by Department of Power and Water. Construction of this dam began in 1932 and finished in 1939 at a cost of 17 million. It is a compacted, earth-filled and rock-filled dam with a concrete crest. San Gabriel Dam is located 7 miles north of the cities of Azusa and Duarte.

Morris Dam: Morris Dam and Reservoir was built by the City of Pasadena in 1934 at a cost of 7.6 million. It was later relinquished to the Metropolitan Water District (MWD) of Southern California. In 1955, it was transferred to the Department of Water and Power. Morris Dam is a concrete, partially arched gravity structure. It is 800 feet long and rises 245 feet above the original streambed. Morris Dam is located just a few miles below the San Gabriel Dam and its primary use is water conservation.

During the large 1938 flood, Cogswell, San Gabriel, and Morris Dams were very beneficial in controlling what was the largest recorded flood up to that time even though the valves at San Gabriel Dam had not been installed. The dams then and since have prevented catastrophic damage to downstream areas such as that in the 1914 flood.

Los Angeles River

Through the early twentieth century, the Los Angeles River, at 55 miles long, was the county's major (and most capricious) drainage. The Los Angeles River had a long history of meandering almost at random across the coastal plain, emptying into the Pacific Ocean at various places from Santa Monica to Long Beach.

Flood destruction and loss of life awakened the growing population of the Los Angeles Basin to the need for flood control. The Los Angeles County Flood Control District was established in 1915, and Congress authorized the U.S. Army Corps of Engineers to work on the Los Angeles River problem at about the same time.

Between 1917 and 1965, the Corps of Engineers undertook numerous public works projects. The cost was high, over two billion dollars in federal and local funds for the entire project, but great benefits were realized. Due to the construction of a series of basins and concrete-lined channels, there were no more catastrophic floods after the 1950s, in spite of the sharp upward trend in urbanization and an increase in the number of heavy rainfall events late in the century.

Flood Characteristics and Terminology

Characteristics of Flooding

Nationwide, floods are caused by many things, including rainstorms, slow water run-off, earthquakes, broken dams, underwater volcanic eruptions and tsunamis, or hurricanes. In Los Angeles County, flooding is most often a factor of rainstorms or broken dams due to the fact that the area is not subject to volcanic eruptions, hurricanes, or frequent tsunamis. Furthermore, millions of dollars have been spent in Los Angeles County on developing a system of dams, flood control reservoirs and flood control channels aimed at controlling rainfall and urban run-off issues.

Often a flood is caused when heavy rain falls for days and days, building up too much water for groundwater systems to handle. Slowly, the water level begins to rise, creeping higher and higher until it floods into homes and covers roads.

In extremely bad cases, flash floods, with their rushing torrents of muddy water, sweep away houses, cars, trees, and people with ease.

Rushing water is so powerful that it resembles a wall of concrete. Water itself is very heavy. A single bathtub full weighs about 1,500 pounds. Imagine this same amount of water crashing through the streets at 80 miles per hour. The water also carries along mud, earth, boulders, and other debris. In 1955 in the U.S., a flood was able to carry away a wooden, four-story hotel.

When water rushes through a town or village in this way, it takes everything in its path, 0including cars, animals, and people. Humans can die from being battered or drowned. The water sometimes mixes with oil and sewage, causing additional damage. Mud will also pour into everything, clogging roads, blocking drains, and burying possessions. Even after the water drains away, a lot of destruction is left behind. Utility lines are destroyed and roads, bridges, and railroads are often damaged or washed away.

Los Angeles County is fortunate to have an extensive network of flood control facilities. The City of Duarte is fortunate to be relatively sheltered from flooding due to the San Gabriel River water conservation system and the major dam construction projects that were completed between 1914 and 1938. However, flood inundation could occur in portions of the City due to dam failure (Map 17, pg. 15).

Loss of life and damage to roads, structures, and utilities, may result from a dam failure. Economic losses can also result due to roads being washed out, mobilization of residents being impaired, and lowered property values. Certainly, any of these factors could be an outcome in the City of Duarte if any of the San Gabriel Canyon Dams were to fail.

Flood & Hydrology Terminology

Base Flood Elevation (BFE): A Base Flood Elevation (BFE) is the average depth of the base flood, usually in feet, above the ground surface**.**

Channel: An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. River, creek, run, branch, and tributary are some of the terms used to describe natural channels. Canal and floodway are some of the terms used to describe artificial channels.

Dam: Any artificial barrier, which impounds or diverts water. The dam is generally hydrologically significant if it is 25 feet or more in height from the natural bed of the stream and has storage of at least 15 acre-feet.

Dam Failure: Catastrophic event characterized by the sudden, rapid, and uncontrolled release of impounded water.

MAP

Discharge: The rate at which water passes a given point. Discharge is expressed in a volume per time with units of L3/T. Discharge is often used interchangeably with stream flow.

Diversion: The taking of water from a stream or other body of water into a canal, pipe, or other conduit.

Flash Flood: A flood which follows within a few hours (usually less than 6 hours) of heavy or excessive rainfall, dam or levee failure, or the sudden release of water impounded by an ice jam.

Flood: An overflow or inundation that comes from a river or other body of water that causes or threatens damage. This is a duration type event with a slower onset than flash flooding, normally greater than 6 hours.

Floodplain: A floodplain is a land area adjacent to a river, stream, lake, or other water body that is subject to flooding. This area, if left undisturbed, acts to store excess floodwater**.** It is usually a strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current.

Floodway: The floodway is one of two main sections that make up the floodplain. The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development or other structures that would obstruct or divert flood flows onto other properties. Floodways are not mapped for all rivers and streams but are generally mapped in developed areas.

Flood Fringe: The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken.

Flood zone: The land bordering a stream which is subject to floods of about equal frequency; for example, a strip of the flood plain subject to flooding more often that once but not as frequently as twice in a century.

Gaging station: A particular site on a stream, canal, lake, or reservoir where systematic observations of gage height or discharge are obtained.

Hundred Year Flood (100- year flood): The 100-year flooding event is the flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.
The 100**-**year floodplain is the area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood.

Maximum Probable Flood: The largest flood for which there is any reasonable expectancy in this climatic era.

Mudflow: A well-mixed mass of water and alluvium which, because of its high viscosity and low fluidity as compared with water, moves at a much slower rate, usually piling up and spreading over the fan like a sheet of wet mortar or concrete.

Reach: The length of channel uniform with respect to discharge, depth, area, and slope. In general terms, it is the length of a river between two gaging stations.

Reservoir: A manmade facility for the storage, regulation and controlled release of water.

Riparian Zone: A stream and all the vegetation on its banks.

Urban Flooding: Flooding of streets, underpasses, low lying areas, or storm drains. This type of flooding is mainly an inconvenience and is generally not life threatening.

Watershed: A watershed is any land area from which water drains toward a common watercourse in a natural basin.

Water Table: The level below the earth's surface at which the ground becomes saturated with water. A water table is an underground boundary where the zone of aeration and the zone of saturation meet.

Hazard Assessment

Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating the area at risk of flooding, estimating the intensity of the flooding, and estimating the probability of occurrence of flood events.

Since the City of Duarte has not been studied by the National Flood Insurance Program to ascertain flood hazards, it is difficult to estimate the area at risk of flooding. However, there may be areas where there “are possible but undetermined flood hazards”. The NFIP has designated Duarte as “Zone D” which means that no analysis of flood hazards has been conducted. City representatives have contacted the National Flood Insurance Program and have been told that Duarte is scheduled to be studied next year.

Since no analysis of flood hazards have been conducted at the national level, city representatives for Duarte contacted the Los Angeles County Department of Public Works to see if they might have information that could help in estimating the area at risk of flooding and estimating the intensity of the flooding. The Los Angeles County Department of Public Works maintains the Los Angeles County Drainage Area flood control system which includes 15 flood control reservoirs, 5 flood control basins, 225

stabilization dams, 33 storm water pumping plants and 470 miles of improved channels. County personnel verified that it is unlikely that Duarte would experience catastrophic flooding based on the existing network of dams and flood control measures. However, they stated that Duarte has not been studied. The County concurred that any hazard assessment or risk assessment should include a dam failure flooding assessment.

Based on the current control measures for the San Gabriel River, it is more likely that Duarte could sustain damage from Dam Failure Flooding than from Riverine Flooding. Therefore, the vulnerability assessment and the risk assessment that follows this section are based on Dam Failure Flooding only.

Vulnerability & Risk Assessment

Vulnerability Assessment is the second step of the flood-hazard assessment. A vulnerability assessment should indicate an inventory of property that will be impacted by a flood or in Duarte's case Dam Failure Flooding. It is by understanding the population and property exposed to natural hazards that we can reduce risk and prevent lost from future events.

In the event of a failure of the Morris Dam or the San Gabriel Dam, portions of Duarte would be inundated. The flood would last for approximately 1 hour. The velocity and height of the water would rapidly diminish due to the alluvial slopes that naturally drain in a southerly direction. In addition, failure of the Sawpit Dam (located in the City of Monrovia) could inundate portions of Monrovia and Duarte. This flood would last approximately 25 minutes.[8] The potential inundation areas and the elapsed time between dam failure and the arrival of floodwaters are indicated on Map 17, pg. 15.

Since flood inundation areas are based on the elapsed time in minutes from dam failure to arrival of first water, this vulnerability assessment is divided into section based on minutes of elapsed time (20 minutes, 30 minutes, 35 minutes and 40 minutes.)

For illustrative purposes, each dam failure scenario contains a Building Loss Estimation. These estimations were calculated using Flood Building Loss Estimation Tables provided by FEMA. However, the only purpose of these estimates is to generate hazard mitigation discussions. These estimates have not been substantiated by any flood hazard studies or historical flood trends. When a flood hazard study has been completed for the City of Duarte, then the city will be able to complete this risk assessment with proper details. For discussion purposes only, we have hypothesized a flood depth of 1 foot and building damages of 14 percent of improvement value.

MAP

Dam Failure Flooding for San Gabriel Dams

20 Minutes/ Elapsed Time From Dam Failure

The area that would be affected in the 20-minute/elapsed time is a single-family residential area containing approximately 17 homes. The estimated improvement value of these homes is a cumulative total of $1,815,064. Therefore, a theoretical flood building loss estimate would be approximately $ 250,000.

30 Minutes/Elapsed Time From Dam Failure

The area that would be affected in the 30-minute/elapsed time is, again, a single-family residential area containing 487 homes. The estimated improvement value of these homes is a cumulative total of $ 47,971,346. Therefore, a theoretical flood building loss estimate would be approximately $ 6.7 million

35 Minutes/Elapsed Time from Dam Failure

The area that would be affected in the 35-minute/elapsed time is primarily a residential neighborhood with one church and one bed & breakfast inn. There are a total of 699 homes in this area that could be impacted. The estimated improvement value of these homes along with the church and inn is a cumulative total of $ 70,504,128. Therefore, a theoretical flood building loss estimate would be approximately $ 9.8 million.

40 Minutes/Elapsed Time from Dam Failure

The area that would be affected in the 40-minute/elapsed time is a mixture of single-family homes, multi-family homes, commercial businesses, light manufacturing, and warehousing, This area also includes a private school, a golf course, and several motels. There are a total of 853 units in this area that could be impacted. The estimated improvement value is a cumulative total of $69,011,909. Therefore, a theoretical flooding building loss estimate would be approximately $ 9.7 million.

Dam Failure Flooding for Sawpit Reservoir

20 Minutes/Elapsed Time from Dam Failure

The area that would be affected in the 20-minute/elapsed time for Sawpit Reservoir is mostly residential units with some small commercial businesses. There are a total of 773 units in this area that could be impacted. The estimated improvement value is a cumulative total of $42,697,118. Therefore, a theoretical flooding building loss estimate would be approximately $ 6 million. It should be noted that Sawpit Reservoir contains just 10 acres of water so the theoretical flood depth of 1 foot may be a high estimate.

Aside from construction of earthquake resistant dams, substantial reduction of inundation potential will be difficult to accomplish.

This is mostly due to the extent and the patterns of urbanization. Through the process of “acceptable risk” determination, choices could be relative to land use/development restrictions in areas subject to inundation. In most cases, however, such decisions would likely be unacceptable economically.

As a result, the principal avenue of hazard reduction lies in the enforcement of design and construction of dams to accommodate any probable seismic force and secondary hazard that may occur at the dam site. The second major avenue would involve strengthening of existing community emergency preparedness programs to efficiently evacuate those areas within the inundation boundaries.

Community Flood and Dam Failure Issues

Three types of flood could impact the City of Duarte: Urban Flooding, Riverine Flooding, and Dam Failure Flooding. Urban flooding is the most likely flood impact that Duarte will experience due to the existing flood control systems.

Urban Flooding
Urban flooding is the flooding of streets, underpasses, low lying areas, or storm drains from heavy rains. This type of flooding is mainly an inconvenience and is generally not life threatening.

Portions of the City of Duarte are prone to urban flooding due to debris accumulation in storm drains and in flood control channels and aged drainage systems. Flood control channels and basins are at risk of overflowing their banks during times of heavy rainfall and reservoir water release, specifically the San Gabriel River basin, which runs along the east side of the City. The Los Angeles County Department of Public Works and the Army Corp of Engineers are responsible for notifying the jurisdiction at the onset of planned water releases.

Riverine Flooding
Riverine flooding is the over bank flooding of rivers and streams. Flooding of rivers and streams typically results from weather systems that generate heavy and prolonged rainfall.

Theoretically, the City of Duarte could experience Riverine flooding due to its location along the west side of the San Gabriel River. However, a carefully maintained network of dams and reservoirs makes this possibility unlikely. There currently exist three dams/reservoirs to control the San Gabriel River north of the City of Duarte. The natural water cycle and flow of the San Gabriel River is significantly altered by numerous flood-controlling methods. Flood channel improvements have been undertaken to confine the waters and convey them safely thorough the urbanized areas to the ocean. When the San Gabriel River water is released from the canyon facilities, it flows to the Santa Fe Dam (which is located immediately south of Duarte) and the Santa Fe Spreading Grounds. The Santa Fe Dam is a compacted earth-fill dam owned by the Army Corp of Engineers and it rises 92 feet in height and spans 23,800 feet in length.

Dam Failure Flooding

In the event of a failure of the Morris Dam or the San Gabriel Dam, portions of Duarte would be inundated. The flood would last for approximately 1 hour. The velocity and height of the water would rapidly diminish at the mouth of the San Gabriel Canyon however; portions of Duarte along the northeast side of the city would be inundated. In addition, failure of the Sawpit Dam (located in the City of Monrovia) could inundate portions of Monrovia and Duarte. This flood would last approximately 25 minutes. The potential inundation areas and the elapsed time between dam failure and the arrival of floodwaters is indicated in Map 17, pg. 15.

Identification of Flood Hazard Zones

Flood Insurance Studies (FIS) and flood maps are often used to identify flood-prone areas. The National Flood Insurance Program (NFIP) was established in 1968 as a means of providing low-cost flood insurance to the nation's flood prone communities. Floodplain maps are used to delineate flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by the Federal Emergency Management Agency, which delineates flood hazard areas in communities where NFIP regulations apply. FIRMs are also used by insurance agents and mortgage lenders to determine if flood insurance is required and what insurance rates should apply.

The City of Duarte entered the National Flood Insurance Program on September 7, 1984. The City was given a Community Panel Number (#065026) however, there have been no Flood Insurance Studies (FIS) completed by NFIP for the City of Duarte, to date. **The flood hazard zone designation for the City of Duarte is "Zone D". The Zone D designation on NFIP maps is used for areas where there are possible but undetermined flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted.** Mandatory flood insurance purchase requirements do not apply, but coverage is available. The flood insurance rates for properties in Zone D are commensurate with the uncertainty of the flood risk. There are currently 4 persons living in Duarte with National Flood Insurance.

Flood insurance is designed to provide an alternative to disaster assistance to reduce the escalating costs of repairing damage to buildings and their contents caused by floods. Flood damage is reduced by nearly $1 billion a year through communities implementing sound floodplain management requirements and property owners purchasing of flood insurance. Additionally, buildings constructed in compliance with NFIP building standards suffer approximately 80 percent less damage annually than those not built in compliance. Every $3 paid in flood insurance claims saves $1 in disaster assistance payments.[9]

In addition to providing flood insurance and reducing flood damages through floodplain management regulations, the NFIP identifies and maps the Nation's floodplains. Mapping flood hazards creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs.

The City of Duarte has been listed on NFIP maps as “unmapped”. This information has been verified several times at both the federal and state levels. In a recent telephone conversation with Kay Cummings at the National Flood Insurance Program, the City was informed that **Duarte is scheduled to be reviewed next year.**

Flooding Mitigation Activities

The current Los Angeles County Drainage Area flood control system is one of the world’s largest and most extensive flood protection infrastructures. This flood protection include

- 15 flood control reservoirs
- 5 flood control basins
- 143 debris control basins
- 225 stabilization dams
- 33 storm water pumping plants
- 470 miles of open, improved channel
- 2,400 miles of underground drains
- 75,000 catch basins

The Corps of Engineers estimates that the value of damages prevented by the system in storms during its lifetime has already reached $3.6 billion.

Projects now underway in the lower Los Angeles River will expand the channel capacity from 133,000 cubic feet per second (cfs) to 182,000 cfs, which would approximate a 133-year flood.

Additional mitigating measures that are currently being conducted by the City of Duarte include:

- Clearing and clean out of all storm drains.
- Monitoring of catch basins, bench drains, and swales on private property.
- Regular inspections of all flood control channels.
- Regular inspections of all debris basins.
- Extension of the Brookridge Road storm drain.
- Staff training of sandbag methods and run-off control measures.

Flood Mitigation Action Items

When a community has an understanding of the risks posed by floods and dam failures, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from a flood. Specific actions have been considered by the steering committee through the aid of public participation that may reduce or lessen the impacts of flood damage in the City of Duarte.

ST-FL #1
Determine existing flood warning system for San Gabriel River and San Gabriel Canyon Dams and establish city procedures to handle early warnings.

Ideas for Implementation

2.1.1 Coordinate with Army Corp of Engineers and Los Angeles County Public Works Department on establishing early flood warning system and communications methods among all government agencies.

2.2 Establish city procedures and evacuation plan for addressing early flood warnings.

Coordinating Organization: Public Works Department
Timeline: 2-4 years
Plan Goals Addressed: Emergency Services, Protect Life and Property

ST-FL #2
Develop program for capping sewer inlets during major storms and flood events to prevent water surges in sewer lines.

Ideas for Implementation

1.1 Research capping alternatives and select best method.
1.2 Develop policy for installing and removing caps.

Coordinating Organization: Public Works Department
Timeline: 2-4 years
Plan Goals Addressed: Prevention, Structural

ST-FL #3
Continue public education program on sandbag techniques and expand to include other flood protection measures.

Ideas for Implementation

3.1 Continue public education program on placement and filling of sandbags.
3.2 Expand education program to include other flood protection measures such as grading, drain clearance, and erosion control planting.
3.3 Explore funding or grant programs for purchasing automatic sand bagging machine.

Coordinating Organization: Field Services Department
Timeline: 2-4 years
Plan Goals Addressed: Public Education and Awareness

LT-FL #1
Upon completion of a Flood Hazard Study or Mapping by the Federal Emergency Management Agency (FEMA), implement proper floodplain management policies.

Ideas for Implementation

1.1 Work with FEMA on identifying flood risk.
1.2 Develop sound floodplain management standards.
1.3 Revise zoning standards, development codes, and building codes, based on the Flood Hazard Study to address the construction of new buildings and infrastructure within the identified floodplain areas.

Coordinating Organization: Community Development Department
Timeline: 5-7 years
Plan Goals Addressed: Prevention, Protect Life and Property

LT-FL #2
Identify areas that are subject to urban flooding and develop programs to minimize or eliminate the flooding.

Ideas for Implementation

2.1 Conduct engineering studies to determine the appropriate size of storm drain facilities that are needed to alleviate urban flooding.
2.2 Explore grant programs and other funding sources that are available to construct recommended storm drain facilities.

Coordinating Organization: Public Works Department
Timeline: 5-7 years
Plan Goals Addressed: Prevention, Structural Projects

Flood Resource Directory
County Resources

Los Angeles County Public Works Department
900 S. Fremont Ave.
Alhambra, CA 91803
Ph: 626-458-5100

Sanitation Districts of Los Angeles County
1955 Workman Mill Road
Whittier, CA 90607
Ph: 562-699-7411 x2301

State Resources

Governor's Office of Emergency Services (OES)
P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911
Fx: 916 845- 8910

California Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814
Ph: 916-653-5656

California Department of Water Resources (DWR)
1416 9th Street
Sacramento, CA 95814
Ph: 916-653-6192

California Department of Conservation: Southern California Regional Office
655 S. Hope Street, #700
Los Angeles, CA 90017-2321
Ph: 213-239-0878
Fx: 213-239-0984

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)
FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance, FEMA also operates the National Flood Insurance Program. FEMA' s mission is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.

Federal Emergency Management Agency, Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607
Ph: 510-627-7100
Fx: 510-627-7112

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

FEMA' s List of Flood Related Websites

This site contains a long list of flood related Internet sites from “American Heritage Rivers" to "The Weather Channel" and is a good starting point for flood information on the Internet.
Contact: Federal Emergency Management Agency, Phone: (800) 480-2520
Website: http://www.fema.gov/nfip/related.htm

National Flood Insurance Program (NFIP)
In Southern California many cities lie within flood zones as defined in FEMA Flood Maps. The flood hazard zone designation for the City of Duarte is “Zone D”. The Zone D designation on NFIP maps is used for areas where there are possible but undetermined flood hazards. In areas designated as Zone D, no analysis of flood hazards has been conducted. Flood insurance is available to citizens in communities that adopt and implement NFIP building standards. The standards are applied to development that occurs within a delineated floodplain, a drainage hazard area, and properties' within 250 feet of a floodplain boundary. These areas are depicted on federal Flood Insurance Rate Maps available through the county.

National Floodplain Insurance Program (NFIP)
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

The Floodplain Management Association
The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of upcoming events, a list of positions available, an index of publications available free or at nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and a catalog of Web links.

Floodplain Management Association
P.O. Box 50891
Sparks, NV 89435-0891
Ph: 775-626-6389
Fx: 775-626-6389

The Association of State Floodplain Managers

The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM Web site includes information on how to become a member, the organization's constitution and bylaws, directories of officers and committees, a publications list, information on upcoming conferences, a history of the association, and other useful information and Internet links.
Contact: The Association of State Floodplain Managers
Address: 2809 Fish Hatchery Road, Madison, WI 53713 Phone: (608) 274-0123
Website: http://www.floods,org

National Weather Service

The National Weather Service provides flood watches, warnings, and information.
National Weather Service
520 North Elevar Street
Oxnard, CA 93030
Ph: 805-988- 6615

Office of Hydrology, National Weather Service

The National Weather Service s Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters, This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.
National Weather Service, Office of Hydrologic Development
1325 East West Highway, SSMC2
Silver Spring, MD 20910
Ph: 301-713-1658
Fx: 301-713-0963

National Resources Conservation Service (NRCS), US Department of Agriculture
NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource, or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clear debris from clogged waterways, restore vegetation, and stabilizing riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more that one property.
National Resources Conservation Service
14th and Independence Ave., SW, Room 5105-A
Washington, DC 20250
Ph: 202-720-7246
Fx: 202-720-7690

USGS Water Resources
This web page offers current US water news; extensive current (including real-time) and historical water data; numerous fact sheets and other publications; various technical resources; descriptions of ongoing water survey programs; local water information; and connections to other sources of water information.
USGS Water Resources
6000 J Street Placer Hall
Sacramento, CA 95819-6129
Ph: 916-278-3000
Fx: 916-278-3070

Bureau of Reclamation
The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The Bureau provides leadership and technical expertise in water resources development and in the efficient use of water through initiatives including conservation, reuse, and research. It protects the public and the environment through the adequate maintenance and appropriate operation of Reclamation's facilities and manages Reclamation's facilities to fulfill water user contracts and protect and/or enhance conditions for fish, wildlife, land, and cultural resources.
Mid Pacific Regional Office
Federal Office Building
2800 Cottage Way
Sacramento CA 95825-1898
Ph: 916- 978-5000
Fax 916- 978-5599
http://www.usbr.gov/

Army Corps of Engineers
The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. The Corps is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation.
US Army Corps of Engineers
P.O. Box 532711
Los Angeles CA 90053- 2325
Ph: 213-452- 3921

Other National Resources

American Public Works Association
2345 Grand Boulevard, Suite 500
Kansas City, MO 64108-2641
Ph: 816-472-6100
Fx: 816-472-1610

Publications

NFIP Community Rating System Coordinator's Manual
Indianapolis, IN.
This informative brochure explains how the Community Rating System works and what the benefits are to communities. It explains in detail the CRS point system, and what activities communities can pursue to earn points. These points then add up to the "rating" for the community, and flood insurance premium discounts are calculated based upon that "rating ". The brochure also provides a table on the percent discount realized for each rating (1-10). Instructions on how to apply to be a CRS community are also included.
Contact: NFIP Community Rating System
Phone: (800) 480-2520 or (317) 848-2898
Website: http://www.fema.gov/nfip/crs

Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP
This document discusses floodplain processes and terminology. It contains floodplain management and mitigation strategies, as well as information on the NFIP, CRS, Community Assistance Visits, and floodplain development standards.
Contact: National Flood Insurance Program Phone: (800) 480-2520
Website: http://www.fema,gov/nfip/

Flood Hazard Mitigation Planning: A Community Guide, (June 1997).
Massachusetts Department of Environmental Management.

This informative guide offers a 10-step process for successful flood hazard mitigation. Steps include: map hazards, determine potential damage areas, take an inventory of facilities in the flood zone, determine what is or is not being done about flooding, identify gaps in protection, brainstorm alternatives and actions, determine feasible actions, coordinate with others, prioritize actions, develop strategies for implementation, and adopt and monitor the plan.
Contact: Massachusetts Flood Hazard Management Program Phone: (617) 626-1250
Website: http://www.magnetstate.ma.us/dem/programs/mitigate

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February 1987), FEMA-116.
This guidebook offers a table on actions that communities can take to reduce flood losses. It also offers a table with sources for floodplain mapping assistance for the various types of flooding hazards. There is information on various types of flood hazards with regard to existing mitigation efforts and options for action (policy and programs, mapping, regulatory, non-regulatory). Types of flooding which are covered include alluvial fan, areas behind levees, areas below unsafe dams, coastal flooding, flash floods, fluctuating lake level floods, ground failure triggered by earthquakes, ice jam flooding, and mudslides.
Contact: Federal Emergency Management Agency Phone: (800) 480-2520
Website: http://www.fema,gov

Flood Endnotes

1 The San Gabriel River Corridor Master Plan, (Draft) Los Angeles Dept. of Public Works.

2 Baldwin Hills Reservoir Failure, Civil Eng. Dept. University at Toronto

3 Threat Assessment – Urban Flooding, City of Duarte, September 1999, SEMS Multihazard Functional Plan.

4 Background: California's Tropical Storms, USA Today, December 2003.

5 San Gabriel River and Montebello Forebay Water Conservation System, Los Angeles Dept. of Public Works.

6 Ben Overturff Trail – Sawpit Dam – hikertechnologies.com

7 San Gabriel River Master Plan, LA County Public Works, Chapter 2.

8 City of Duarte General Plan, 1987

9 Mitigation Division, FEMA – www.fema.gov/fima/

Section 9:

WINDSTORM

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Why Are Windstorms A Threat To The City of Duarte?

The speed at which the air current moves and direction from which it moves determine whether wind is harmful or beneficial. A windstorm is defined as a storm with a strong wind but little or no rain. Severe windstorms pose a significant risk to life and property in a community by creating conditions that disrupt public utility services and impact transportation routes. High winds can have destructive impacts by toppling trees over on cars and roads. High winds can also cause widespread power outages and can cause telephone poles and power poles to topple. In rarer cases, windstorms can result in collapsed or damaged buildings. After such an event, it can take days or weeks for a community to return to its normal activities. Windstorms have, on occasion, resulted in death or injury of persons living in a wind-struck community.

Historical Windstorm Events

1961

On November 5-6, 1961, Santa Ana winds caused minor property damage and downing of trees.

1973

Strong storm winds blew through Duarte on February 10-11,1973 causing damage to many trees. It was reported that wind conditions caused some flying debris.

1997

On January 7,1997, the City of Duarte proclaimed the existence of a local emergency when a windstorm struck the local area. The windstorm of January 6, 1997 and January 7, 1997 caused the closure of the Foothill Freeway, damage to vehicles, sidewalks, irrigation systems and public buildings. Over 50 trees were lost in Duarte as a result of this windstorm including 28 landmark trees on the City's main boulevard, Huntington Drive. Several local streets were closed to traffic shortly after the windstorm due to leaning power poles and downed electrical lines. It was estimated at the time that the windstorm caused $310,000 in damage.

The 1997 windstorm was one of the most severe windstorms to strike Duarte. It is the only windstorm that resulted in the proclaiming of a local emergency. While high wind incidents are not frequent in the area, significant Santa Ana wind events have been known to negatively impact the local community.

Wind Characteristics in Southern California

California lies within the zone of prevailing westerlies and on the east side of the semi-permanent high-pressure area of the northeast Pacific Ocean. The basic wind flow is from the west or northwest during most of the year. However, in the Los Angeles area the local mountain chains deflect these winds and, therefore, the wind direction is likely to be more a product of local terrain than it is of prevailing circulation.

The Los Angeles Basin is almost completely enclosed by mountains on the north and east. Coupled with this is a characteristic of the air along most of the coastal area of California. The vertical temperature structure (inversion) tends to prevent vertical mixing of the air through more than a shallow layer (1,000 to 2,000 feet deep). The geographical configuration and the southerly location of the Basin permit a fairly regular daily reversal of wind direction—offshore at night and onshore during the day.

Blasts of air blowing in from the northeastern desert, reversing the normal westerly winds, are called Santa Ana Winds. Santa Ana Winds area generally defined as warm, dry winds that blow from the east or northeast. Hence, they are considered “offshore” winds. The name Santa Ana Winds was derived from Santa Ana Canyon, located in Orange County, through which the winds often pass. [1]

Santa Ana winds are most common from late summer to early fall. These winds occur below the passes and canyons of the coastal ranges of the Los Angeles Basin. Although they can cause temperature drops, they usually bring very hot, very dry weather. They are also effective in clearing out the smog in the LA basin and providing beautifully clear skies. [2]

Santa Ana wind is a special type of wind known as a katabatic wind. These winds result from interaction of atmospheric conditions and terrain. First, air pools at high elevations, where it cools. Certain weather conditions can cause this cooled air to spill down from its high elevation position. In the case of the Santa Ana wind, these conditions are usually provided by high pressure in the northern Rocky Mountains. The clockwise air circulation of this high-pressure system forces the winds downwards from the high plateau. Once the air is dislodged, it sinks rapidly, because it is cooler than the surrounding air below, and cooler air has greater density than warmer air. As it sinks the surrounding pressure increases, which compresses this cool, dry air. Under compression, its temperature increases at a rate of 29 degrees per mile. As it warms, it expands or at least, seeks to expand. When the wind is channeled through mountain valleys, the expansion of the wind is limited which forces the winds down through the valleys, often at high and increasing speeds. By the time the winds reach the Los Angeles basin, the temperature and speeds of the Santa Ana winds have increased and their relative humidity has decreased. It is an intensely hot, and powerful wind that can quickly cause damage to building, utilities, and infrastructure. Santa Ana winds are potentially threatening in their ability to fan and spread wildfires.

Forecasters at the National Weather Service usually place speed minimums on these winds and reserve the use of “Santa Ana” for winds greater than 25 knots. These winds can accelerate to speeds of 35 knots as they move through canyons and passes, with gusts up to 50 or even 60 knots.

While the effects of Santa Ana Winds are often overlooked, it should be noted that in 2003, two deaths in Southern California were directly related to the these strong wind conditions. A falling tree struck one woman in San Diego. The second death occurred when a flying pickup truck cover launched by the Santa Ana Winds hit a passenger in a vehicle.

Wind Terminology

Building Envelope:
A building envelope is the building surface through which wind tries to infiltrate during strong winds. Wind seeps in through the weakest elements, e.g. openings, windows and doors. The internal pressure build up is what causes roofs to blow off wood frame buildings. Once the roof is blown, the whole structure disintegrates. Wind is blown in the windward side and out from the leeward side of the building.

Cyclone:
Another name for a hurricane, commonly used in the Western Pacific.

El Nino:
Refers to the abnormal warming of the equatorial eastern Pacific Ocean that changes and disrupts global climate conditions. It is caused by diminishing westward trade winds allowing warmer water to build up in the eastern Pacific. In California, El Nino has caused winter storms with high winds, torrential rain causing millions of dollars in damages.

Gradient Wind Speed:
Wind speeds measured at high altitudes unaffected by local terrain conditions. Hurricane hunters, the planes flown over hurricanes to make measurements of wind speeds and pressures, measure the gradient wind speed. Gradient wind speeds are usually measured over a 10-minute duration. At any given location, wind speed increases with height in what is known as the boundary layer, up till a certain point, beyond which wind speed does not increase. The minimum height for measuring the gradient wind speed is the thickness of that boundary layer, usually in the order of 1 kilometer.

Hurricane:
Hurricanes are large circulating windstorms covering hundreds of miles forming over warm oceans. The hurricane season in the U.S. officially begins around June 1 and ends November 30 every year. Most hurricanes occur in the later summer when the ocean water temperature rises. In the northern hemisphere, that corresponds to August-September, and in the southern hemisphere that means February-March.

Hurricanes in the U.S. are named alphabetically every year. So, Hurricane Andrew was the first in 1992 and the worst natural disaster in U.S. history.

Hurricanes in the northern hemisphere rotate anti-clockwise and vice versa for the southern hemisphere due to earth's rotation. Most hurricanes in the Atlantic Ocean are "born" off the coast of West Africa and travel across the ocean picking up energy as they travel.

Microburst:
A microburst is a type of localized downdraft, often associated with thunderstorms, producing very strong, short-lived wind shears.

Peak Gust:
The highest 2-5 second wind speed. It is approximately 20% larger than the fastest mile wind speed, and about 50% larger than the 1-minute wind speeds. The shorter the duration of measurement, the higher the wind speed due to the gust factor, i.e. the rapid variation of wind speed in time.

Santa Ana Winds:
The Santa Ana is a dry desert wind that blows from out of the northeast, most frequently during late fall and winter. The characteristic low humidity and strong gusts of Santa Ana winds (which can exceed 70 miles per hour at times) usually create very high fire hazards, but can also be instrumental in drying a saturated watershed, thus reducing the flood hazard from later events.

Sustained Wind Speed:
Wind speeds measured over an extended period of time, usually a minute, as opposed to peak gusts measured during very short period of times, e.g., 2-5 seconds.

Tropical Depression:
Storms with sustained wind speeds up to 38 miles per hour. Higher wind speeds would be classified as tropical storms (39-73 mph), or a hurricane if sustained wind speeds exceeded 73 mph.

Tropical Storm:
A storm with sustained wind speeds 40-73 miles per hour. At this stage, the storm is assigned a name. If wind speeds exceeded 73 mph, the storm is upgraded to a hurricane. Storms with lower wind speeds are called tropical depressions. A *storm* or *gale warning* is issued for tropical storms depending on whether sustained wind speeds exceed the 54 mph wind speed or not, respectively.

Windstorm Hazard Assessment

Hazard Identification

A windstorm is generally a short duration event involving winds and/or gust in excess of 50 mph. A windstorm event in Southern California can range from a short-term microburst activity lasting only a few minutes to a long duration Santa Ana wind condition that can last for several days. Windstorms in the City of Duarte, as experienced in past wind hazard events, can cause extensive damage to above-ground utility lines, roads, heavy tree stands, critical facilities, and major infrastructure.

Santa Ana winds are an important wind hazard challenge because of the high fire danger associated with them. Santa Anas can cause a great deal of damage. The fast, hot winds cause vegetation to dry out, increasing the danger of wildfire. Once the fires start, the winds fan the flames and hasten their spread. Santa Ana winds can also cause structural damage to homes and businesses as well as topple power lines and cause tree branches to snap off.

Wind speeds are typically north to east at 35 knots through and below passes and canyons with gusts to 50 knots. Stronger Santa Ana winds can have gusts greater than 60 knots over widespread areas and gusts greater than 100 knots in favored areas. Frequently, the strongest winds in the basin occur during the night and morning hours due to the absence of a sea breeze. The sea breeze, which typically blows onshore daily, can moderate the Santa Ana winds during the late morning and afternoon hours. [3]

Vulnerability and Risk

The most damaging windstorm in Duarte occurred in the winter of 1997. It was not related to Santa Ana wind conditions but rather was a short duration wind event with wind gusts that caused power poles to lean, electrical lines to fall, roof tiles to fly off, and trees branches to break off. The City of Duarte suffered approximately $310,000.00 loss in the windstorms of January 6, 1997, and January 7, 1997. The Duarte City Council proclaimed a local emergency after the 1997 windstorm and emergency support was sought from the California Office of Emergency Services (OES). However, the OES denied the request because it was not demonstrated that “the damages caused by the windstorms were beyond the City’s capability”.

If economic disruptions are factored into the losses of the 1997 windstorm along with electrical outages and transportation disruptions, then the total economic hardship of this windstorm was a half million dollars or better.

Based on the 1997 windstorm, it is not difficult to assume that a future windstorm event could generate similar damage. It is also possible that a strong Santa Ana wind condition could cause significant damage in the City of Duarte based on Duarte’s location near the canyons of the San Gabriel Mountains.

Factors that should be considered in a windstorm risk analysis include: population, frequency of windstorm events, property damage, and information on the types of trees and failure rates most susceptible to windstorm events. A detailed windstorm risk analysis for the City of Duarte would be difficult to conduct at this time based on insufficient data. The 1997 windstorm caused a half million dollars in damage and future windstorms may cause similar impacts in the City. However, one major event provides insufficient data to consider failure rates or frequency of windstorm events. Therefore, there is insufficient data currently to complete a risk analysis.

Community Windstorm Issues

What is Susceptible to Windstorms?

Life and Property

Based on the history of the region, windstorm events can be expected at some future date in the City of Duarte. Previous windstorm events in the City of Duarte have required prompt action by emergency personnel and public works crews to clear blocked roadways and secure damaged power lines. Minor structural damage has occurred to some government buildings and residences, primarily roof tiles blowing off. A future windstorm event could cause higher levels of damage to both residential and commercial structures particularly ones with weak reinforcement. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail causing considerable damage.

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls. When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery.

The Beaufort scale below, coined and developed by Sir Francis Beaufort in 1805, illustrates the effect that varying wind speed can have on structures and sea swells:

BEAUFORT SCALE		
Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air Ripples look like scales; No crests of foam - Smoke drift shows direction of wind, but wind vanes do not
2	4-7	Light Breeze – Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face

BEAUFORT SCALE		
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper; Small branches move
5	19-24	Fresh Breeze - Moderate, long waves; Many whitecaps; Some spray - Small trees with leaves begin to move
6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted; Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide small and medium sized ships; Sea covered with patches of white foam; Edges of wave crests blown into froth; Poor visibility - Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent - Widespread damage. Very rarely experienced on land.
Source: http://www.compuweather.com/decoder-charts.html		

Utilities

Historically, falling trees have been the major cause of power outages in the region. Windstorms such as strong microbursts and Santa Ana wind conditions can cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. As such, overhead power lines can be damaged even in relatively minor windstorm events. Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the region creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

Infrastructure

Windstorms can damage buildings, power lines, and other property and infrastructure due to falling trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

Windstorms can result in collapsed or damaged buildings, blocked roads and bridges, damaged traffic signals, toppled streetlights, and damaged parks.

Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Increased Fire Threat

Perhaps the greatest danger from windstorm activity in Southern California comes from the combination of the Santa Ana winds with the major fires that occur every few years in the urban/wildland interface. With the Santa Ana winds driving the flames, the speed and reach of the flames is even greater than in times of calm wind conditions. The higher fire hazard raised by a Santa Ana wind condition requires that even more care and attention be paid to proper brush clearances on property in the wildland/urban interface areas.

Transportation

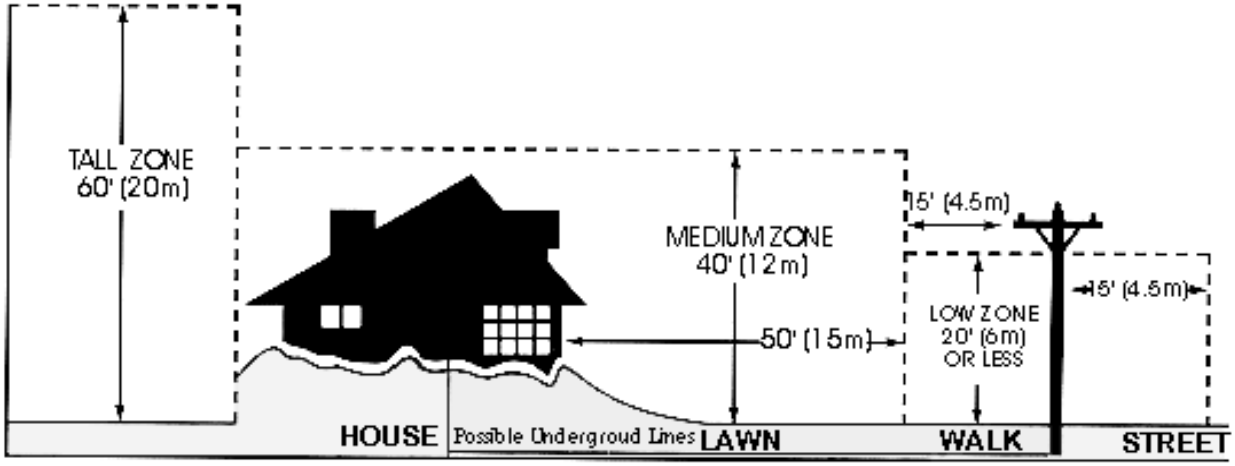
Windstorm activity can have an impact on local transportation in addition to the problems caused by downed trees and electrical wires blocking streets and highways. During periods of extremely strong Santa Ana winds, major highways can be temporarily closed to truck and recreational vehicle traffic. However, typically these disruptions are not long lasting, nor do they carry a severe long-term economic impact on the region.

Windstorm Mitigation Activities

One of the most common problems associated with windstorms is power outage. High winds commonly occur during winter storms, and can cause trees limbs or entire trees to come into contact with nearby distribution power lines. Fallen trees can cause short-circuiting and conductor overloading. Wind-induced damage to the power system causes power outages to customers, incurs cost to make repairs, and in some cases can lead to ignitions that start wildland fires.

One of the strongest and most widespread existing mitigation strategies pertains to tree clearance. Currently, California State Law requires utility companies to maintain specific clearances (depending on the type of voltage running through the line) between electric power lines and all vegetation. Enforcement of the following California Public Resource Code Sections provides guidance on tree pruning regulations: [1]

4293: Power Line Clearance Required
4292: Power Line Hazard Reduction
4291: Reduction of Fire Hazards Around Buildings
4171: Public Nuisances



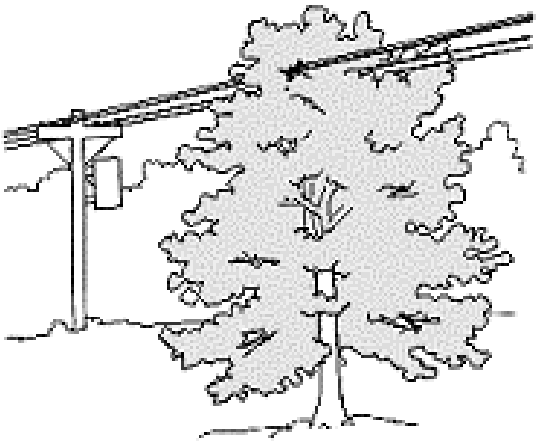
The following pertain to tree pruning regulations and are taken from the California Code of Regulations:

Title 14: Minimum Clearance Provisions
Sections 1250-1258
General Industry Safety Orders
Title 8: Group 3: Articles 12, 13, 36, 37, 38
California Penal Code Section 385

The California Public Utilities Commission section also has additional guidance for tree trimming:

California Public Utilities Commission
General Order 95: Rule 35.

Each year, Southern California Edison trims more than 750,000 trees away from power lines where the trees have the potential to cause service interruptions, start fires and/or damage utility lines and equipment. Trees can break, causing power disruptions during stormy wind conditions. Downed power lines and lines running through trees can carry high voltage. Even touching a tree limb that is touching a power line can cause severe injury or even death.



To further this program, city staff communicates frequently with Southern California Edison regarding trees in the community that are interfering with utility lines. Some of these communications are outcomes of direct observations by city personnel and other communications are results of service requests by citizens of Duarte.

Another program that is currently conducted in the City of Duarte in order to reduce wind damage is the parkway tree inspection program. This program is managed by the

Field Services Department and is involves regular inspections of all parkway trees that are located in the City's right-of-way areas. Tree trimming is scheduled on a regular basis based on street location. Service requests may also be submitted by residents on an as needed basis.

Lastly, the City of Duarte has taken great strides to underground utilities. New developments in the City are required to construct utility lines underground. Utilities must be placed underground for commercial developments as well as new housing tracts. In addition, the City has required that several redevelopment projects incorporate underground utilities.

Windstorm Mitigation Action Items

When a community has an understanding of the risks posed by windstorms, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from windstorms. Specific actions have been considered by the steering committee through the aid of public participation that may reduce or lessen the impacts of wind damage in the City of Duarte.

ST - Short Term
LT – Long Term
WS - Windstorm

ST-WS #1
Identify trees that could be a problem in a windstorm event and implement measures to prevent trees from causing damage to property, public infrastructure and threatening lives.

Ideas for Implementation

1.1 Coordinate with utility companies and other responsible agencies to design and disseminate educational information to property owners to reduce risk from tree failure.
1.2 Develop partnerships between utility providers, city, and county agencies to document known hazard areas.
1.3 Identify on an on-going basis potentially hazardous trees and determine responsible action taker (city, Edison, or property owner).

Coordinating Organization: Field Services Department and Administration.
Timeline: 2 years
Plan Goals Addressed: Prevention, Partnerships and Implementation

ST-WS #2
Expand Debris Management Program for community clean up after windstorm events.

Ideas for Implementation

2.1 Develop and identify debris drop-off sites for residents to bring tree and vegetation debris that can be collected and disposed of by city personnel.

2.2 Seek funding to expand debris management program (e.g. purchase wood chipper).

2.3 Expand coordinated management strategies for clearing roads and public and private property from windstorm debris.

Coordinating Organization: Field Services Department and Administration.
Timeline: 2 years
Plan Goals Addressed: Emergency Services, Protect Life and Property

LT-WS #1
Develop program and seek grant funding to install permanent back-up power units for powering signalized intersections in the event of an electrical failure.

Ideas for Implementation

1.1 Determine if grant monies are available for purchasing back-up power units.

Coordinating Organization: Administration.
Timeline: 3 – 4 years
Plan Goals Addressed: Structural, Protect Life and Property

LT-WS #2
Collect windstorm risk analysis data including failure rates, frequency of events, and locations around the City that have the highest incidence of property damage from wind events.
Ideas for Implementation

2.1 Identify a city department or responsible agency for central collection and reporting of windstorm data including wind speeds, storm durations, and locations of damage.
2.2 Identify types of trees damaged in storms and map locations.
2.3 Prepare a map of locations within the City that are most vulnerable to high winds and wind damage.

Coordinating Organization: Public Safety
Timeline: 6-10 years
Plan Goals Addressed: Prevention, Protect Life and Property

LT-WS #3
Increase public awareness of windstorm mitigation activities in order to protect life and property before, during, and after a windstorm.

Ideas for Implementation:
3.1 Compile mitigation brochures from the following organizations: FEMA; California Public Utilities Commission; County of Los Angeles Public Works and Southern California Edison.

3.2 Distribute these materials to City of Duarte residents and school district members. Materials can be distributed at City Council Meetings, Commission Meetings, City Hall, Parks and Recreation Centers, Fire Departments, Police Departments, Chamber of Commerce Meetings, School Administration Offices and other appropriate venues.

Coordinating Organization: Administration
Timeline: 3-5 years
Plan Goals Addressed: Public Awareness

LT-WS #4
Encourage utility companies and land developers to use underground utility methods where possible to reduce power outages from windstorms.

Ideas for Implementation
4.1 Increase the use of underground utilities where possible.

Coordinating Organization: Community Development Department
Timeline: 6-10 years
Plan Goals Addressed: Structural, Prevention

LT-WS #5
Review the Los Angeles County Uniform Building Code and all other applicable City development codes with the Los Angeles County Building and Safety Department to update wind safety standards and construction codes to reduce windstorm hazards to new buildings and infrastructure.

Ideas for Implementation
5.1 Collect and review historical data and structural damage reports related to windstorms in Duarte.
5.2 Meet with the Los Angeles County Building and Safety Department to review the structural damage reports and determine areas that need improvement.
5.3 Review updated wind safety standards with the Los Angeles County Building and Safety Department and determine if additional measures need to be implemented in Duarte to protect new buildings and infrastructure.

Coordinating Organization: Community Development Department
Timeline: 6-10 years
Plan Goals Addressed: Prevention, Structural

WINDSTORM RESOURCE DIRECTORY

State Resources

California Division of Forestry & Fire Protection
1416 9th Street
PO Box 944246
Sacramento, California 94244-2460
916-653-5123
http://www.fire.ca.gov/php/index.php

Federal Resources

National Oceanic and Atmospheric Administration (NOAA)
14th Street & Constitution Avenue, NW, Room 6013
Washington, DC 20230
http://www.noaa.gov

National Weather Service
Los Angeles/Oxnard Weather Forecast Office
520 North Elevar Street
Oxnard, CA 93030
Forecast and weather infor: 805-988-6610
Administrative issues: 805-988-6615
E-mail: Webmaster.LOS@noaa.gov
http://weather.noaa.gov/

Additional Resources

International Society of Arboriculture
PO Box 3129
Champaign, IL 61826-3129
Phone: 217-355-9411
Fax: 217-355-9516
Web: www.isa-arbor.com
E-mail: isa@isa-arbor.com

Publications:

WINDSTORMS: Protect Your Family and Property from the Hazards of Violent Windstorms
http://emd.wa.gov/5-prep/trng/pubed/Windstrm.pdf

Preparing Your Home for Severe Windstorms is available from
http://www.chubb.com/personal/html/helpful_tips_home_windstorm.html

Windstorm Endnotes

[1] Los Angeles A to Z, Pitt and Pitt, 1997

[2] Trails of the Angeles, John Robinson, 1998

[3] Facts About Los Angeles, 2004

SECTION 10

LANDSLIDES & DEBRIS BASINS

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WHY ARE LANDSLIDES A THREAT TO THE CITY OF DUARTE?

It is not unusual to hear about a landslide in California, especially during the winter months or when earthquakes or storms sweep the state. The Northridge earthquake in 1994 in the San Fernando Valley triggered thousands of landslides in the Santa Susanna Mountains north of the epicenter. California's fault zones are prone to landslides. Tectonic activity creates steep slopes and uplifts naturally weak materials, such as the unconsolidated sediments or marine sandstone and shale-materials that in most areas would be found beneath lowlands. In addition, shearing and faulting have weakened rocks along fault zones. [1]

The San Gabriel Mountains, which may rise several feet with every noticeable earthquake, are constantly shedding their outer layer in mudslides caused by heavy rain. While Los Angeles mountainsides can usually absorb a rainfall of up to 6 inches, larger downpours saturate the soil, triggering landslides. This usually occurs when a winter weather system brings two or more storms in a row.

Rainstorms and wet weather can have a tremendous amount of impact on landslides. Some of the most destructive landslides in this region over the past few decades have occurred during El Nino events. Many studies demonstrate the threshold effect of combined intensity and duration of rainfall for unleashing landslide. Such thresholds vary from place to place because of different conditions of bedrock, soil, slope, and climate". [2] In northern California, thresholds of combined rainfall and duration triggered thousands of landslides during 32-hour rainstorms in the San Francisco Bay area in January 1982.

Landsliding is a natural process on California's hillslopes, and destruction by landsliding has predictably increased as hillsides have been developed. Even though landslides are generally not as spectacular or costly as earthquakes, major floods, hurricanes and some other natural catastrophes, they are more widespread and may cause more property loss than any other geological hazard.

HISTORY OF LANDSLIDE EVENTS AND IMPACTS

Landslides and mudslides constitute a perpetual danger to hillside dwellings in Los Angeles County, especially in wet weather. Slippage results from natural faulting and from rainstorms that soften the layers of soil and rock, turning solid ground to mush. Defoliation caused by wildfires, when followed by rainstorms, compounds the problem. The fires weaken root systems and the residue from the burnt chaparral lubricates the soil, further loosening the soil and encouraging slides.

In Duarte, wildfires have, in fact, been the contributing factor for debris and mudflows that have impacted two residential neighborhoods. The first hazard event occurred in 1952 when large quantities of debris were carried down Vineyard Avenue. The second <u>potential</u> hazard event occurred in 1980 following the Stables Fire. Additional details are provided below.

1952

In September of 1952, a fire burned 500 acres of watershed in the foothills north of Duarte. Of the 500 acres, approximately, 150 acres of vegetation cover was destroyed in the Maddock Canyon Area just north of Vineyard Avenue. Maddock Canyon is one of two small canyons located between Fish Canyon and Spinks Canyon and it extends from the mountains toward Vineyard Avenue. In December of 1952, fours months after the fire, a light rainstorm caused post fire canyon flows in Maddock Canyon. "Large quantities of silt and debris were carried down Vineyard Avenue and deposited at points along the route where velocity was reduced by obstructions or flattening of the street grade". [3] The debris flow caused considerable damage to a new residential subdivision and other residential properties along Vineyard Avenue, Conata Street, and Royal Oaks Drive. Due to the potential for more debris flow and mudslides, the residents of the area sent a petition to the Los Angeles County Board of Supervisors requesting aid. The County responded as follows:

> "It appears that the solution to this problem consists of the construction of a suitable debris basin and a channel to carry the storm water to the Santa Fe Basin. It is my understanding that such a project will be included in the Flood Control Program and that the Chief Engineer of the Flood Control District is concurrently preparing a report on its status."

In July of 1953, the County of Los Angeles committed to the building of a debris basin in Maddock Canyon. This was followed by the adoption of a U.S. Congress Bill that provided a million dollars in funding for the construction of five debris basins along the San Gabriel foothills as well as improvements for Sawpit Wash. (More discussions on the construction of Debris Basins are contained on the next page under <u>Construction of Debris Basins</u>).

1980

In 1980, a wildfire defoliated several steep slopes and exposed a residential subdivision to mudslides. On November, 16, 1980 a "fire storm' that had been fanned by Santa Ana Wind conditions swept down from the foothills and destroyed 35 homes in the City of Duarte and 14 homes in the neighboring City of Bradbury. Reports indicated that the fire had moved from the City of Azusa, east of the San Gabriel River to the Duarte and Bradbury homes in 8 to 10 minutes, due to strong shift in winds.

Immediately after the "Stable Fire", city and county personnel began taking measures to deal with possible floods and mudslides. Mud diversion structures were constructed, 50,000 sandbags were distributed, and parking was restricted on streets with potential slides. Since the Stable Fire occurred during California's rainy season, "Storm Watch" flyers were also issued to residents in Duarte's hillside areas. A Disaster Center was also established at City Hall to monitor weather reports and storm situations and to inform residents. City staff was also prepared to mobilize personnel and equipment if needed to clear mud flows from the public streets and parkways.

As quickly as possible, several temporary debris basins were constructed and existing debris basins were cleared and reinforced with sandbags.

The City also provided free erosion control consultation to residents and, where needed, provided ground-cover plastic sheets to protect embankments.

Sheer drop, located on the Duarte Mesa, covered in plastic sheeting to prevent erosion. In the background, several homes that survived the Stable Fire. (1980)

Major mudslide damage was averted that winter due to the quick actions of the residents and the strategic steps taken by City and County Personnel. In the months that followed the City sponsored the re-seeding of hillside areas both from airdrops and hand spreading.

Construction of Debris Basins

Since the 1930's, debris basins have been used along the base of the San Gabriel Mountains to catch sediments that otherwise could damage land downstream. The huge basins are designed to catch large amounts of sediment. When they become about 25 percent full, the debris basins are cleaned out by city and county personnel. Removing the debris is expensive due to the fact that Southern California is running out of places to put the debris. The sediments have to be taken further away for disposal, increasing the cost. During large storms many of these debris basins have filled up quickly requiring immediate removal. When debris basins are in the right place, they do a good job of protecting developments downstream from debris flows.

In the steep mountainous segment of the San Gabriel watershed, sediment production can be very high, particularly following periods in which wildfire impacts the watershed. It is estimated that the San Gabriel Canyon watershed generates about 1.3 million cubic yards of sediment annually. Cogswell, San Gabriel, and Morris Dams initially intercept much of the sediment produced by the 211 square miles upstream of theses structures.

Since construction of the Cogswell, San Gabriel, and Morris Dams in the 1930's approximately 68 mcy of sediment has deposited in the three dams. Over the years, the Los Angeles Department of Public Works has removed about 36mcy. The remaining 32 mcy of sediment is trapped behind the dams. [4]

Bradbury, Maddock, and Spinks debris basins also intercept additional debris from the southern flank of the mountains downstream of Morris Dam. This debris would normally impact the urbanized areas immediately downstream. Bradbury, Maddock, and Spinks Debris Basins are owned and maintained by the Los Angeles County Department of Public Works. Two additional debris basins were constructed almost thirty years after the construction of Bradbury, Maddock, and Sprinks debris basins. Los Lomas debris basin was constructed in 1983 and Buena Vista debris basin was constructed in 1983.

Debris Basin	Years Built	Elev. Spillway Crest	Width Spillway
Bradbury	1954-55	920	58.0
Buena Vista	1985-86	992	39.0
Las Lomas	1983-84	906	77.0
Maddock	1954-55	901	36.0
Spinks	1958-59	762	40.0

These debris basins have played a major role in controlling sediment and erosion from the San Gabriel Canyon. During heavy rainfall seasons, they have also provided protection for the residential neighborhoods adjacent to the foothills from mud and debris flow. The capacity of each debris basin is noted in the following table.

Debris Basin	Year Built	Capacity ($yd^{3)}$	Debris Stored (yd^3)	Debris Removed (yd^3)
Bradbury	1954	90000	8000	266161
Buena Vista	1985	22000	250	440
Las Lomas	1983	17000	10	605
Maddock	1954	45000	2200	54934
Spinks	1958	56000	1990	66382

MAP

Landslide Characteristics & Terminology

Landslide Characteristics

Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flow and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors:

- erosion by rivers, glaciers, or ocean waves create oversteepened slopes
- rock and soil slopes are weakened through saturation by snowmelt or heavy rains
- earthquakes create stresses that make weak slopes fail
- earthquakes of magnitude 4.0 and greater have been known to trigger landslides
- volcanic eruptions produce loose ash deposits, heavy rain, and debris flows
- excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures.

What is a Landslide?

A landslide is the rapid downward sliding, flowing, or falling of rock and/ or soil under the influence of gravity. Landslides are a natural process, which occurs readily in certain earth materials. The size of a landslide usually depends on the initial cause of the landslide as well as geologic factors. Some of the characteristics that determine the type of landslide are moisture content, the degree of slope, and the nature of the underlying materials.

Failure of a slope occurs when the force that is pulling the slope downward (gravity) exceeds the strength of the earth materials that compose the slope. They can move slowly, (millimeters per year) or can move quickly and disastrously, as is the case with debris-flows. Debris-flows can travel down a hillside of speeds up to 200 miles per hour

(more commonly, 30 – 50 miles per hour), depending on the slope angle, water content, and type of earth and debris in the flow. These flows are initiated by heavy, usually sustained, periods of rainfall, but sometimes can happen as a result of short bursts of concentrated rainfall in susceptible areas. Burned areas charred by wildfires are particularly susceptible to debris flows, given certain soil characteristics and slope conditions. [5]

What is Debris Flow?

A debris or mudflow is a river of rock, earth and other materials, including vegetation that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows often with speeds greater than 20 mile per hour, and can often move much faster. [(6)] This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Landslide Terminology

ACTIVE LANDSLIDE: Most landslides are classified as active or dormant. Active landslides are those which are presently moving or have recently moved, as indicated by the presence of distinct topographic slide features such as sharp barren scarps, cracks, and tipped trees. Major revegetation has not occurred on slides in the active category.

AVALANCHE: An Avalanche is a massive fall of ice and snow.

DEBRIS BASIN: A concrete, bowl-shaped pit built on a mountainside to catch debris from mud and rock slides.

DEBRIS SLIDE: A debris slide is a small, rapid movement of largely unconsolidated material that slides or rolls downward to produce irregular topography.

DORMANT LANDSLIDE: Dormant slides show little evidence of recent movement; slide features have been modified by weathering and erosion and vegetation generally is well established. Although some large-scale landslides may have developed under conditions different from today, the causes of failure may remain and movement could be renewed.

EARTHFLOW: Earth flow occurs when the wet ground breaks up and falls down a mountainside, making a rounded, tongue-like shape; usually occurs on clay, silt, or sand; the slowest, driest flow of weathered material down a hillside.

EROSION: the natural wearing away or weathering of rocks or soil.

LANDSLIDE: A landslide is the downhill movement of rock, debris or soil mass. It is usually the sudden collapse of a large mass of hillside; the falling of masses of earth or rock.

MUDFLOW: Mudflow occurs when a slope is so heavily saturated with water that it rushes downhill as a muddy river, carrying down debris and spreading out at the base of the slope; the fastest, wettest flow of weathered material down a hillside.

QUICKSAND: Quicksand is a mass of loose, wet sand that becomes fluid when suddenly vibrated; heavy objects will sink into it

ROCK FALL: Rock fall occurs when fragments break away from the face of a steep slope and fall.

ROCK SLIDE: A rockslide is similar to a rock fall, except they take place on lower slopes, closer to inhabited areas, and are thus more dangerous.

SINKHOLES: Sinkholes are natural depressions on the land surface that are shaped like a bowl or cone. They are common in regions of karst, where mildly acidic groundwater has dissolved rock such as limestone, dolomite, marble, or gypsum. As the rock dissolves, spaces and caverns develop underground. Sinkholes are dramatic because the land usually stays intact for a while until the underground spaces just get too big. If there is not enough support for the land above the spaces then a sudden collapse of the land surface can occur.

SOIL CREEP: Soil creep is the gradual downhill slide of weathered material. It can also be defined as the slow, gradual movement of a hill's upper layers caused by the pull of gravity on loose stones, gravel, and soft-top soil.

SUBSIDENCE: Subsidence is the vertical fall of earth, usually caused by the loss of underground water or gas support, sometimes resulting from man-made pumping and sometimes from seismic action.

TRANSLATIONAL/SLIDE (ROTATIONAL): The translational/rotational slide is characterized by a somewhat cohesive slide mass and a failure plane that is relatively deep when compared to that of a debris slide of similar extent. The sense of the motion is linear in the case of a translational slide and is rotational in the case of the rotational slide.

Landslide Hazard Assessment

Hazard Identification

Wildfires in hills covered with chaparral are often a precursor to debris flows in burned out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water by creating a waxy-like layer just below the ground surface. Since the water cannot be absorbed into the soil, it rapidly accumulates on slopes, often gathering loose particles of soil in to a sheet of mud and debris. Debris flows can often originate miles away from unsuspecting persons, and approach them at a high rate of speed with little warning.

Post fire canyon flows in Maddock Canyon in 1951 created the biggest landslide hazard event in Duarte's history. Since that time, Duarte has had no major landslide events. This may be due, in part, to Duarte's adoption in 1981 of the Hillside Development Overlay Zone that restricts certain grading practices and excavation procedures in the hillside areas of the city. (see Page 14 for further details on the Hillside Development Overlay Zone).

Heavy rainstorms have caused little damage in Duarte due to the construction of several debris basins. While the city has been fortunate to encounter few debris flow events or slope failure events, the City may be susceptible to earthquake-induced landslides.

The Seismic Hazards Mapping Act, adopted September 21, 1990, requires that the State Geologist identify and map areas that are susceptible to liquefaction, earthquake-induced landslides, and other ground failures. The purpose of the Seismic Hazards Mapping Act is to reduce threats to public health and safety, protect lives, and to minimize property damage from the next earthquake.

The Seismic Hazards Zone maps result from detailed analyses by California Department of Conservation geologist and seismologists. These scientists gather information about surface and underground geology, historic groundwater levels and damage from other earthquakes throughout California. They use the data to make a three-dimensional computer model of the local terrain and analyze the effects of earthquake shaking on the soils below the foundation level of buildings. [7]

Production of the Seismic Hazard Zone maps is funded by the Federal Emergency Management Agency's Hazard Mitigation Program and by the California Department of Conservation in cooperation with the Governor's Office of Emergency Services.

The Official Seismic Hazard Zone Map for the City of Duarte is the Azusa Quadrangle Map that was released on March 25, 1999. The legend for this map shows three Zones of Required Investigation. The zones are as follows:

<u>Liquefaction</u>

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

<u>Earthquake-Induced Landslides</u>

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Overlapping Liquefaction and Earthquake-Induced Landslides

Areas that lie within zones of required investigation for both liquefaction and earthquake-induced landslides.

Vulnerability and Risk

The Azusa Quadrangle Official Map of Seismic Hazard Zones indicates that the foothill areas above the developed city are subject to earthquake-induced landslides. This wilderness area north of the existing urban development constitutes the largest land use area within the city's boundaries totaling 2,251 acres of land. The northernmost portion of this area lies within the Angeles National Forest, which covers 1,913 acres of land. The remaining area is rugged mountainous topography unsuitable for urban development.

Within the urbanized area of the city there are several undeveloped slopes that could be subject to earthquake-induced landslides. The proximity of these slopes to residential developments could, potentially, cause exposure to landslides for residents living in these hillside areas. The areas are as follows:

- North of Brookridge Road near Mountain Crest Road
- North of Greenbank Road
- West of Las Lomas Road, north of Willowglen Drive
- North of Crestview Court
- Northwest of Westvale Road
- Northeast of High Mesa Drive
- East of Tall Pine Drive
- Northwest of Spinks Canyon Road

The above list is only a general indicator of locations of Seismic Hazard Zones that are subject to landslides. Specific locations should be determined by reviewing the Official Map that has been produced by the California Department of Conservation.

Economic Losses Caused by Landslides

Landslide costs include both direct and indirect losses affecting private and public properties. Direct costs can be defined as the costs of replacement, rebuilding, repair, or maintenance resulting from direct landslide-caused damage or destruction to property or installations (Schuster and Fleming, 1986; Schuster, 1996). All other costs of landslides are indirect; examples are:

- Reduced real estate values in areas threatened by landslides.
- Loss of tax revenues on properties devalued as a result of landslides.
- Loss of productivity from damaged to facilities or interruption of transportation systems.
- Loss of human productivity because of death, injury, or psychological trauma.
- Costs of measures to prevent or mitigate potential landslide activity.

MAP

Landslide losses can also be divided into costs to private and public entities (Fleming and Taylor, 1980). Private costs are incurred mainly as damage to land and structures, either private property or corporate industrial facilities. A destructive landslide can result in financial ruin for property owners because landslide insurance or other means to offset damage costs usually are unavailable. Public costs are those costs borne by government agencies, national, regional, or local. The largest direct public costs resulting from landslides most often have been for repairing or relocating highways/roads and accessory structures, such as sidewalks and storm drains. Indirect public costs include losses of tax revenues and reduction public utilities. [8]

Vulnerability Assessment is the second step of the landslide-hazard assessment. A vulnerability assessment should indicate an inventory of property that will be impacted by a landslide. It is by understanding the population and property exposed to natural hazards that we can reduce risk and prevent lost from future events.

In the event of a landslide, the neighborhoods identified in the Hazard Identification section of this report could be impacted. The level and extent of damage is difficult to determine based on the Azusa Quadrangle Seismic Hazard Zones map that was produced by the California Department of Conservation. Therefore, for the purposes of this report, city staff has identified the residential properties and public facilities that are closest to each potential slide area and from this information has extrapolated direct cost affecting private property.

The total number of residential units that were identified for this risk assessment was 26. All of these residential units are single-family homes on individual lots. Five of the parcels are currently developed with swimming pools.

One public park was also factored into the risk assessment based on its close proximity to one of the designated hazard zones. However, it is questionable as to whether a landslide would affect the park. The identified park is Glen Miller Park located at 205 Melcanyon Road.

Land Use	Number of Units	Improvement Value	Replacement Estimate
Residential Homes	26	$4,085,249	$6,500,000
Public Park	1	$ 93,230	$ 197,500

COMMUNITY LANDSLIDE ISSUES

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produces conditions conducive to landslides and human activity further exacerbate many landslide problems. Seismic tremors and earthquakes can trigger landslides. Earthquakes can even trigger lateral spreading and debris flows on gentle slopes above streams and riverbanks.

Many landslides are difficult to mitigate, particularly in areas with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Even with proper planning, landslides will continue to threaten the safety of people, property, and infrastructure, but without proper planning, landslide hazards will be even more common and more destructive.

The increasing scarcity of build-able land, particularly in urban areas, increases the tendency to build on geologically marginal land. Additionally, hillside housing developments in Southern California are prized for the view lots that they provide.

What is Susceptible to Landslides?

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.

Road and Transportation Modes

Several roads were impacted during the 1952 debris flows including Vineyard Avenue, Conata Street and Royal Oaks Drive. Road usage was also impacted on Duarte Mesa after the Stables Fire as road crews prohibited parking in order to monitored debris flows and to provide sandbagging and other landslide mitigation techniques. The Field Services Division is responsible for responding to road impairments and for clearing debris from city streets.

Alternative modes of transportation in Duarte include a railroad and several bus providers. The AT&SF Railroad traverses the city in an east to west direction just north of Duarte Road. At the present time, the line is not available for commuters. In the near future, the Metro Gold Line, a light rail line currently planned from Los Angeles to Montclair, may provide a commuter service. The city operates its own bus system within the incorporated limits of the city. The transit system travels on most arterial and collector roads and passengers can make direct connections with the regional public transit system. In addition, Duarte is served by Foothill Transit, which connects the city with the surrounding region

As daily transit rises, there is an increased risk that a natural hazard event such as a landslide could disrupt the commuting for thousands of Duarte residents and businesspersons. For example, a severe storm that caused mudslides or debris flows could disrupt automobile traffic and the local transit systems.

There is less concern that an earthquake-induced landslide could disrupt public transportation. This is due to the fact that most of the public transportation routes are located near the center of town rather than up against the foothills were an earthquake-inducted landslide is more likely.

Lifelines and Critical Facilities

Lifelines and critical facilities should remain accessible, if possible, during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is critical for hospitals and other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines that are located in vulnerable soils.

LANDSLIDE MITIGATION ACTIVITIES

While natural processes such as rain and earthquakes can trigger landslides, human impacts can substantially affect the potential for landslide failures. Slope excavation, for the purpose of developing a hillside with a new housing tract, can result in slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, proper planning and grading can reduce the risk of landslides.

In 1981, the City of Duarte adopted a **Hillside Overlay District** to provide regulations for the development of the hillside areas in the city. The intent of the Hillside Overlay District was to “regulate use, development, and alteration of land in hillside areas so that essential natural characteristics such as land form, vegetation, and wildlife communities, scenic qualities, and open space were protected and maintained”. One of the main development policies of the “hillside ordinance” is the conservation of natural topographic features and appearances by means of land sculpturing so as to blend any manufactured slopes or benches into the natural topography. The hillside ordinance also requires that the development of homes in the hillside areas provide maximum safety with respect to fire hazards, exposure to geological and geotechnical hazards, drainage, and erosion.

The development standards of the Hillside Overlay District establish a maximum land coverage formula for each parcel based on the average slope. For example if the average slope is 25 percent, then the maximum land coverage is 30 percent. There are also very specific grading standards in the hillside ordinance that regulate the height of fill and cut slopes as well as the construction of drainage benches paved in concrete. Houses must be designed to fit the natural landform in a manner that does not require extensive grading, through split-level house designs and other similar techniques.

To further reduce the risk of landslides, the hillside ordinance establishes regulations for erosion control planting of all cut and fill slopes. The slopes shall be planted with adequate plant materials so as to protect the slope from erosion and the plants must be selected from an approved list.

Landslide Mitigation Action Items

When a community has an understanding of the risks posed by landslides, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from a landslide. Specific actions have been considered by the steering committee through the aid of public participation that may reduce or lessen the impacts of landslide damage in the City of Duarte.

ST – Short Term
LT – Long Term
LS – Landslide

ST-LS #1
Increase public awareness of Earthquake-Induced Landslide Hazard Areas as delineated on State of California Seismic Hazard Zones Official Map.

Ideas for Implementation

1.1 Consider amending the Duarte Hillside Development Overlay Zone to reference the Landslide Hazard Areas as delineated on the Official State Map.

1.2 Make the map available at neighborhood meetings and provide public information as needed.

Coordinating Organization: Planning Department
Timeline: 2 years
Plan Goals Addressed: Public Awareness

ST-LS #2
Identify safe evacuation routes in high-risk debris flow and landslide areas.

Ideas for Implementation

2.1 Determine emergency evacuation routes.
2.2 Identify potential debris removal resources.

Coordinating Organization: Field Services Department
Timeline: 2 years
Plan Goals Addressed: Emergency Services

LT-LS #1
Review existing soil stability construction practices and determine if additional measures are needed.

Ideas For Implementation

1.1 Review Hillside Overlay Zone development standards to determine if additional grading or soil compaction measures are needed to safeguard new construction and new buildings.

1.2 Review erosion-control requirements pertaining to vegetation on slopes and placement of jute netting and other erosion control measures.

Coordinating Organization: Community Development Department
Timeline: 3-5 years
Plan Goals Addressed: Property Protection, Prevention

LT-LS #2
Continue public education program on sandbag techniques and expand to include other landslide protection measures.

Ideas for Implementation

3.1 Continue public education program on placement and filling of sandbags.

3.2 Expand education program to include other landslide protection measures such as grading and erosion control planting.

3.3 Explore funding or grant programs for purchasing automatic sand bagging machine.

Coordinating Organization: Field Services Department
Timeline: 3-5 years
Plan Goals Addressed: Public Education and Awareness

Landslide Resource Directory

County Resources

Los Angeles County Public Works Department
900 S. Fremont Ave.
Alhambra, CA 91803
Ph: 626-458-5100
www.lapwd.org

State Resources

California Department of Transportation (CalTrans)
120 S. Spring Street
Los Angeles, CA 90012
Ph. (213) 897-3656
www.dot.ca.gov

California Department of Water Resources (DWR)
1416 9th Street
Sacramento, CA 95814
Ph: 916-653-6192
http://www.dwr.water.ca.gov

California Department of Conservation: Southern California Regional Office
655 S. Hope Street, #700
Los Angeles, CA 90017-2321
Ph: 213-239-0878
Fx: 213-239-0984
www.consrv.ca.gov

California Division of Forestry
210 W. San Jacinto
Perris, CA 92570
Ph: (909) 940-6900
Http://www.fire.ca.gov

California Division of Mines and Geology
801 K Street
Sacramento, CA 95814
Ph: (916) 445-1825
http://www.consrv.ca.gov

California Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814

Ph: 916-653-5656
Http://resources.ca.gov

Governor's Office of Emergency Services (OES)
P.O. Box 419047
Rancho Cordova, CA 95741-9047
Ph: 916 845- 8911
Fx: 916 845- 8910

FEDERAL RESOURCES AND PROGRAMS

Federal Emergency Management Agency, Region IX
1111 Broadway, Suite 1200
Oakland, CA 94607
Ph: 510-627-7100
Fx: 510-627-7112

Federal Emergency Management Agency, Mitigation Division
500 C Street, S.W.
Washington, D.C. 20472
Ph: 202-566-1600

National Landslide Hazards Program, USGS
12201 Sunrise Valley Drive
Reston, VA 20192
(703) 648-4000
(800) 654-4966
http://landslides.usg.gov

National Resource Conservation Service (NRCS)
256 Warner Milne Road
Oregon City, OR 97232
(503) 655-3144
www.nrcs.usda.gov

PUBLICATIONS

Olshansky, Robert B., Planning for Hillside Development (1996) American Planning Association.
This document describes the history, purpose, and functions of hillside development and regulation and the role of planning, and provides excerpts from hillside plans, ordinances, and guidelines from communities throughout the US.

Olshansky, Robert B. & Rogers, J. David, Unstable Ground: Landslide Policy in the United States (1987) Ecology Law Quarterly.

This is about the history and policy of landslide mitigation in the US.

Public Assistance Debris Management Guide (July 2000) Federal Emergency Management Agency.

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and city emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The Guide is available in hard copy or on the FEMA website.

USGS Landslide Program Brochure. National Landslide Information Center (NLIC), United States Geologic Survey.

The brochure provides good, general information in simple terminology on the importance of landslide studies and a list of databases, outreach, and exhibits maintained by the NLLC. The brochure also includes information on the types and causes of landslides, rock falls, and earth flows.

City of Duarte, Hillside Development Overlay District Zoning Code, 1982. This zoning ordinance provides guidelines to land developers and homeowners on the development of land in the Hillside Development Overlay zone. Guidelines include grading issues, erosion control, slope stability, and home design to fit the landform.

Landslide Endnotes

1. Landslides, Josie Zelaya, CSU Hayward, http://isis.scuhayward.edu

2. Landslide and Debris Flows, Peter Schweitzer and Randy Schumann, http:// geochange.er.usgs.gov/sw/changes.

3. Watershed Characteristics, Santa Fe Dam Report, US Army Corp of Engineers http://spl.usace.army.mil

4. Watershed Management, LA County Department of Public Works, http://ladpw.org.services.water

5. Interagency Hazard Mitigation Team, State Hazard Mitigation Plan (2000) Oregon Emergency Management.

6. California Division of Mines and Geology Note 13, Alan Barrows and Ted Smith. http://www.consrv.ca.gov/cgs/information/publications.cgs.notes/note_33/

7. Seismic Hazards in California, California Geological Survey, California Department of Conservation, Seismic Hazard Mapping Program.

8. Damaging Landslides Caused by El Nino Rainstorms, Jonathon Godt, 1997 USGS.

SECTION 11

MULTI-HAZARD GOALS AND ACTION ITEMS

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Identify & pursue grant programs and funding opportunities **11-1**

ST-MH#2
Establish a formal role for the City of Duarte Natural Hazard Mitigation Steering Committee **11-1**

ST-MH#3
Integrate the goals and action items from The Natural Hazard Mitigation Plan **11-2**

LT-MH#1
Explore developing emergency access road/ Evacuation route for Duarte Mesa area **11-2**

LT-MH#2
Develop, enhance & implement education programs **11-3**

MULTI-HAZARD GOALS AND ACTION ITEMS

Multi-Hazard Action Items are those activities that pertain to all five hazards in the mitigation plan: Earthquake, Wildfire, Flood, Windstorm, and Landslide.

When a community has an understanding of the risks posed by natural hazards, it is essential that local decision makers, residents, and business leaders seek measures to reduce or minimize the loss of life and property damage resulting from natural hazard events. Specific actions have been considered by the steering committee through the aid of public participation that may reduce or lessen the impacts of natural hazard damage in the City of Duarte.

ST = Short Term
LT = Long Term
MH= Multi-Hazard

ST-MH #1: Identify and pursue grant programs and funding opportunities from County, State, and Federal sources to implement mitigation goals and activities.

Ideas for Implementation:

- Contact the State Hazard Mitigation Officer at the California Office of Emergency Services to obtain information on hazard mitigation funding.
- Contact the Federal Emergency Management Agency to explore grant programs to implement mitigation goals.
- Identify other organizations and agencies that may support mitigation activities.

Coordinating Organization: Natural Hazard Mitigation Steering Committee
Timeline: On-going
Plan Goals Addressed: Partnerships and Implementation

ST-MH 2: Establish a formal role for the City of Duarte Natural Hazard Mitigation Steering Committee to develop a sustainable process for implementing, monitoring, and evaluating citywide mitigation activities.

Ideas for Implementation:

- Establish clear roles for implementing the mitigation plan.
- Provide training for Committee members to remain current on developing issues in the natural hazard loss reduction field.
- Develop updates for the mitigation plan based on new information.
- Establish criteria for conducting 5-year review of mitigation plan.

Coordinating Organization: Natural Hazard Mitigation Steering Committee
Timeline: On-going
Plan Goals Addressed: Partnerships and Implementation

ST-MH #3: Integrate the goals and action items from the City of Duarte Natural Hazard Mitigation Plan into existing documents and programs where appropriate:

Ideas for Implementation

- Consider incorporating mitigation goals and action items into Public Safety Element of the Duarte General Plan when the General Plan is updated in the future.
- Partner with Los Angeles County Building Department and other government agencies to promote seismic safety codes.

Coordinating Organization: Natural Hazard Mitigation Steering Committee
Timeline: On-going
Plan Goals Addressed: Partnerships and Implementation

LT-MH #1: Explore the possibilities of developing emergency access road/evacuation route for the Duarte Mesa area in the north section of town.

Ideas for Implementation

- Consider alternatives to address singular road access/evacuation for the Duarte Mesa.
- Meet with the City of Bradbury to discuss the possibility of constructing a new road that would lead out of the Duarte Mesa area into Bradbury.
- Review funding sources that might be available for the construction of an emergency access/evacuation road for the Duarte Mesa.

Coordinating Organization: Natural Hazard Mitigation Steering Committee
Timeline: 3-5 years
Plan Goals Addressed: Partnerships and Implementation, Structural

LT-MH #2: Develop, enhance, and implement education programs aimed at mitigating natural hazards, reducing risk to citizens, public agencies, private property owners, businesses, and schools.

Ideas for Implementation

- Conduct natural hazard awareness workshop at the community center to provide information specific to the City of Duarte including site-specific hazards information, building codes information, sandbagging techniques and educational information on damage prevention.
- Work with Duarte School District on educational natural hazard awareness programs.
- Place public information brochures related to mitigating natural hazards at the Senior Citizen Center, Teen Center, Library, and City Hall.

Coordinating Organization: Natural Hazard Mitigation Steering Committee
Timeline: On-going
Plan Goals Addressed: Partnerships and Implementation, Public Awareness

SECTION 12

PLAN MAINTENANCE

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- Implementation Through Existing Programs 12-3

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PLAN MAINTENANCE

> *Implementation is the culmination of the initial planning process. Monitoring progress and maintaining momentum is the key to ensuring success of the planning process.*
> *FEMA How-to-Guide, Bringing the Plan to Life*

The City of Duarte can bring this Natural Hazard Mitigation Plan to life by implementing specific mitigation projects and by implementing on-going programs. To ensure the success of these projects and programs, it is critical that the plan remains relevant. Thus it is important to conduct periodic evaluations and make revisions as needed.

The plan maintenance section of this document details the formal process that will ensure that the City of Duarte Natural Hazard Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the city will integrate public participation throughout the plan maintenance process. Finally, this section includes an explanation of how the City of Duarte intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the Duarte General Plan, the Hillside Overlay District Zone, and the Capital Improvement Plan.

Plan Adoption

The Duarte Planning Commission will review the document at a regularly scheduled public meeting, will seek public input, and will make recommendations to the Duarte City Council.

The Duarte City Council will be responsible for adopting the City of Duarte Natural Hazard Mitigation Plan. The Duarte City Council, as the governing body, has the authority to promote sound public policy regarding natural hazards.

Monitoring and Implementing the Plan

Coordinating Body

The City of Duarte Natural Hazard Mitigation Steering Committee will be responsible for coordinating implementation of the Plan action items and for undertaking the formal review process. The City of Duarte has formed a Natural Hazard Mitigation Steering Committee that consists of city department staff members, local agencies, organizations, and citizens. In the event there is a vacancy on the Committee, the relevant agency or organization will be asked to provide a replacement representative. The City of Duarte Natural Hazard Mitigation Steering Committee is as follows:

CITY STAFF:

Public Safety Department
Director of Safety Coordination

Code Enforcement Division
Code Enforcement Manager

Crime Prevention Division
Crime Prevention Specialist

Community Development Department
Planning Division
Associate Planner
Planning Intern

Public Works Division
Engineering Division Director
Public Works Technician

Field Services Division
Field Services Supervisor
Field Services Division Manager

Finance and Personnel Department
Deputy Finance Director

ORGANIZATIONS AND AGENCIES:

Duarte Historical Society
Duarte Mesa Association
City of Hope Medical Center
Duarte Library
Neighborhood Watch
Southern California Edison
Duarte Chamber of Commerce

Convener

The Duarte City Council will adopt the Duarte Natural Hazard Mitigation Plan, and the City of Duarte Natural Hazard Mitigation Steering Committee will be responsible for the implementation of the Plan. The City Manager will serve as the **Convener** to facilitate the Natural Hazard Mitigation Steering Committee meetings and will assign task to ensure implementation of the Plan. The Convener will also be responsible for assigning public appearances and speaking presentations to community groups and organizations.

Implementation Through Existing Programs

The City of Duarte addresses state mandated planning goals and legislative requirements through its General Plan, Zoning Codes, Capital Improvement Plans and Los Angeles County Uniform Building Code. The City of Duarte Natural Hazard Mitigation Plan provides a series of recommendations that are closely related to the goals and objectives of these existing planning programs. The City of Duarte will have the opportunity to implement many of the recommended mitigation action items through existing programs and department procedures.

Evaluating and Updating the Plan

The City of Duarte Natural Hazard Mitigation Plan will be evaluated on an annual basis to determine the effectiveness of mitigation actions and programs. The convener will be responsible for contacting the Natural Hazard Mitigation Steering Committee members and organizing the annual meeting.

The delineated timelines for each Mitigation Action Item will be reviewed at the annual meeting and projects will be assigned to meet the established goals. The Committee will also review the goals and action items to determine their relevance to changing situations in the city as well as changes in State or Federal policy and to ensure they are addressing current and expected conditions.

The Committee will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. In light of the studies currently being completed by the California Department of Conservation related to the Sierra Madre fault and the Duarte fault, it is anticipated that the Risk Assessment will be updated in *Section 6 Earthquake* in the very near future. It is also anticipated that the Risk Assessment in *Section 8 Flood* will be updated upon receiving information from the National Flood Insurance Program or upon completion of a Flood Study by NFIP as is scheduled.

The convener will assign the duty of updating the plan as is appropriate. When the plan has been updated it will formally be presented to the Natural Hazard Mitigation Steering Committee and the Duarte City Council. Every five years the updated plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review.

Public Participation

The City of Duarte is committed to ensuring full public participation in the continual review and updates of the Natural Hazard Mitigation Plan. Copies of the Plan will be available at the City Clerk's Office, the Community Development Department and the Public Safety Offices. All updated and revised copies of the Natural Hazard Mitigation Plan will also be kept on file at the previously listed locations. Each plan that is available for public review will contain the address and phone number of the city Planning Division, responsible for keeping track of public comments on the Plan. In addition, the city website will be utilized to inform residents as to the time and date of the annual evaluation meetings on the Plan. The city website will also contain an email address and phone number to which people can direct their comments and concerns.

The 5-year review of the Plan by the Duarte City Council will be an agenda item at a regularly scheduled City Council meeting. Public input and comments will be received at that time.

APPENDIX

Appendix A – Master Resource Directory

Appendix B – Acronyms

Appendix C – Southern California Edison, Summary of Mitigation Measures

Appendix D – City of Hope National Medical Center Buildings Profile

Appendix E – Cost-Benefit Analysis

Appendix A - Resources

Master Resource Directory

The Resource Directory provides contact information for local, regional, state, and federal programs that are currently involved in hazard mitigation activities. The City of Duarte Natural Hazard Mitigation Steering Committee may look to the organizations on the following pages for resources and technical assistance. The Resource Directory provides a foundation for potential partners in action item implementation.

The Hazard Mitigation Advisory Committee will continue to add contact information for organizations currently engaged in hazard mitigation activities. This section may also be used by various community members interested in hazard mitigation information and projects.

American Public Works Association			
Level: National	Hazard: Multi	http://www.apwa.net	
2345 Grand Boulevard		Suite 500	
Kansas City, MO 64108-2641		Ph: 816-472-6100	Fx: 816-472-1610
Notes: The American Public Works Association is an international educational and professional association of public agencies, private sector companies, and individuals dedicated to providing high quality public works goods and services.			
Association of State Floodplain Managers			
Level: Federal	Hazard: Flood	www.floods.org	
2809 Fish Hatchery Road			
Madison, WI 53713		Ph: 608-274-0123	Fx:
Notes: The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery			
Building Seismic Safety Council (BSSC)			
Level: National	Hazard: Earthquake	www.bssconline.org	
1090 Vermont Ave., NW		Suite 700	
Washington, DC 20005		Ph: 202-289-7800	Fx: 202-289-1092
Notes: The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.			

Appendix A - Resources

California Department of Transportation (CalTrans)			
Level: State	Hazard: Multi	http://www.dot.ca.gov/	
120 S. Spring Street			
Los Angeles, CA 90012		Ph: 213-897-3656	Fx:
Notes: CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. Alone and in partnership with Amtrak, Caltrans is also involved in the support of intercity passenger rail service in California.			
California Resources Agency			
Level: State	Hazard: Multi	http://resources.ca.gov/	
1416 Ninth Street		Suite 1311	
Sacramento, CA 95814		Ph: 916-653-5656	Fx:
Notes: The California Resources Agency restores, protects and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration and respect for all the communities and interests involved.			
California Division of Forestry (CDF)			
Level: State	Hazard: Multi	http://www.fire.ca.gov/php/index.php	
210 W. San Jacinto			
Perris CA 92570		Ph: 909-940-6900	Fx:
Notes: The California Department of Forestry and Fire Protection protects over 31 million acres of California's privately-owned wildlands. CDF emphasizes the management and protection of California's natural resources.			
California Division of Mines and Geology (DMG)			
Level: State	Hazard: Multi	www.consrv.ca.gov/cgs/index.htm	
801 K Street		MS 12-30	
Sacramento, CA 95814		Ph: 916-445-1825	Fx: 916-445-5718
Notes: The California Geological Survey develops and disseminates technical information and advice on California’s geology, geologic hazards, and mineral resources.			

Appendix A - Resources

California Environmental Resources Evaluation System (CERES)			
Level: State	Hazard: Multi	http://ceres.ca.gov/	
900 N St.		Suite 250	
Sacramento, Ca. 95814		Ph: 916-653-2238	Fx:
Notes: CERES is an excellent website for access to environmental information and websites.			

California Department of Water Resources (DWR)			
Level: State	Hazard: Flood	http://wwwdwr.water.ca.gov	
1416 9th Street			
Sacramento, CA 95814		Ph: 916-653-6192	Fx:
Notes: The Department of Water Resources manages the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.			

California Department of Conservation: Southern California Regional Office			
Level: State	Hazard: Multi	www.consrv.ca.gov	
655 S. Hope Street		#700	
Los Angeles, CA 90017-2321		Ph: 213-239-0878	Fx: 213-239-0984
Notes: The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources.			

California Planing Information Network			
Level: State	Hazard: Multi	www.calpin.ca.gov	
		Ph:	Fx:
Notes: The Governor's Office of Planning and Research (OPR) publishes basic information on local planning agencies, known as the California Planners' Book of Lists. This local planning information is available on-line with new search capabilities and up-to-the- minute updates.			

Appendix A - Resources

EPA, Region 9			
Level: Regional	Hazard: Multi	http://www.epa.gov/region09	
75 Hawthorne Street			
San Francisco, CA 94105		Ph: 415-947-8000	Fx: 415-947-3553
Notes: The mission of the U.S. Environmental Protection Agency is to protect human health and to safeguard the natural environment through the themes of air and global climate change, water, land, communities and ecosystems, and compliance and environmental stewardship.			
Federal Emergency Management Agency, Region IX			
Level: Federal	Hazard: Multi	www.fema.gov	
1111 Broadway		Suite 1200	
Oakland, CA 94607		Ph: 510-627-7100	Fx: 510-627-7112
Notes: The Federal Emergency Management Agency is tasked with responding to, planning for, recovering from and mitigating against disasters.			
Federal Emergency Management Agency, Mitigation Division			
Level: Federal	Hazard: Multi	www.fema.gov/fima/planhowto.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			
Floodplain Management Association			
Level: Federal	Hazard: Flood	www.floodplain.org	
P.O. Box 50891			
Sparks, NV 89435-0891		Ph: 775-626-6389	Fx: 775-626-6389
Notes: The Floodplain Management Association is a nonprofit educational association. It was established in 1990 to promote the reduction of flood losses and to encourage the protection and enhancement of natural floodplain values. Members include representatives of federal, state and local government agencies as well as private firms.			

Appendix A - Resources

Governor's Office of Emergency Services (OES)			
Level: State	Hazard: Multi	www.oes.ca.gov	
P.O. Box 419047			
Rancho Cordova, CA 95741-9047		Ph: 916 845- 8911	Fx: 916 845- 8910
Notes: The Governor's Office of Emergency Services coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.			

Landslide Hazards Program, USGS			
Level: Federal	Hazard: Landslide	http://landslides.usgs.gov/index.html	
12201 Sunrise Valley Drive		MS 906	
Reston, VA 20192		Ph: 703-648- 4000	Fx:
Notes: The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.			

Los Angeles County Economic Development Corporation			
Level: Regional	Hazard: Multi	www.laedc.org	
444 S. Flower Street		34th Floor	
Los Angeles, CA 90071		Ph: 213-236-4813	Fx: 213- 623-0281
Notes: The LAEDC is a private, non-profit 501 (c) 3 organization established in 1981 with the mission to attract, retain and grow businesses and jobs in the Los Angeles region. The LAEDC is widely relied upon for its Southern California Economic Forecasts and Industry Trend Reports. Lead by the renowned Jack Kyser (Sr. Vice President, Chief Economist) his team of researchers produces numerous publications to help business, media and government navigate the LA region's diverse economy.			

Appendix A - Resources

Los Angeles County Public Works Department			
Level: County	Hazard: Multi	http://ladpw.org	
900 S. Fremont Ave.			
Alhambra, CA 91803		Ph: 626-458-5100	Fx:
Notes: The Los Angeles County Department of Public Works protects property and promotes public safety through Flood Control, Water Conservation, Road Maintenance, Bridges, Buses and Bicycle Trails, Building and Safety, Land Development, Waterworks, Sewers, Engineering, Capital Projects and Airports			

National Wildland/Urban Interface Fire Program			
Level: Federal	Hazard: Wildfire	www.firewise.org/	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617 770-0700
Notes: Firewise maintains a Website designed for people who live in wildfire- prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.			

National Resources Conservation Service			
Level: Federal	Hazard: Multi	http://www.nrcs.usda.gov/	
14th and Independence Ave., SW		Room 5105-A	
Washington, DC 20250		Ph: 202-720-7246	Fx: 202-720-7690
Notes: NRCS assists owners of America's private land with conserving their soil, water, and other natural resources, by delivering technical assistance based on sound science and suited to a customer's specific needs. Cost shares and financial incentives are available in some cases.			

National Interagency Fire Center (NIFC)			
Level: Federal	Hazard: Wildfire	www.nifc.gov	
3833 S. Development Ave.			
Boise, Idaho 83705-5354		Ph: 208-387- 5512	Fx:
Notes: The NIFC in Boise, Idaho is the nation’s support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations.			

Appendix A - Resources

National Fire Protection Association (NFPA)			
Level: National	Hazard: Wildfire	http://www.nfpa.org/catalog/home/index.asp	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617-770-0700
Notes: The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training and education			
National Floodplain Insurance Program (NFIP)			
Level: Federal	Hazard: Flood	www.fema.gov/nfip/	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			
National Oceanic /Atmospheric Administration			
Level: Federal	Hazard: Multi	www.noaa.gov	
14th Street & Constitution Ave NW		Rm 6013	
Washington, DC 20230		Ph: 202-482-6090	Fx: 202-482-3154
Notes: NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.			
National Weather Service, Office of Hydrologic Development			
Level: Federal	Hazard: Flood	http://www.nws.noaa.gov/	
1325 East West Highway		SSMC2	
Silver Spring, MD 20910		Ph: 301-713-1658	Fx: 301-713-0963
Notes: The Office of Hydrologic Development (OHD) enhances National Weather Service products by: infusing new hydrologic science, developing hydrologic techniques for operational use, managing hydrologic development by NWS field office, providing advanced hydrologic products to meet needs identified by NWS customers			

Appendix A - Resources

National Weather Service			
Level: Federal	Hazard: Multi	http://www.nws.noaa.gov/	
520 North Elevar Street			
Oxnard, CA 93030		Ph: 805-988- 6615	Fx:
Notes: The National Weather Service is responsible for providing weather service to the nation. It is charged with the responsibility of observing and reporting the weather and with issuing forecasts and warnings of weather and floods in the interest of national safety and economy. Briefly, the priorities for service to the nation are: 1. protection of life, 2. protection of property, and 3. promotion of the nation's welfare and economy.			

San Gabriel Valley Economic Partnership			
Level: Regional	Hazard: Multi	www.valleynet.org	
4900 Rivergrade Road		Suite A310	
Irwindale, CA 91706		Ph: 626-856-3400	Fx: 626-856-5115
Notes: The San Gabriel Valley Economic Partnership is a non-profit corporation representing both public and private sectors. The Partnership is the exclusive source for San Gabriel Valley-specific information, expertise, consulting, products, services, and events. It is the single organization in the Valley with the mission to sustain and build the regional economy for the mutual benefit of all thirty cities, chambers of commerce, academic institutions, businesses and residents.			

Sanitation Districts of Los Angeles County			
Level: County	Hazard: Flood	http://www.lacsd.ora/	
1955 Workman Mill Road			
Whittier, CA 90607		Ph:562-699-7411 x2301	Fx:
Notes: The Sanitation Districts provide wastewater and solid waste management for over half the population of Los Angeles County and turn waste products into resources such as reclaimed water, energy, and recyclable materials.			

South Coast Air Quality Management District (AQMD)			
Level: Regional	Hazard: Multi	www.aqmd.gov	
21865 E. Copley Drive			
Diamond Bar, CA 91765		Ph: 800-CUT-SMOG	Fx:
Notes: AQMD is a regional government agency that seeks to achieve and maintain healthful air quality through a comprehensive program of research, regulations, enforcement, and communication. The AQMD covers Los Angeles and Orange Counties and parts of Riverside and San Bernardino Counties.			

Appendix A - Resources

Southern California Earthquake Center (SCEC)			
Level: Regional	Hazard: Earthquake	www.scec.org	
3651 Trousdale Parkway		Suite 169	
Los Angeles, CA 90089-0742		Ph: 213-740-5843	Fx: 213/740-0011
Notes: The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.			

Southern California Association of Governments (SCAG)			
Level: Regional	Hazard: Multi	www.scag.ca.gov	
818 W. Seventh Street		12th Floor	
Los Angeles, CA 90017		Ph: 213-236-1800	Fx: 213-236-1825
Notes: The Southern California Association of Governments functions as the Metropolitan Planning Organization for six counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. As the designated Metropolitan Planning Organization, the Association of Governments is mandated by the federal government to research and draw up plans for transportation, growth management, hazardous waste management, and air quality.			

State Fire Marshal (SFM)			
Level: State	Hazard: Wildfire	http://osfm.fire.ca.gov	
1131 "S" Street			
Sacramento, CA 95814		Ph: 916-445-8200	Fx: 916-445-8509
Notes: The Office of the State Fire Marshal (SFM) supports the mission of the California Department of Forestry and Fire Protection (CDF) by focusing on fire prevention. SFM regulates buildings in which people live, controls substances which may, cause injuries, death and destruction by fire; provides statewide direction for fire prevention within wildland areas; regulates hazardous liquid pipelines; reviews regulations and building standards; and trains and educates in fire protection methods and responsibilities.			

Appendix A - Resources

The Community Rating System (CRS)			
Level: Federal	Hazard: Flood	http://www.fema.gov/nfip/crs.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within the County would receive reduced NFIP flood insurance premiums if the County implements floodplain management practices that qualify it for a CRS rating. For further information on the CRS, visit FEMA's website.			
United States Geological Survey			
Level: Federal	Hazard: Multi	http://www.usgs.gov/	
345 Middlefield Road			
Menlo Park, CA 94025		Ph: 650-853-8300	Fx:
Notes: The USGS provides reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.			
US Army Corps of Engineers			
Level: Federal	Hazard: Multi	http://www.usace.army.mil	
P.O. Box 532711			
Los Angeles CA 90053- 2325		Ph: 213-452- 3921	Fx:
Notes: The United States Army Corps of Engineers work in engineering and environmental matters. A workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals provide engineering services to the nation including planning, designing, building and operating water resources and other civil works projects.			
USDA Forest Service			
Level: Federal	Hazard: Wildfire	http://www.fs.fed.us	
1400 Independence Ave. SW			
Washington, D.C. 20250-0002		Ph: 202-205-8333	Fx:
Notes: The Forest Service is an agency of the U.S. Department of Agriculture. The Forest Service manages public lands in national forests and grasslands.			

Appendix A - Resources

USGS Water Resources			
Level: Federal	Hazard: Multi	www.water.usgs.gov	
6000 J Street		Placer Hall	
Sacramento, CA 95819-6129		Ph: 916-278-3000	Fx: 916-278-3070
Notes: The USGS Water Resources mission is to provide water information that benefits the Nation's citizens: publications, data, maps, and applications software.			

Western States Seismic Policy Council (WSSPC)			
Level: Regional	Hazard: Earthquake	www.wsspc.org/home.html	
125 California Avenue		Suite D201, #1	
Palo Alto, CA 94306		Ph: 650-330-1101	Fx: 650-326-1769
Notes: WSSPC is a regional earthquake consortium funded mainly by FEMA. Its website is a great resource, with information clearly categorized - from policy to engineering to education.			

Appendix B Acronyms

Federal Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ATC	Applied Technology Council
b/ca	benefit/cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CRS	Community Rating System
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United States, Department of)
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard Mitigation Team
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as "409 Plan")
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service

SBA	Small Business Administration
SEAO	Structural Engineers Association of Oregon
SHMO	State Hazard Mitigation Officer
TOR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

California Acronyms

A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
ARC	American Red Cross
ARP	Accidental Risk Prevention
ATC20	Applied Technology Council20
ATC21	Applied Technology Council21
BCP	Budget Change Proposal
BSA	California Bureau of State Audits
CAER	Community Awareness & Emergency Response
CalARP	California Accidental Release Prevention
CalBO	California Building Officials
CalEPA	California Environmental Protection Agency
CalREP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
CalTRANS	California Department of Transportation
CBO	Community Based Organization
CD	Civil Defense
CDF	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEPEC	California Earthquake Prediction Evaluation Council
CESRS	California Emergency Services Radio System
CHIP	California Hazardous Identification Program
CHMIRS	California Hazardous Materials Incident Reporting System
CHP	California Highway Patrol
CLETS	California Law Enforcement Telecommunications System
CSTI	California Specialized Training Institute

CUEA	California Utilities Emergency Association
CUPA	Certified Unified Program Agency
DAD	Disaster Assistance Division (of the state Office of Emergency Svcs)
DFO	Disaster Field Office
DGS	California Department of General Services
DHSRHB	California Department of Health Services, Radiological Health Branch
DO	Duty Officer
DOC	Department Operations Center
DOE	Department of Energy (U.S.)
DOF	California Department of Finance
DOJ	California Department of Justice
DPA	California Department of Personnel Administration
DPIG	Disaster Preparedness Improvement Grant
DR	Disaster Response
DSA	Division of the State Architect
DSR	Damage Survey Report
DSW	Disaster Service Worker
DWR	California Department of Water Resources
EAS	Emergency Alerting System
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EMA	Emergency Management Assistance
EMI	Emergency Management Institute
EMMA	Emergency Managers Mutual Aid
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency (U.S.)
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ESC	Emergency Services Coordinator
FAY	Federal Award Year
FDAA	Federal Disaster Assistance Administration
FEAT	Governor's Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FIR	Final Inspection Reports
FIRESCOPE	Firefighting Resources of So. Calif Organized for Potential Emergencies
FMA	Flood Management Assistance
FSR	Feasibility Study Report
FY	Fiscal Year
GIS	Geographical Information System
HAZMAT	Hazardous Materials

HAZMIT	Hazardous Mitigation
HAZUS	Hazards United States (an earthquake damage assessment prediction tool)
HAD	Housing and Community Development
HEICS	Hospital Emergency Incident Command System
HEPG	Hospital Emergency Planning Guidance
HIA	Hazard Identification and Analysis Unit
HMEP	Hazardous Materials Emergency Preparedness
HMGP	Hazard Mitigation Grant Program
IDE	Initial Damage Estimate
IA	Individual Assistance
IFG	Individual & Family Grant (program)
IRG	Incident Response Geographic Information System
IPA	Information and Public Affairs (of state Office of Emergency Services)
LAN	Local Area Network
LEMMA	Law Enforcement Master Mutual Aid
LEPC	Local Emergency Planning Committee
MARAC	Mutual Aid Regional Advisory Council
MHID	Multihazard Identification
MOU	Memorandum of Understanding
NBC	Nuclear, Biological, Chemical
NEMA	National Emergency Management Agency
NEMIS	National Emergency Management Information System
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Association
NPP	Nuclear Power Plant
NSF	National Science Foundation
NWS	National Weather Service
OA	Operational Area
OASIS	Operational Area Satellite Information System
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OEP	Office of Emergency Planning
OES	California Governor's Office of Emergency Services
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PDA	Preliminary Damage Assessment
PIO	Public Information Office
POST	Police Officer Standards and Training
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
PTAB	Planning and Technological Assistance Branch
PTR	Project Time Report

RA	Regional Administrator (OES)
RADEF	Radiological Defense (program)
RAMP	Regional Assessment of Mitigation Priorities
RAPID	Railroad Accident Prevention & Immediate Deployment
RDO	Radiological Defense Officer
RDMHC	Regional Disaster Medical Health Coordinator
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information
RES	Regional Emergency Staff
RIMS	Response Information Management System
RMP	Risk Management Plan
RPU	Radiological Preparedness Unit (OES)
RRT	Regional Response Team
SAM	State Administrative Manual
SARA	Superfund Amendments & Reauthorization Act
SAVP	Safety Assessment Volunteer Program
SBA	Small Business Administration
SCO	California State Controller's Office
SEMS	Standardized Emergency Management System
SEPIC	State Emergency Public Information Committee
SLA	State and Local Assistance
SONGS	San Onofre Nuclear Generating Station
SOP	Standard Operating Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TRU	Transuranic
TTT	Train the Trainer
UPA	Unified Program Account
UPS	Uninterrupted Power Source
USAR	Urban Search and Rescue
USGS	United States Geological Survey
WC	California State Warning Center
WAN	Wide Area Network
WIPP	Waste Isolation Pilot Project

APPENDIX C

Summary of Mitigation Measures by Southern California Edison

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

John Steelesmith
Region Manager
Public Affairs

June 4, 2004

Don Anderson
Director of Safety Coordination
City of Duarte
1600 South Huntington Drive
Duarte, CA 91010

Dear Don,

Several cities and counties have asked Southern California Edison (SCE) to participate in their planning process, by providing information to assist them as they develop their Hazard Mitigation Plan.

To assist you in preparing your plan, SCE has prepared a summary of our planning and exercise activities, external coordination, and mitigation. Feel free to use this information and include it in your Hazard Mitigation Plan, as appropriate.

If you have any questions about SCE's plan or any other aspect of the attached document, please call SCE's Emergency Planning & Preparedness Manager, Kelly Shivertaker at 626-302-6492.

John Steelesmith
Region Manager

1440 So. California Ave.
Monrovia, CA 91016
626-303-8429/PAX 47229
Fax 626-303-8452
steelejg@sce.com

Southern California Edison
Hazard Mitigation Planning

The Federal Emergency Management Agency's Hazard Mitigation Planning Program encourages integrated planning between utilities and the cities and counties they serve.

In order to meet the hazard mitigation planning needs of communities we serve, we have developed this document to provide an overview of our own hazard mitigation and planning process. You may use this document within your local planning process to affirm that we at Southern California Edison (SCE) have taken the necessary pre-disaster steps to mitigate threats to our electric system.

SCE is committed to providing reliable electric service to our customers. We have an emergency preparedness program in place to address pre- and post-disaster planning needs. Additionally, we have developed the necessary plans to allow SCE to communicate post-disaster with the jurisdictions we serve and, as necessary, to integrate our response activities with theirs. Finally, we have assessed the vulnerability of our equipment to hazards and have taken steps to mitigate that vulnerability.

Planning

The California Public Utilities Commission (PUC), which regulates SCE, has devoted considerable attention to disaster preparedness and system response. SCE has undertaken an all-hazards approach to planning for an emergency event. The plans are updated annually and employees are trained on these plans. Plan contents are specified by the PUC's General Order No. 166, Standards for Operations, Reliability, and Safety during Emergencies and Disasters. A summary of General Order No. 166 is attached.

SCE's Emergency Response & Recovery Plan provides a framework for coordinating and integrating the response and recovery for all of SCE's business units and departments during emergency situations, in order to meet our goal of providing safe and reliable electric service. As an event begins to develop and increase in magnitude, SCE takes the appropriate actions to increase its readiness. Actions taken during normal operations are elevated to respond to a more serious situation. These increased actions may include:

- Activation of Emergency Response & Recovery Plans
- Activation of the Emergency Information Coordination Center, Emergency Operation Center, or Mobile Command Center
- Mobilization of resources such as manpower and equipment
- Escalation of the amount of material and equipment on hand
- Communication of emergency and safety information to the public

Testing the Plans

SCE tests its plans annually through a corporate emergency preparedness exercise. Hundreds of employees from organizations across the company participate in these exercises. In addition to this annual exercise, the company also conducts "tabletop" exercises that provide an opportunity

APPENDIX D

City of Hope National Medical Center
Buildings Profile

APPENDIX D

CITY OF HOPE BUILDINGS PROFILE

(REPORT TO CITY OF DUARTE (SUBMITTED: JUNE 6, 2004))

Building Code	Building Name	Function	Number of Floors	Int. Gross Area	Comments
005	Utah	LAB	1	4,636	
007	Montana/Smith	LAB	1	3,224	
013	Med.Rec/O.L.	STORAGE	1	5,080	
014	Boiler	STORAGE	1	1,243	
020	Wing 1	PATIENT	1	11,141	
023	Main Medical	PATIENT	3	30,407	
024	Wing 6	PATIENT	1	9,568	
025	Wing 5	PATIENT	1	9,999	
026	Wing 4	OFFICE	1	9,448	
027	Helford Offices	OFFICE	1	6,548	
029	Sirbu	LAB	1	7,047	
035	Engineering	SERVICE	1	10,556	
038	Rosenkranz	LAB	1	2,169	
042	Visitors Center	OFFICE	1	2,370	
043	Temple Beth	TEMPLE	1	1,917	
051	Central Svcs.	OFFICE	1	6,690	
051A	Central Proc.	OFFICE	1	2,649	
051B	Mail	SERVICE	1	531	
051C	Cafe./Conf.Rms	SERVICE	1	26,052	
051D	Human Resources	OFFICE	1	2,178	
052	Machris	PATIENT	3	24,982	
058	Hope Village/Rms. 20...	TEMPOR HOUSING	1	1,693	
059	Hope Village/Rms. 30...	TEMPOR HOUSING	1	1,691	
060	Hope Village/Rms. 40...	TEMPOR HOUSING	1	1,693	
061	Hope Village/Rms. 50...	TEMPOR HOUSING	1	1,693	
062	Hope Village/Rms. 60...	TEMPOR HOUSING	1	1,693	
063A	Quonset	STORAGE	1	1,009	
063B	Quonset	STORAGE	1	944	
064	Hope Village Office	OFFICE	1	2,944	
066	Familian Research	LAB	2	10,521	
067	Piness	DATA	1	3,161	
068	Lippman-Graff	LAB	2	17,709	
069	Warehouse A	STORAGE	1	6,072	
070	Chiller	STORAGE	1	1,102	
071	Infect. Waste	STORAGE	1	1,534	
072	Amado/D.P.	OFFICE	1	5,233	
073	Hortic./Grounds	SERVICE	1	5,914	
074	Vogel	OFFICE	1	3,259	
075	BIS/Goodman	SERVICE	1	5,224	
076	Northwest	PATIENT	3	95,525	
077	Greenhouse	STORAGE	1	1,740	
081	Warehouse	STORAGE	1	1,797	
082	Maint. Garage	SERVICE	1	1,416	
083	Halper	LAB	1	8,480	
084	Familian/BMT/Womens Ctr.	PATIENT	3	35,570	
085B	Warehouse B	STORAGE	1	5,067	
085C	Warehouse C	STORAGE	1	5,037	

CITY OF HOPE BUILDINGS PROFILE

(REPORT TO CITY OF DUARTE (SUBMITTED: JUNE 6, 2004))

Building Code	Building Name	Function	Number of Floors	Int. Gross Area	Comments
085D	Warehouse D	STORAGE	1	6,913	
085E	Warehouse E	STORAGE	1	7,158	
086	Grad.St.Lounge	OFFICE	1	736	
090	Blood Don.Ctr.	PATIENT	1	6,239	
090A	Finance	OFFICE	1	2,054	
091	I.C.U.	PATIENT	1	5,586	
092	Blood Donor	OFFICE	1	1,368	
092A	Modular 92A	OFFICE	1	1,524	
093	Kaplan Black	LAB	1	9,940	
094	Modular 94	OFFICE	1	1,370	
095	Plant/Boiler	SERVICE	1	4,757	
095A	Plant/Chiller	SERVICE	1	8,224	
096	Shapiro	LAB	1	10,960	
097	Graff Library	LIBRARY	1	12,593	
098	1 West	OFFICE	1	3,471	
099	2 West	OFFICE	1	2,351	
100	3 West	OFFICE	1	2,317	
101	Security	OFFICE	1	2,335	
102	Safety,Visitor,Donor	OFFICE	1	2,313	
103	Clin.Cancer Gen	OFFICE	1	2,320	
105	Research Modular 105	LAB	1	2,467	
106	Records Storage 106	STORAGE	1	2,004	
106A	Records Storage 106A	STORAGE	1	1,145	
107	Needleman	OFFICE	2	10,828	
108	Hilton	LAB	1	15,579	
109	Furth	LAB	1	12,702	
110	Parsons Village/Rms 130..	TEMPOR HOUSING	1	1,680	
111	Parsons Village/Rms 120..	TEMPOR HOUSING	1	1,680	
112	Parsons Village/Rms 140..	TEMPOR HOUSING	1	1,680	
113	Parsons Village/Rms 150..	TEMPOR HOUSING	1	1,680	
114	Parsons Village/Rms 160..	TEMPOR HOUSING	1	1,680	
115	I.V./Eng. Shed	STORAGE	1	1,359	
116	Storage-Temp.	STORAGE	1	273	
127	Buena Vista	VACANT	1	879	
128	Parvin	LAB	1	21,952	
130	Platt Confer./Cooper Aud.	CONFERENCE CTR	1	14,089	
131	Disp/Chem.Hand.	STORAGE	1	1,188	
133	4 West	OFFICE	1	2,065	
134	5 West	OFFICE	1	657	
135	Blood Donor	OFFICE	1	609	
136	Health Ed.	OFFICE	1	1,345	
137	Inform. Booth	SERVICE	1	78	
138	6 West	OFFICE	1	649	
139	Thermal Storage	STORAGE	1	2,585	
140	Miller	OFFICE	1	5,664	
141	Patient Business Svcs.	OFFICE	1	6,774	
142	MRI	PATIENT	1	970	

CITY OF HOPE BUILDINGS PROFILE

(REPORT TO CITY OF DUARTE (SUBMITTED: JUNE 6, 2004))

Building Code	Building Name	Function	Number of Floors	Int. Gross Area	Comments
144	Marketing/P.A.	OFFICE	1	2,055	
145	Research Store	STORAGE	1	2,058	
146	Managed Care	OFFICE	1	1,362	
147	Marketing	OFFICE	1	2,036	
148	Architects	OFFICE	1	487	
149	Proj. Admin.	OFFICE	1	2,719	
150	Storage-Proj.Ad	STORAGE	1	396	
151	Corp. Acctg.	OFFICE	1	5,533	
152	Research Modular	LAB	1	1,763	
154	Kaplan Plant	STORAGE	1	1,599	
157	Warsaw/MOB	OFFICE	5	31,758	
158	Kaplan CRB	LAB	4	33,333	
160	Amb.Care/Braw.	PATIENT	4	94,217	
161	Diabetes/Gonda	LAB	4	37,882	
162	Fox North	LAB	2	17,540	
163	Fox South	LAB	2	17,474	
166	House	TEMPOR HOUSING	1	581	
167	Apartments	TEMPOR HOUSING	2	2,989	
169	CBG	LAB	2	19,381	
170	Med.Office Mod.	OFFICE	1	2,734	
171	Info. Sciences	OFFICE	1	13,593	
172	Helford Clinical Research Hospital	VACANT	7	347,000	Under construction

BUILDING COUNT = 116

APPENDIX E

COST-BENEFIT ANALYSIS
FOR
CITY OF DUARTE
NATURAL HAZARD MITIGATION PLAN

A Cost-Benefit Analysis is a technique used for considering the benefits and cost of a project or a plan. In simple terms, a cost-benefit analysis is a means of adding up the value of the benefits of a course of action and subtracting the cost associated with it. In more sophisticated terms a cost-benefit analysis places value on tangible and sometime intangible costs and benefits to aid decision makers in organizing the decision making process and for evaluating potential outcomes. When utilized by government agencies a cost-benefit analysis can direct public policy and provide a framework for a complex set of alternative actions.

The City of Duarte utilized a cost-benefit analysis in preparation of the Duarte Natural Hazard Mitigation Plan to provide a systematic means to evaluate the benefits and the cost of each of the proposed Hazard Mitigation Action Items. The valuation of benefits and costs aided the Natural Hazard Mitigation Steering Committee, and ultimately the Duarte City Council, in prioritizing the alternative mitigation actions that were available to the City. It was also beneficial to the Steering Committee in determining Short Term goals based on funds immediately available to the City versus determining Long Term goals that may require grant funds or outside funding.

Evaluating mitigation projects is a complex process that must take into account the actual cost associated with damage sustained by a community from a natural hazard events as well as indirect cost that are outcomes of a natural hazard event. Indirect cost may include economic consequences such as lost wages, halted production, or businesses moving out of the area.

A cost-benefit analysis can be effectively used in natural hazard mitigation in evaluating the benefits to life and property that have been safeguarded through mitigation actions and the cost to provide the mitigation activity. The cost of a mitigation action is not always measured in easy to determine dollar amounts. Often the benefit is an economic one that impacts a large number of people or it is a social benefit that is difficult to place a dollar amount on. However, the organizational framework of a cost-

benefit analysis can greatly aid a community in determining whether a project or a mitigation action should be implemented.

The framework used by the Duarte Natural Hazard Mitigation Steering Committee and the Duarte City Council in prioritizing the alternative available for Mitigation Actions included three steps. The steps are outlined below:

Step I – Identify the Alternative Mitigation Actions

To initiate the first step, the Duarte Natural Hazard Mitigation Steering Committee met on several occasions to brainstorm alternative mitigation actions for each of the five natural hazards selected (Earthquake, Wildfire, Windstorm, Flood & Dam Failure, and Landslides). Past hazard events were discussed in detail and emergency service response was evaluated to determine areas that could be improved. For example, while discussing the 1980 Stable Fire the Committee discussed the problems encountered when the electricity failed and the fire department was unable to initiate the electronic pump switch for the reserve water tanks. The Committee determined that it was a high priority to have an alternative power source (e.g. portable generators).

Step 2- Estimate the Benefits & Determine Cost

In order to prioritize the large list of mitigation actions, the Hazard Mitigation Steering Committee implemented a method of weighing the benefits of each mitigation action based on the following criteria:

Community Support of Proposed Action.
The Mitigation Steering Committee considered the community's acceptance of each of the proposed mitigation actions. Existing programs were evaluated to ensure that the proposed mitigation actions did not conflict with existing community programs or community values. Each mitigation action was evaluated to determine if there was sufficient public support to ensure the success of the action. Political acceptability and support for each action was also considered.

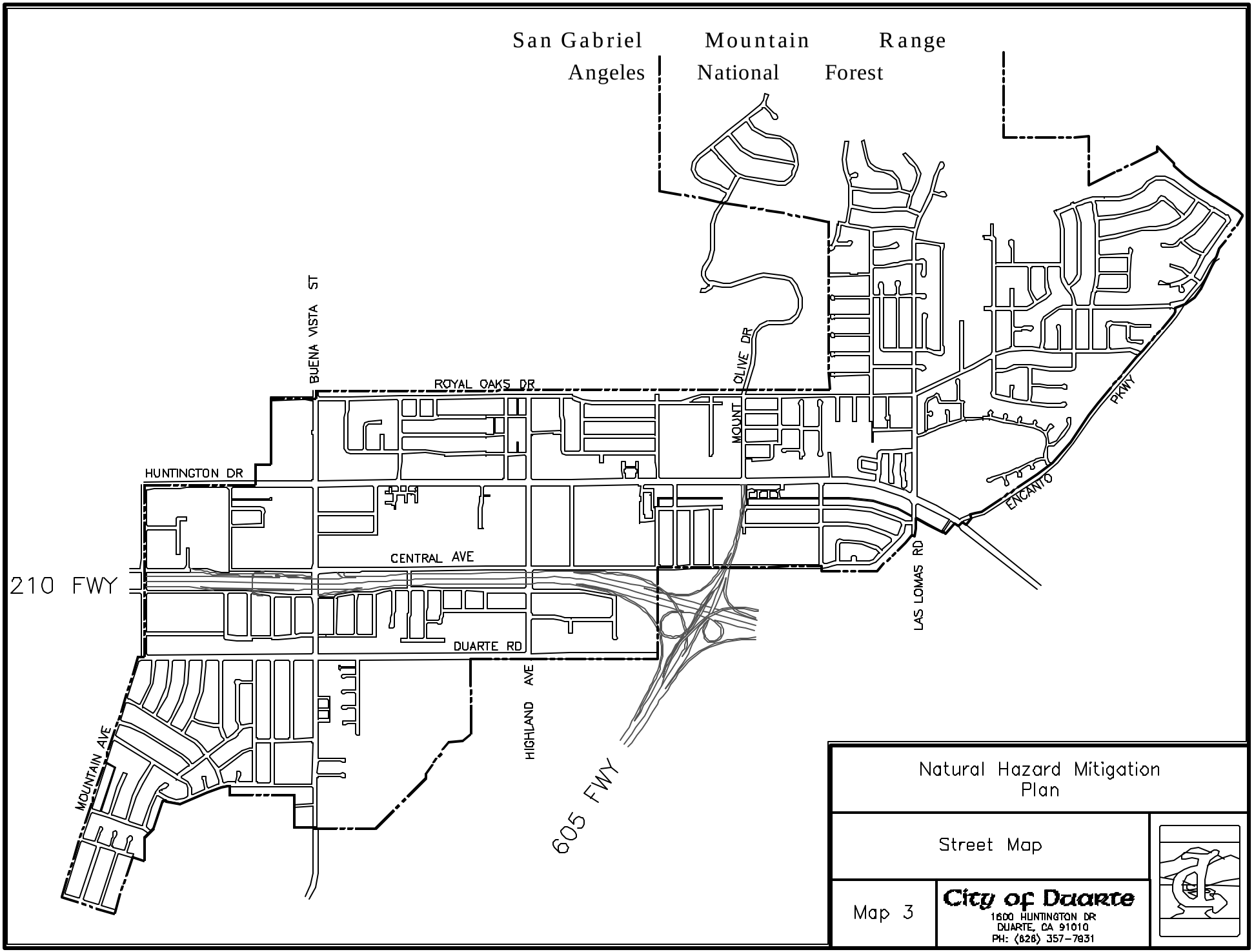
Administrative Capacity.
Each of the proposed mitigation actions was reviewed to determine if there was adequate staffing, funding, and expertise to accomplish the action. If existing funding was not adequate, then the Committee evaluated funding alternatives and the likelihood of obtaining additional funds. The need to obtain additional funds was measured against the benefits of implementing the proposed mitigation action. During this stage of the cost-benefit review, the Committee evaluated whether the proposed action could be accomplished in a short timeframe of 1 to 4 years or would it take longer. This provided the structure needed for the Committee to determine short-term and long-term mitigation actions.

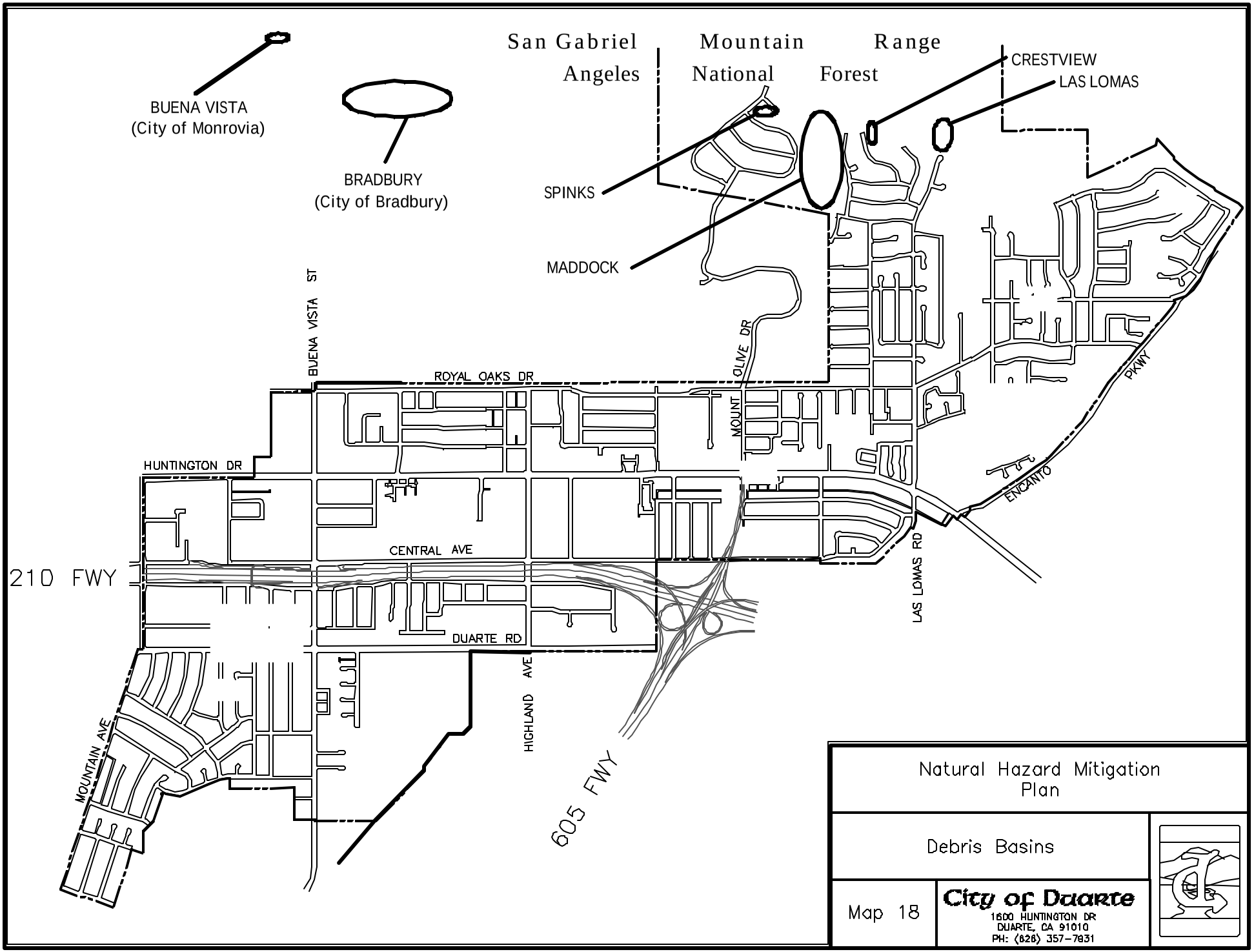
Feasibility & Effectiveness of Action

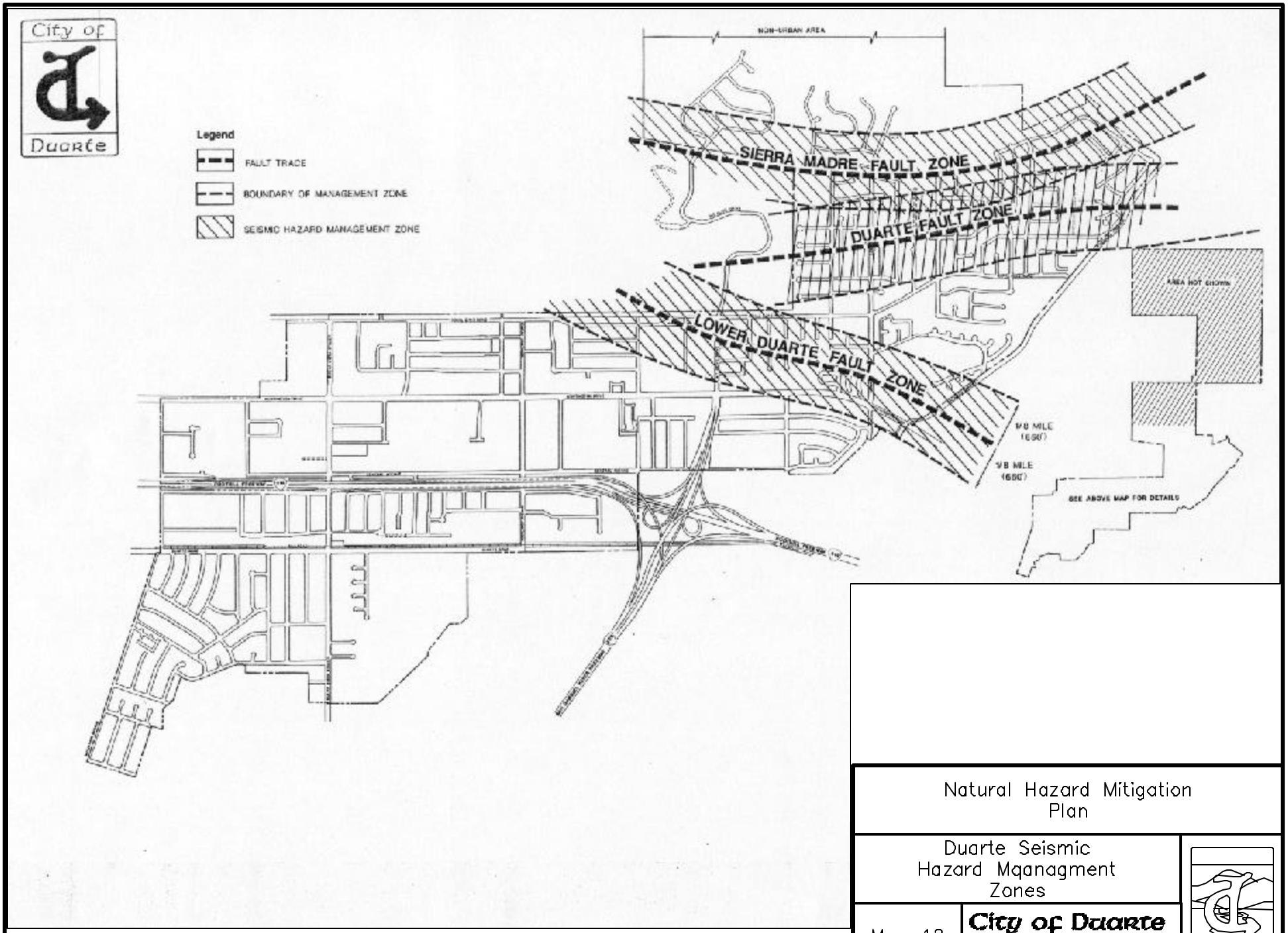
The final criteria applied to the cost-benefit analysis were a feasibility and effectiveness review of each proposed action. During this step the Steering Committee determined whether the proposed Mitigation Action was technically feasible and would the action be effective in avoiding or reducing future losses. To complete this step the Committee had to determine if a proposed Mitigation Action would minimize hazard events losses or provide some other type of community benefit such as increased public awareness or education. A "High Potential for Reducing Losses" coupled with "Low Cost to Implement" ranked higher than other mitigation action alternatives that had "Low Potential for Reducing Losses" or "Very High Cost to Implement".

Step 3 – Select and Prioritize Mitigation Actions.

In this step, the Mitigation Steering Committee selected mitigation actions that were the most suitable and feasible for our community, determined timeframes for each selected mitigation action, and determined what agency or city department would be responsible for each action. The short-term and long-term mitigation actions were grouped together for each natural hazard and placed at the end of each of the respective chapters (Earthquake, Wildfire, Flood, Windstorm, Landslide) to provide for easy review each year by the Committee. For a comprehensive review of all of the mitigation actions, a matrix was created and placed in Section 3 along with the Multi-Hazard Mitigation Goals.


San Gabriel Mountain Range
Angeles National Forest
BUENA VISTA ST
ROYAL OAKS DR
OLIVE DR
MOUNT
HUNTINGTON DR
CENTRAL AVE
210 FWY
DUARTE RD
HIGHLAND AVE
MOUNTAIN AVE
605 FWY
LAS LOMAS RD
ENCANTO
PKWY
Natural Hazard Mitigation Plan
Street Map
Map 3
City of Duarte
1600 HUNTINGTON DR
DUARTE, CA 91010
PH: (626) 357-7931


San Gabriel Mountain Range
Angeles National Forest
BUENA VISTA
(City of Monrovia)
BRADBURY
(City of Bradbury)
SPINKS
MADDOCK
CRESTVIEW
LAS LOMAS
BUENA VISTA ST
ROYAL OAKS DR
MOUNT OLIVE DR
HUNTINGTON DR
CENTRAL AVE
210 FWY
DUARTE RD
HIGHLAND AVE
605 FWY
MOUNTAIN AVE
LAS LOMAS RD
ENCANTO PKWY
Natural Hazard Mitigation Plan
Debris Basins
Map 18
City of Duarte
1600 HUNTINGTON DR
DUARTE, CA 91010
PH: (626) 357-7931



Natural Hazard Mitigation Plan

Duarte Seismic Hazard Mqanagment Zones

Map 12

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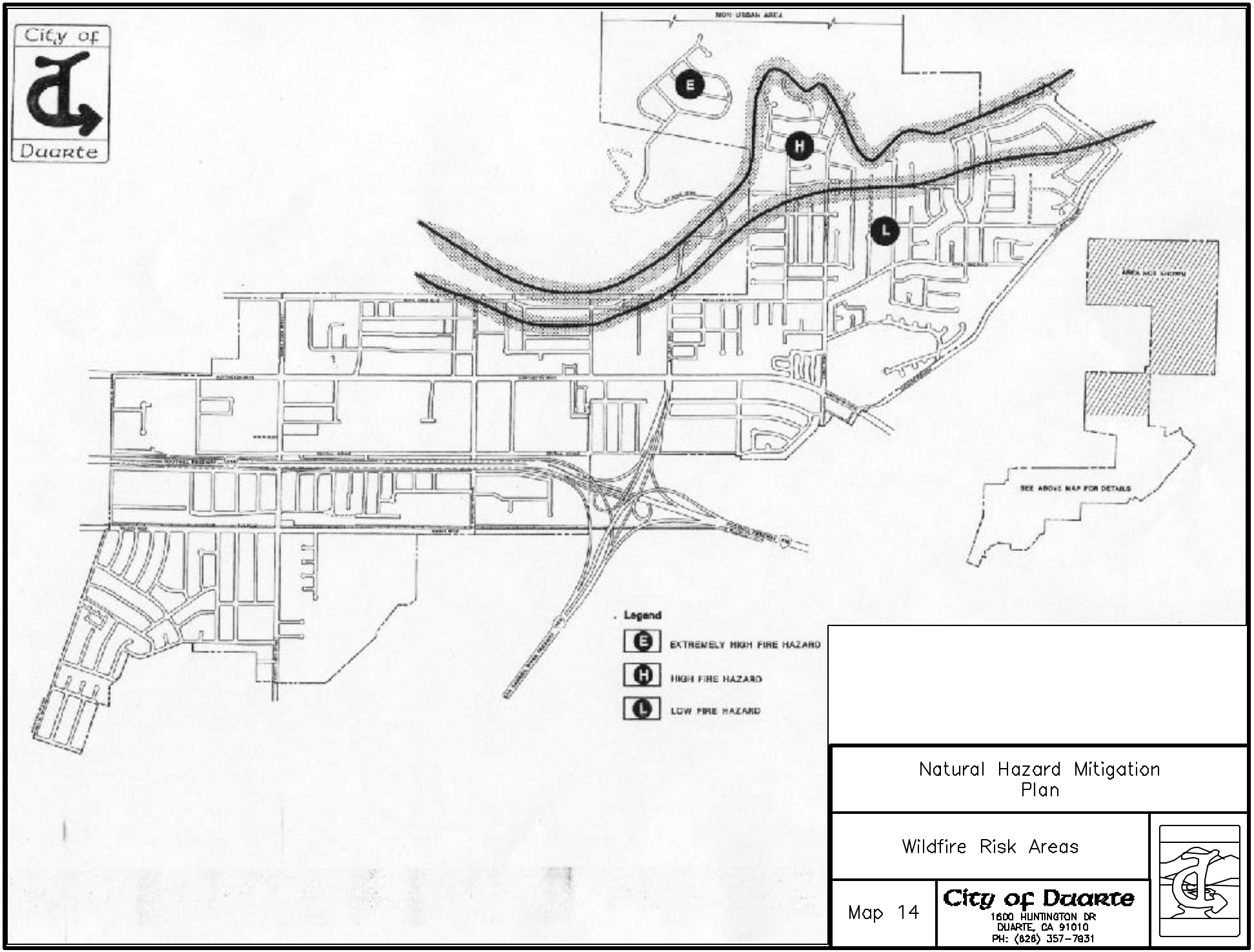

Natural Hazard Mitigation Plan

Wildfire Risk Areas

Map 14

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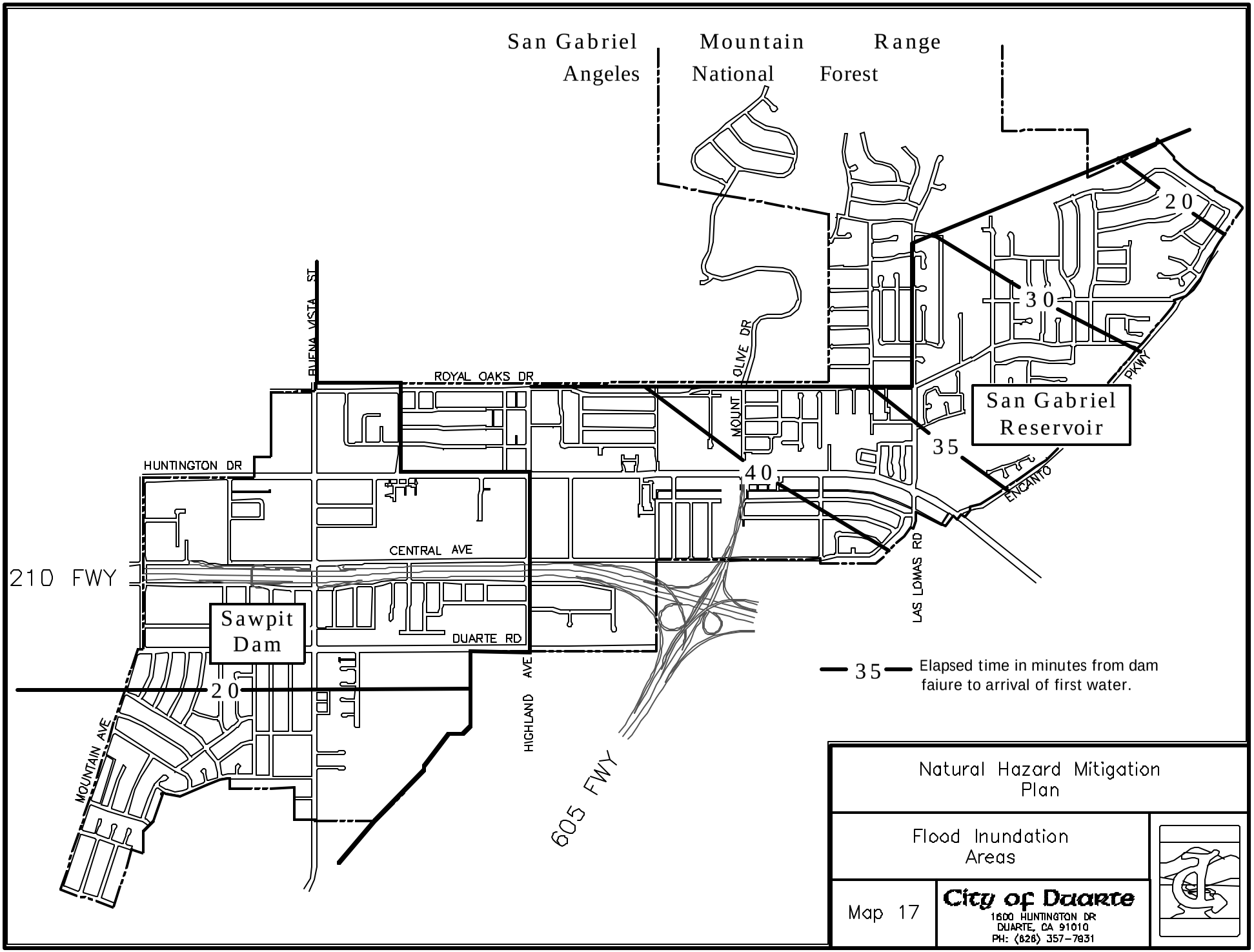
San Gabriel Mountain Range
Angeles National Forest
BUENA VISTA ST
ROYAL OAKS DR
OLIVE DR
MOUNT
HUNTINGTON DR
CENTRAL AVE
210 FWY
DUARTE RD
HIGHLAND AVE
MOUNTAIN AVE
605 FWY
LAS LOMAS RD
ENCANTO
PKWY
San Gabriel Reservoir
Sawpit Dam
20
30
35
40
20
35 Elapsed time in minutes from dam faiure to arrival of first water.
Natural Hazard Mitigation Plan
Flood Inundation Areas
Map 17
City of Duarte
1600 HUNTINGTON DR
DUARTE, CA 91010
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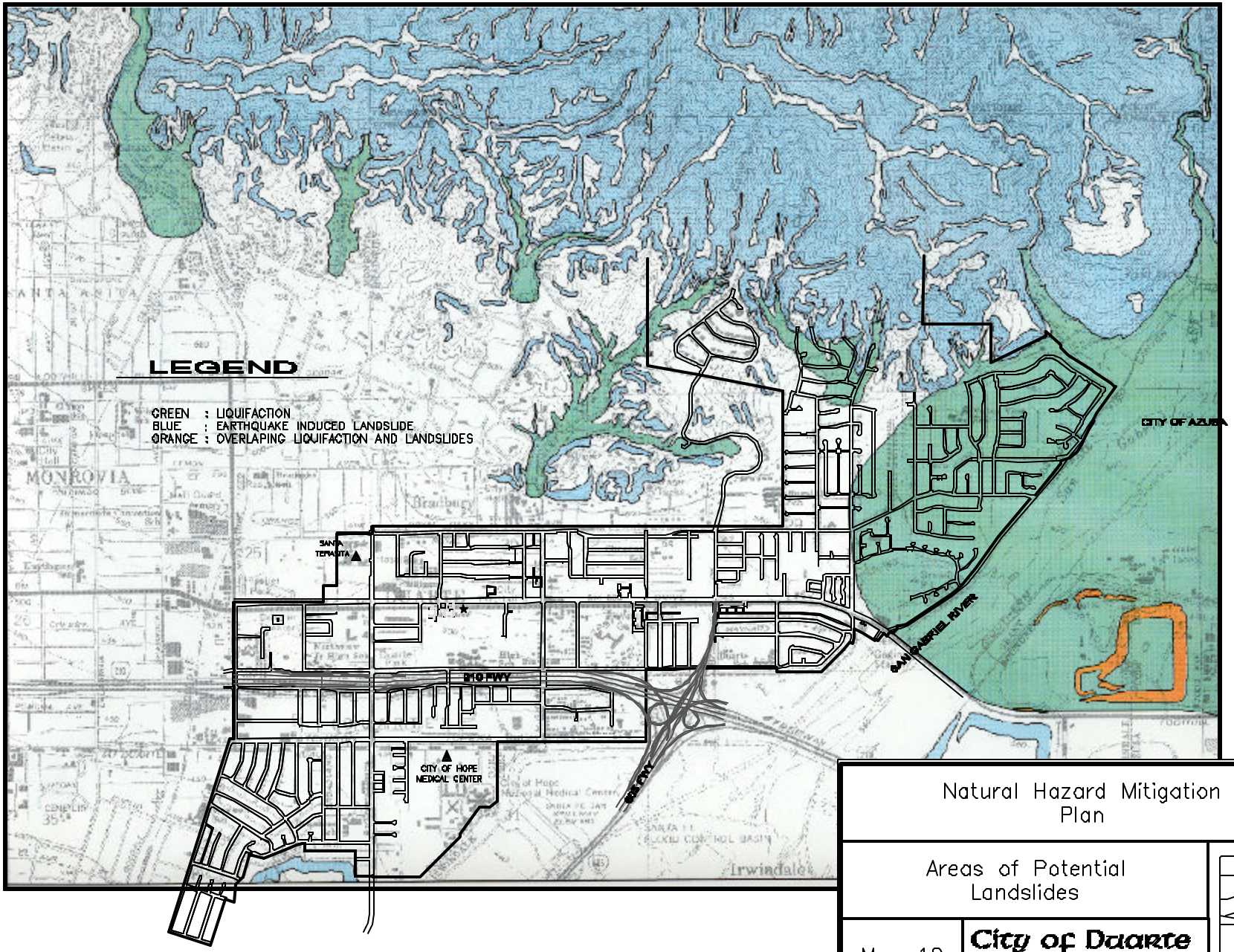

Natural Hazard Mitigation Plan

Areas of Potential Landslides

Map 19

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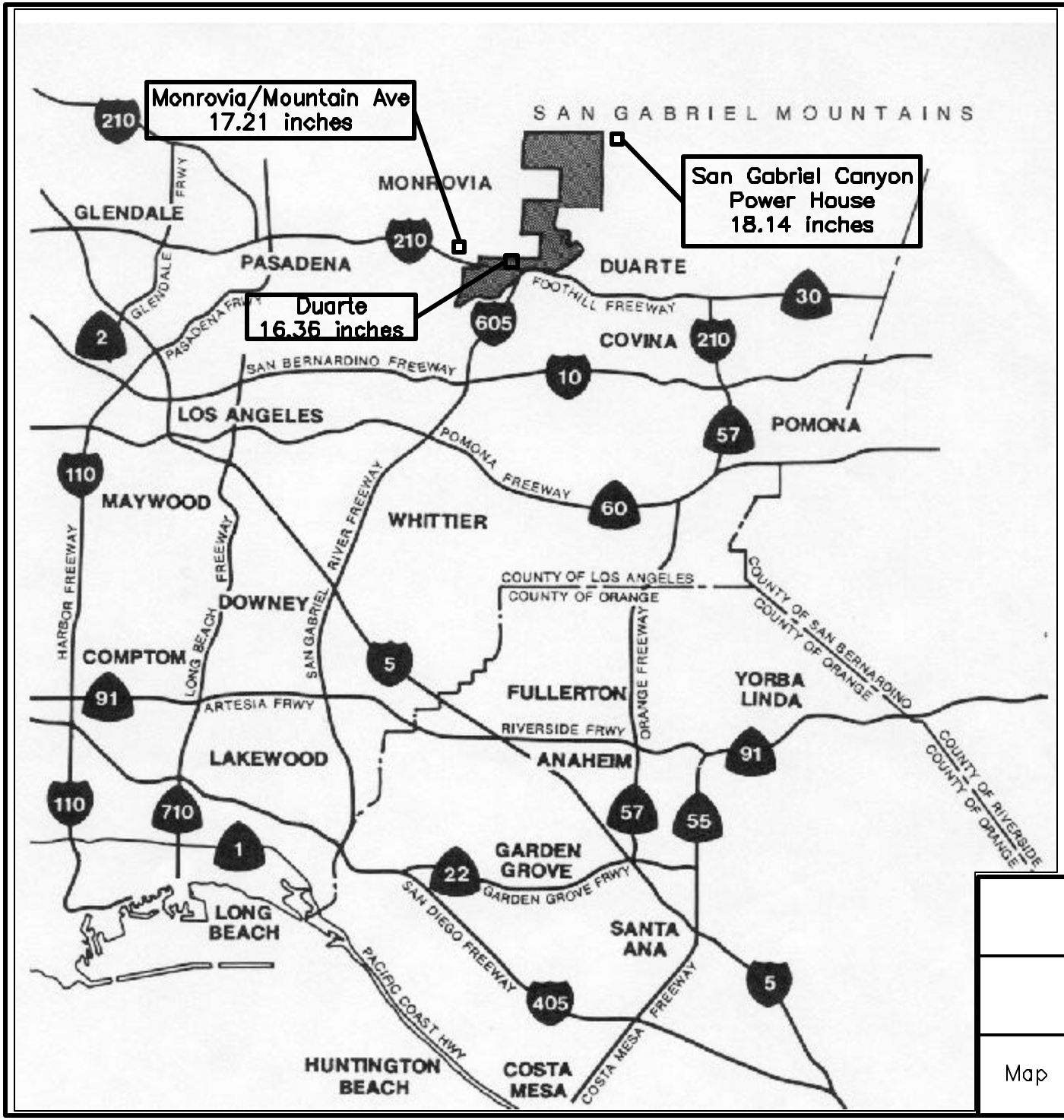

Active rain gage data
Water year 2001–2002

Natural Hazard Mitigation Plan

Precipitation

Map 2

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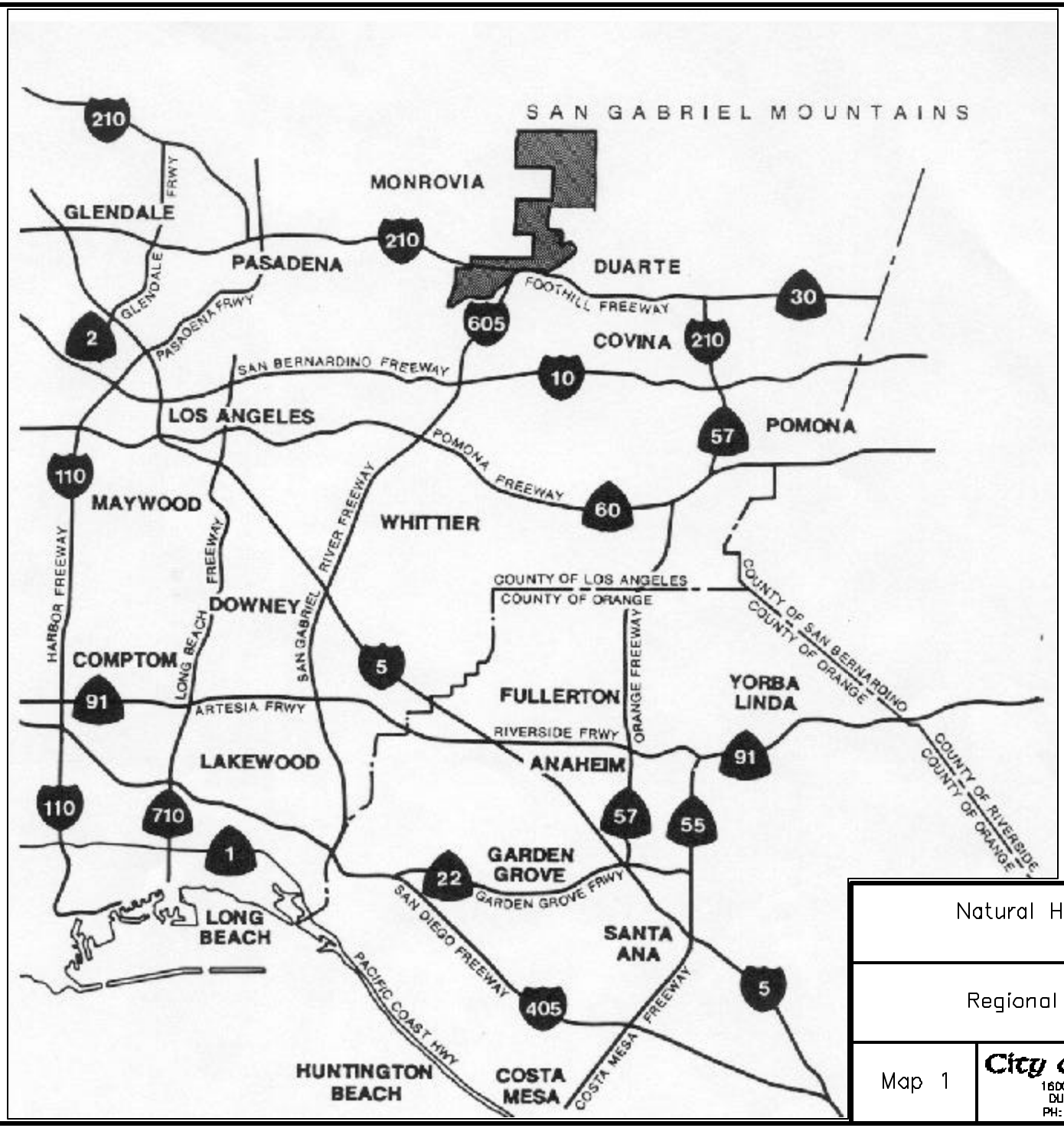

Natural Hazard Mitigation Plan

Regional Map

Map 1

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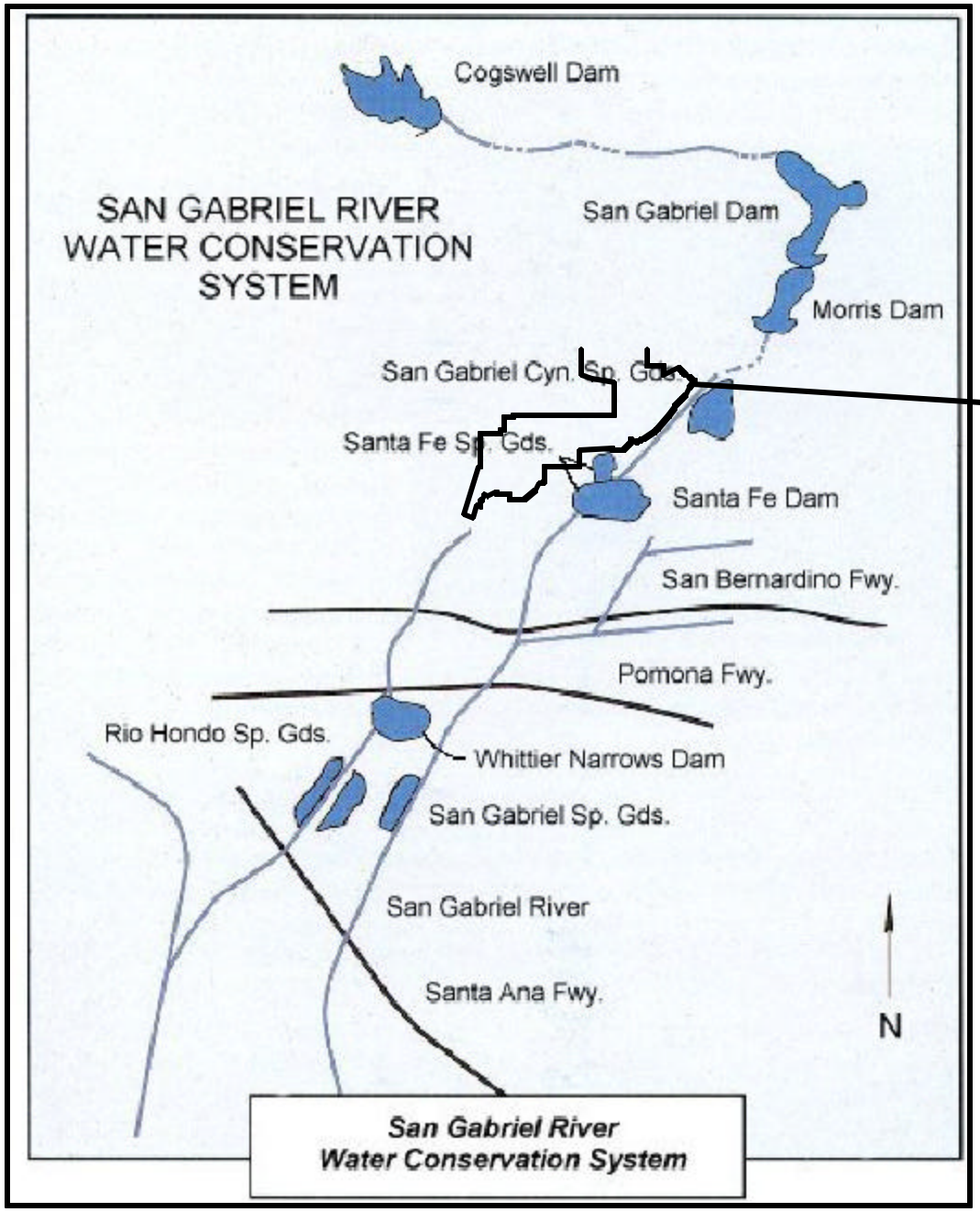

Duarte City Limits

Natural Hazard Mitigation Plan

San Gabriel Canyon Dams and Reservoirs Map

Map 16

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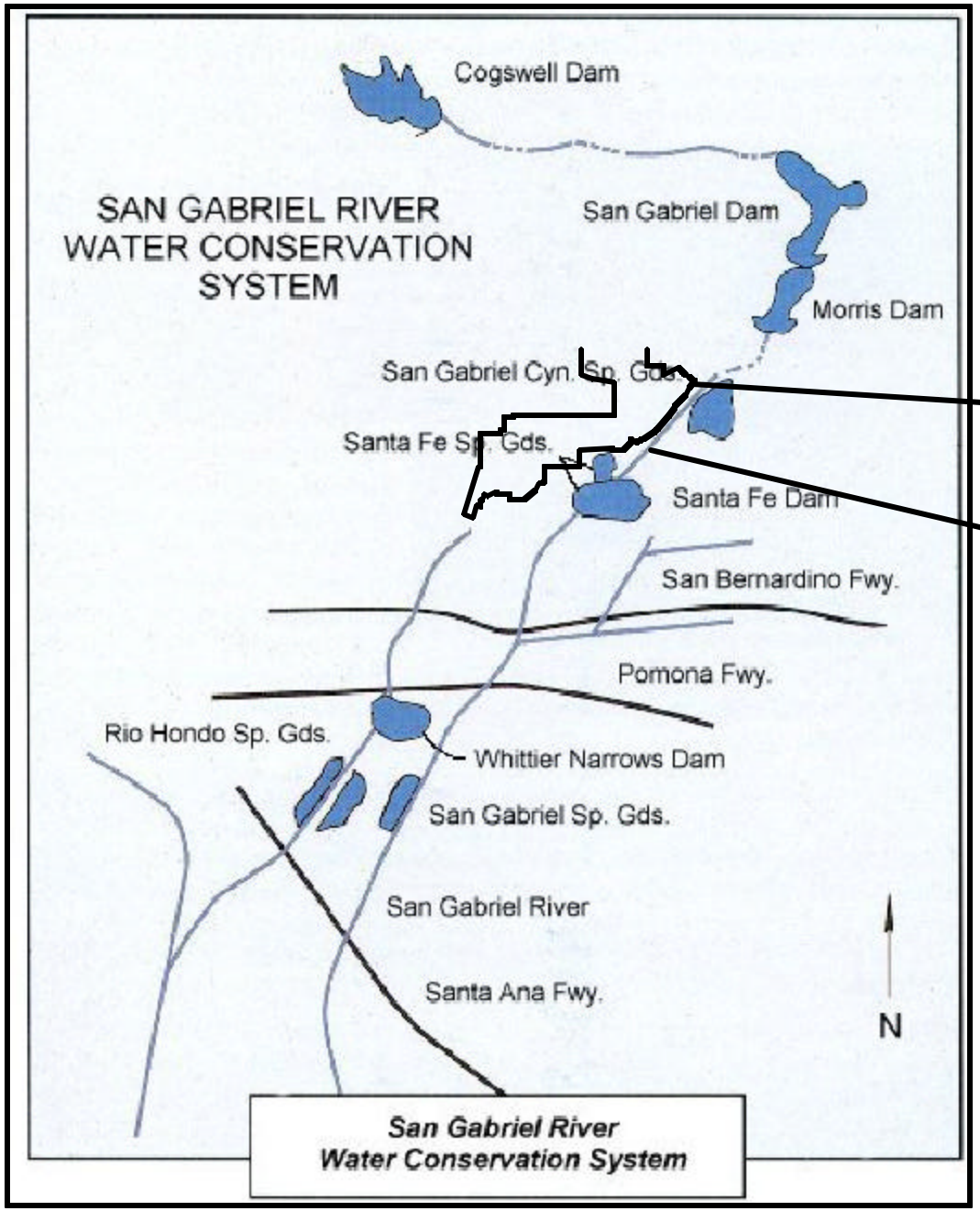

Duarte City Limits

San Gabriel River

Natural Hazard Mitigation Plan

San Gabriel River Map

Map 15

City of Duarte
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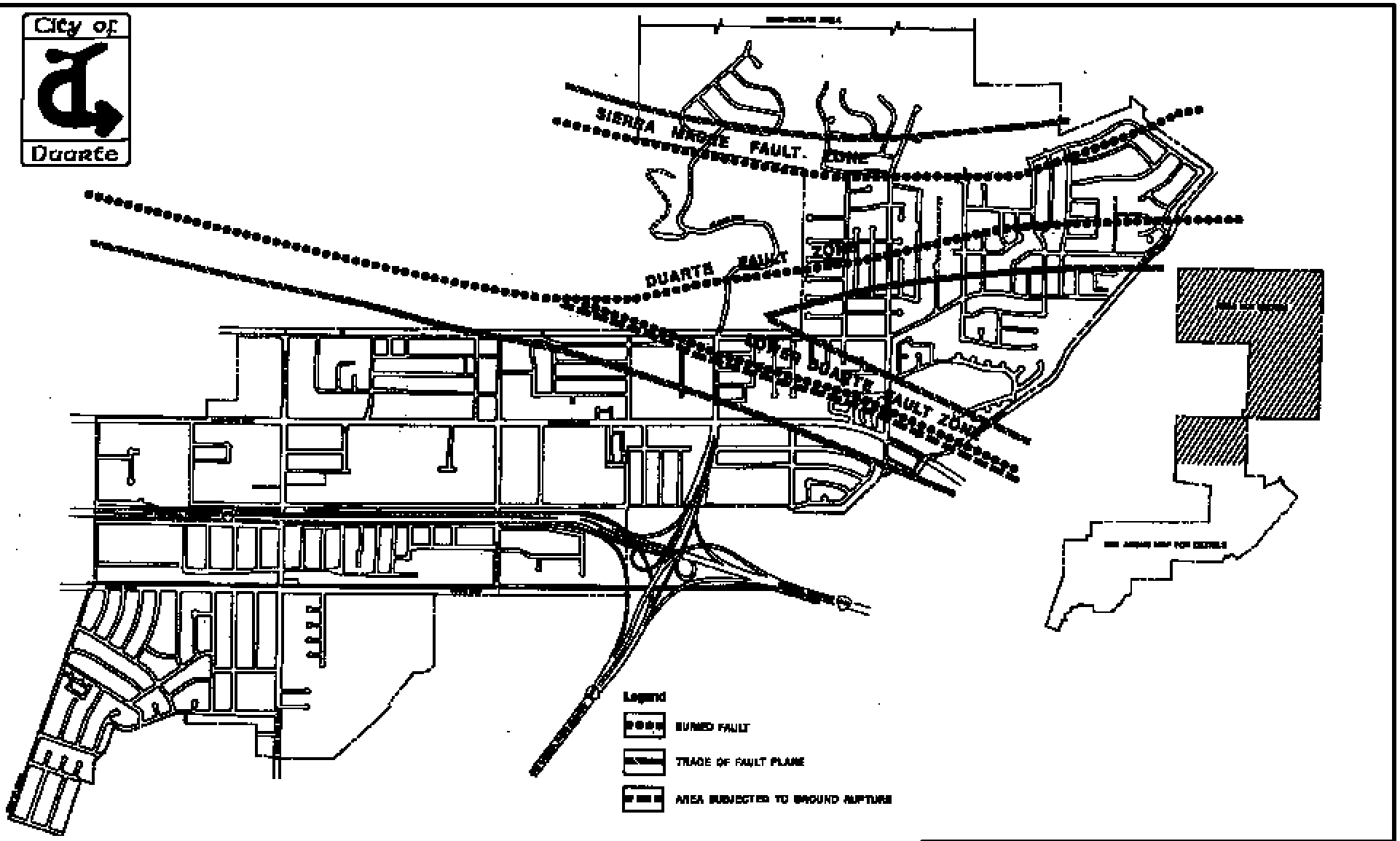

Natural Hazard Mitigation Plan

Duarte Fault Map

Map 11

City of Duarte
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