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Part One

Chapter One
Introduction

EXECUTIVE SUMMARY

The City of Anaheim (City) Hazard Mitigation Plan includes resources and information to assist City residents, public and private sector organizations, and others interested in participating in planning for natural hazards. The mitigation plan provides a list of activities that may assist the City of Anaheim in reducing risk and preventing loss from future hazard events. The mitigation action items address multi-hazard issues, as well as specific activities for Flood/Storm, Wildland & Urban Fire, Earthquakes, Dam Failure, Epidemic, Vector Control, Mud/Landslide, Tornado, and Seasonal Winds.

The Mitigation Plan contains a five-year action plan matrix, background on the purpose and methodology used to develop the mitigation plan, a profile of details on eight potential hazards within the City, and a number of appendices. The plan is divided into three parts.

Part I of the City's Hazard Mitigation Plan consists of six chapters, including the Introduction, Community Profile, Risk Assessment, Mitigation Strategy, Plan Maintenance, and the Local Capability Assessment.

Part II of the City of Anaheim Hazard Mitigation Plan consists of Resources.

Part III of the City of Anaheim Hazard Mitigation Plan incorporates the Appendices to the plan.

Plan Mission

The mission of the City of Anaheim Hazard Mitigation Plan is to promote sound public policy designed to protect City owned critical facilities and infrastructure from natural hazards. This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss-prevention, and identifying activities to guide the City towards building a safer, more sustainable community.

Hazard Mitigation Planning Process

The Hazard Mitigation Planning process began with the organization of resources including the identification of the members of the Hazard Mitigation Plan Task Force. A task force member was selected to represent each of the City departments and specific divisions within certain departments (See Appendix A for a list of team members). The task force met every third week during the project timeline of 11 months. The task force identified characteristics and potential consequences of natural hazards affecting the City. With the understanding of the risks posed by the identified hazards, a hazard mitigation strategy and goals were developed. The group then went on to determine hazard mitigation priorities. The Hazard Mitigation Plan will be implemented through various hazard mitigation projects, changes in day-to-day city operations, and through continued hazard mitigation development.

Public Participation

Public input during development of the mitigation plan assisted in shaping plan goals. Meetings with the Hazard Mitigation Task Force, one public workshop and meetings with representatives from businesses and school districts were held to obtain input and identify priorities in developing goals for reducing risk and preventing loss from natural hazards in the City. Furthermore, a draft of the plan was posted on the City website for public review. Copies of the plan were made available at the Canyon Hills and Central Public Libraries for public review and comment. Please see Appendix B for supporting documentation regarding public participation and meetings. Although we used several different methods for public outreach and provided a variety of ways to receive comments, we ultimately received no public comment on the plan.

City of Anaheim and Hazard Mitigation

The potential impacts of natural hazards associated with the City's location and varying terrain make the environment and population vulnerable to natural disaster situations. The City of Anaheim is subject to

earthquakes, floods/storms, wildland/urban fires, dam failures, epidemics, high winds, mud/landslides and tornados. It is impossible to predict exactly when these disasters will occur, or the extent to which the City will be affected. However, with careful planning and collaboration among public agencies, private sector organizations and citizens within the community, it is possible to minimize the losses that can result from these natural disasters.

From its founding in 1857, the residents of the City of Anaheim have endured a variety of natural hazards. Photographs, diaries and newspapers from the 1800s demonstrate that residents of Anaheim experienced earthquakes, droughts, floods, wildfires, freezes and insect invasions.

Although sparsely populated, the natural hazards adversely affected the lives of the residents who depended on the land and climate conditions for food and welfare. Today, as the population of the City of Anaheim continues to increase, the exposure to natural hazards creates an even higher risk than previously experienced.

The City of Anaheim has experienced four federally declared disasters within the last 25 years. The disaster resulted in over $50 million in reimbursement funds from Federal (FEMA) and State (NDAA) Public Assistance Program.

Over the years Anaheim has endured a variety of natural disasters. Anaheim is most commonly affected by flood, earthquake, and wildfire. The table below indicates

Table 1.1 Natural Disasters in Anaheim 1933 to Present

Disaster Type	Date	Description of Damage	Fiscal Impact	Federal Disaster Declared
Earthquake	March 10, 1933	Damaged many buildings in downtown Anaheim, including the Anaheim Union High School and Pickwick Hotel.	Unknown	Unknown
Flood	March 3, 1938	A 40-year flood. 19 deaths in Anaheim (58 county-wide), widespread damage to public, commercial and residential property.	Unknown	Unknown
Flood	February 26, 1969	Countywide flood responsible for damage to homes along Santa Ana Canyon Rd.	$213 Million	Yes
Wildfire	April 21, 1982	Ball-Euclid Firestorm, 10 injured, destroyed 53 buildings, including nearly 400 apartment units.	$50 Million	Yes
Wildfire	October 9, 1982	Gypsum Canyon firestorm, destroyed 6 houses in Anaheim Hills, 17,000 acres burned.	Unknown	Unknown
Landslide	January 18, 1993	Santiago landslide, 23 acres at Avenida de Santiago & Georgetown Circle affected, involving 36 houses.	$19 million	Yes
Wildfire	October 27, 1993	Anaheim Hills firestorm, 2 houses destroyed and 27 houses damaged, 750 acres burned.	Unknown	Unknown
Earthquake	January 17, 1994	Northridge Earthquake. Jumbotron scoreboard fell into upper deck seats of Angel Stadium of Anaheim.	$10 million	Yes
Wildfire	February 10, 2002	Coal Canyon firestorm, 2,400 acres burned.	Unknown	Unknown

Strategy for Mitigation Planning

As the cost of damage from natural disasters continues to increase nationwide, the City of Anaheim recognizes the importance of identifying effective ways to reduce vulnerability to disasters. Hazard

mitigation plans assist communities in reducing risk from natural hazards by identifying resources, information and strategies for risk reduction, while helping to guide and coordinate mitigation activities throughout the City.

The plan provides a set of action items to reduce risk from natural hazards through education and outreach programs and to foster the development of partnerships. Further, the plan provides for the implementation of preventative activities, including programs that restrict and control development in areas subject to damage from natural hazards.

The resources and information within the Mitigation Plan:

1. Establish a basis for coordination and collaboration among agencies and the public in the City of Anaheim.
2. Identify and prioritize future mitigation projects; and
3. Assist in meeting the requirements of federal assistance programs.

The mitigation plan works in conjunction with other City plans including the City of Anaheim Emergency Response Plan, the General Plan and its associated Environmental Impact Report, as well as department specific standard operating procedures.

Mitigation Plan Jurisdiction and Scope

The City's Hazard Mitigation Plan affects the areas within the City of Anaheim boundaries and City owned facilities and land. This plan provides a framework for planning for natural hazards. The resources and background information in the plan are applicable Citywide and to City-owned facilities outside of the City boundaries, and the goals and recommendations provide groundwork for local mitigation plans and partnerships.

Natural Hazard Land Use Policy in California

All California cities and counties have plans, policies and ordinances to address the safety of its residents, their property and City facilities in an effort to comply with the statewide planning regulations. The continuing challenge faced by local officials and state government is to keep the network of local plans effective in responding to the changing conditions and needs of California's diverse communities, particularly in light of the very active seismic region in which we live.

Planning for natural hazards calls for local plans to include inventories, policies, and ordinances to guide development in hazard areas. These inventories should include the compendium of hazards facing the community, the built environment at risk, the personal property that may be damaged by hazard events and most of all, the people who live in the shadow of these hazards.

Support for Hazard Mitigation

- The Governor's Office of Emergency Services (OES) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;
- The Southern California Earthquake Center (SCEC) gathers information about earthquakes, integrates this information on earthquake phenomena, and communicates this to end-users and the general public to increase earthquake awareness, reduces economic losses, and save lives.
- The California Division of Mines and Geology (DMG) is responsible for geologic hazard characterization, public education, the development of partnerships aimed at reducing risk, and exceptions to state mandated tsunami zone restrictions;
- The California Division of Water Resources (DWR) plans, designs, constructs, operates, and maintains the State Water Project, regulates dams; provides flood protection and assists in emergency management. It also educates the public and serves local water needs by providing technical assistance.

- The United State Army Corps of Engineers plans, designs, constructs, operates, and maintains flood, waterway, and dam facilities to protect public and private property on major waterways, including the Santa Ana River and its watershed.
- The Federal Emergency Management Agency
- The United States Census Bureau provides demographic data on the populations affected by natural disasters to assist with the preparation of assistance programs and…
- The United State Department of Agriculture

State and Federal Guidelines and Requirements for Mitigation Plans

Federal requirements for approval of a Natural Hazard Mitigation Plan include:

- Open public involvement, with public meetings that introduce the process and project requirements.
- The public must be afforded opportunities for involvement in: identifying and assessing risk, drafting a plan, and public involvement in the approval stages of the plan.
- Community cooperation, with opportunity for other local government agencies, the business community, educational institutions, and non-profits to participate in the process.
- Incorporation of local documents, including the local General Plan, the Zoning Ordinance, the Anaheim Building Code AMC 15.02, and other pertinent documents.

Planning process components:

- Complete documentation of the planning process
- A detailed risk assessment on hazard exposures in the community
- A comprehensive mitigation strategy, which describes the goals & objectives, including proposed strategies, programs & actions to avoid long-term vulnerabilities.
- A plan maintenance process, which describes the method and schedule of mentoring, evaluating and updating the plan and integration of the All Hazard Mitigation Plan into other planning mechanisms.
- Formal adoption by Anaheim City Council
- Plan review by both State OES and FEMA

Plan Use

Each section of the mitigation plan provides information and resources to assist people in understanding the City and the hazard-related issues facing residents, businesses, and the environment. 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 structure of the plan enables people to use a section of interest to them and allows City to review and update sections when new data is available. The ability to update individual sections of the mitigation plan places less of a financial burden on the City. Decision makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time consuming. The ease of incorporating new data into the plan will result in a hazard mitigation plan that remains current and relevant to the City of Anaheim.

The plan is divided into three parts: Part I contains an Executive Summary, Introduction, Community Profile, Risk Assessment, Multi-Hazard Goals and Action Items, and Plan Maintenance Local Capabilities; Part II contains resources; and Part III includes the Appendices. A detailed explanation follows.

Part 1: City of Anaheim Hazard Mitigation Plan

The Hazard Mitigation Plan is a five-year action plan. The five-year action plan provides an overview of the mitigation plan mission, goals, and action items. The plan action items included in this section address multi-hazard issues, as well as hazard specific activities that when implemented will reduce risk and prevent loss in future natural hazard events. The following chapters comprise the Hazard Mitigation Action Plan:

Chapter 1: Introduction
The Introduction describes the background and purpose of developing the mitigation plan.

Chapter 2: Community Profile
This chapter presents the history, geography, demographics, and socioeconomics of the City. It serves as a tool to provide an historical perspective of natural hazards in the City.

Chapter 3: Risk Assessment
This chapter provides information on hazard identification, hazard profiles, vulnerability and risk associated with natural hazards in the County.

Chapter 4: Multi-Hazard Goals and Action Items
This chapter provides information on the process used to develop goals and action items that cut across the eight natural hazards addressed in the mitigation plan.

Chapter 5: Plan Maintenance
This chapter provides information on plan implementation, monitoring and evaluation.

Chapter 6: Additional State Requirements
This chapter encompasses the Local Capabilities Assessment.

Part II: Resources
The plan appendices provide users of the City of Anaheim Hazard Mitigation Plan additional information regarding the contents of the mitigation plan and potential resources to assist in implementation of the plan.

Part III: Appendices

Appendix A: Hazard Mitigation Task Force Team Members
Appendix B: Public Participation
Appendix C: List of Maps
Appendix D: Fire Defense Analysis
Appendix E: List of Acronyms
Appendix F: List of Tables

Part One

Chapter Two
Community Profile

Brief History

The City of Anaheim was once part of an enormous land grant given by Spain to the San Gabriel Mission of the Roman Catholic Church. In 1834, the Mexican Government granted 35,970 acres to Juan Pacifico Ontiveros, creating Rancho San Juan Cajon de Santa Ana, which included the present sites of Anaheim, Brea, Fullerton and Placentia. In 1857, Ontiveros sold 1,165 acres to John Frohling and George Hansen, agents of the Los Angeles Vineyard Society, who wished to start a community in Southern California to grow grapes and produce wine. The Society voted to name the community Annaheim (later changed to Anaheim), “Ana” referring to Santa Ana River and "heim" meaning home. A disease struck the vineyards in 1884 and killed most of the vines by 1888. Although some of the colonists became discouraged and left, the persistent German colonists gradually turned to the citrus industry and lived to see their city prosper again.

The City was first incorporated by the State Legislature in 1870. The first mayor, Major Max Strobel, was elected directly by voters. The City found that it could not afford to maintain the streets, which had been the responsibility of the Water Company until that time. At the request of the taxpayers the Legislature revoked the incorporation in 1872. However, the City was again incorporated, first by the Board of Supervisors in 1876 and then by the State Legislature in 1878. The voters adopted a charter form of city government in June 1964, which was ratified by the State Legislature in 1965.

In 1879, when water needs exceeded what backyard wells could supply, a municipal water system with a pumping plant was installed. The water system and the municipal electric power system, established in 1894, continue to serve the residents of Anaheim. Anaheim is one of the original members of the Metropolitan Water District and began receiving Colorado River water transported by Metropolitan's Colorado River Aqueduct in July 1941. In the 1950s, when the population increased significantly, Anaheim turned to new industries such as aerospace, tourism and light manufacturing. In 1953 Walt Disney began his search for an ideal location to make a dream come true. In July 1955 Disneyland was opened to the public and soon became an important tourist center. Attendance each year now exceeds 10 million.

In 1966, Anaheim opened beautiful Anaheim Stadium, home to the Major League Baseball Anaheim Angels. At the same time the world-famous Convention Center also opened its doors, and this one-two punch helped solidify Anaheim as an attractive tourist destination. In 1994 the Anaheim Arena, now known as the Arrowhead Pond, became home to the Anaheim Mighty Ducks professional hockey team. This state-of-the art facility - which also showcases several games per season for the Los Angeles Clippers professional basketball team - is now the de facto standard by which many cities design their entertainment facilities.

The City of Anaheim, with world-renowned attractions such as Disneyland, Anaheim Stadium, Convention Center and Arena, is also home to more than 700 industries. It hosts millions of visitors each year from every corner of the world. Thirty-six parks are located within the City's boundaries with more planned. Over 60 elementary, junior high and high schools; two city-run golf courses; two senior centers; five libraries and a cultural arts center also contribute to the quality of life for Anaheim residents.

Why Plan for Natural Hazards in the City of Anaheim?

Natural hazards impact residents, property, the environment, and the economy of the City. Floods/storms, urban/wildland fires, earthquakes, dam failure, epidemics, high winds (Santa Ana Winds), vector invasions, mud and landslides, and in the past have exposed the City residents and businesses to the financial and emotional costs of recovering after natural disasters. The risk associated with natural hazards increases as more people move to areas affected by natural hazards.

Even in those communities that are essentially “built-out” (i.e. have little or no vacant land remaining for development) population density can continue to increase if low-density housing is replaced with medium and high-density development projects, or if the persons per household trend happens to rise.

The inevitability of natural hazards, and the growing population and activity within the City, create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events. Identifying the risks posed by natural hazards, and developing strategies to reduce the impact of a hazard event can assist in protecting life and property of residents and communities. Local residents and businesses can work together with the City to create a natural hazards mitigation plan addressing the potential impacts on City facilities and, thus, City services that would result from a hazard event.

Geography and the Environment

Located in northeastern Orange County, the City of Anaheim and its Sphere-of-Influence lies approximately 35 miles southeast of downtown Los Angeles and 7 miles north of Santa Ana. The City is surrounded by the Cities of Fullerton, Placentia, and Yorba Linda to the north; Riverside County to the east; the Cities of Orange, Garden Grove, Stanton, and unincorporated Orange County to the south; and, the Cities of Cypress and Buena Park to the west. The City encompasses over 32,000 acres of land, stretching nearly 20 miles along the Riverside (SR-91) Freeway, and includes another 2,431 acres of unincorporated land within its Sphere-of-Influence. In addition to SR-91, regional access to and from Anaheim is provided by the Santa Ana (I-5), Orange (SR-57) and Costa Mesa (SR-55) Freeways; the Eastern Transportation Corridor (SR 241); and Amtrak and Metrolink passenger train services at Angel Stadium and Anaheim Canyon Stations.

Anaheim is currently home to over 343,000 people, approximately 16,000 businesses, and over 4,600 acres of parks and open space. Over the next 20 years, the population is expected to grow to over 400,000. The City includes approximately 49.7 square miles. The City boundaries generally form an elongated irregularly shaped area, which extends approximately 16 miles east to west. Major freeways traversing the City include the I-5 Freeway, which travels generally northwest to southeast; the SR-57 Freeway, which travels north and south through the central portion of the City; the SR-55 Freeway, which abuts the southern edge of the City at the western edge of the Hill and Canyon Area; the SR-91 Freeway, which travels east and west along the northern portion of the City; and, the SR- 241, which travels north and south near the eastern edge of the City.

Figure 2.1 Regional Vicinity Map

The City of Anaheim and Sphere-of-Influence (see Figure 2-1, *Regional Vicinity Map*). Orange County is bordered by the Pacific Ocean to the west, Los Angeles County to the north and northwest, San Bernardino County to the northeast, Riverside County to the east, and San Diego County to the southeast. Orange County is comprised of approximately 798

square miles, stretching approximately 40 miles along the coast and extending inland approximately 20 miles.

Source: General Plan and Zoning Code Update, EIR No. 330. Certified May 25, 2004

Geographically, the City may be divided into to general areas to the west and east. The western portions of the City are characterized by relatively broad, flat lying ground which slopes gently to the southwest. This portion of the city consists of the alluvial plain areas between the Santa Ana River and the San Gabriel River. Ground elevations range from a low of approximately 45 feet above mean sea level (MSL) near the western boundary of Anaheim to a high of approximately 250 feet MSL near the intersection of the State Route 91 and State Route 55 freeways.

The eastern portions of the City include the relatively narrow alluvial plain areas along the Santa Ana River and relatively steep hillside terrain south of the Santa Ana River channel. The Santa Ana River flows through the eastern portions of the City entering from Riverside County and the Prado Flood Control Basin. The Santa Ana River flows through the Santa Ana Narrows, a steep canyon which has been cut through the Santa Ana Mountains to the south and Chino Hills to the north. The river channel generally flows from east to west along the north side of State Route 91 and then heads south near State Route 57. Elevations along the Santa Ana River range from approximately 250 to 400 feet MSL in the eastern half of the City. The steep terrain south of the Santa Ana River includes the Peralta Hills, which form a westerly trending ridge. The westerly nose of this ridge terminates at Burruel Point near the intersection of State Routes 55 and 91. The Peralta Hills reach elevations ranging from approximately 500 to 1,000 feet MSL along the ridgeline within the City. The majority of the hills within the City limits slope to the north toward the Santa Ana River. Major tributary drainages include Walnut Canyon, Gypsum Canyon, and Coal Canyon. The Peralta Hills merge with the Santa Ana Mountains to the east. In general, the ground topography to the east rises in elevation and becomes more rugged. The eastern limits of the City include the western flanks of Sierra Peak, which reaches an elevation of approximately 3,045 feet and is situated on the main divide of the Santa Ana Mountains.

One open reservoir is located in the eastern half of the City. The Walnut Canyon Reservoir is located on the east at the head of Walnut Canyon and has a spillway elevation of approximately 857 feet MSL. Walnut Canyon Reservoir became operational in 1963 and has a capacity of approximately 920 million gallons.

The Prado Dam and reservoir are located approximately 2 miles east of the City in Riverside County. The Prado Dam was completed in 1941, and was intended to provide flood protection to the Lower Santa Ana River Basin.

Source: General Plan and Zoning Code Update, EIR No. 330. Certified May 25, 2004

Land Use

The City of Anaheim is a geographically diverse community. The western and central portions of the City are characterized by relatively flat ground that slopes gently to the southwest. The land uses in this portion of the City are characterized by a mix of suburban and urban development and the area is relatively built-out. The area is home to the Downtown and the Anaheim Colony Historic District, which are located within the City's original 1.8 square mile boundary and contain a vast majority of Anaheim's valued historic structures.

The eastern portion of the City extends generally along the Santa Ana River to the Riverside County line. This part of the City includes hillside terrain and an abundance of natural resources. Residential development in the eastern portion of Anaheim largely consists of the various hillside communities on the south side of the Riverside Freeway that extend to the Eastern Transportation Corridor (SR-241). Other relatively flat residential neighborhoods are located north of the Santa Ana River and east of Imperial Highway, and generally south of the Santa Ana River at the intersection of the Riverside (SR-91) and Costa

Mesa (SR-55) Freeways. The Canyon, a regional employment center consisting of office, industrial and commercial uses that generally spans the north side of the Riverside (SR-91) Freeway between the Orange (SR-57) Freeway and Imperial Highway, is also located in the eastern part of the City.

In addition to the area contained within the City's boundaries, Anaheim's sphere of influence areas represent area where the City is anticipated to grow. Established by the Local Agency Formation Commission (LAFCO), spheres-of-influence are intended to reflect "the probable physical boundaries and service area" of cities. LAFCO is directed by State law (the Cortese/Knox Local Government Reorganization Act of 1985, as amended) to establish and periodically review the spheres-of-influence for each agency under its jurisdiction. These areas are characterized by a mix of residential and commercial uses.

Summary of Existing Land Uses

Various types of existing land uses are found throughout Anaheim and are categorized by uses that can be grouped into nine broad categories: Residential, Quasi-Public/Governmental, Industrial/Manufacturing, Commercial/Office, Entertainment/Lodging, Parks/Open Space, Water Uses/Waterways, Agriculture/Vacant, and Other.

Residential
Residential land uses account for nearly half of the total land area in the City, and are primarily devoted to single-family residential uses. Residential uses are found in nearly all areas of the City. A wide variety of housing types and affordability can be found throughout the City making it possible to provide for a diverse population both in age and income. Housing types range from large hillside estates to historic single-family homes, to duplexes and four-plexes, to multiple-family apartments and townhomes, and mixed-use developments.

Commercial/Office
Retail and service commercial uses in Anaheim follow the same basic pattern as most cities in North Orange County. That is, they are located primarily along arterial corridors. Two regional shopping areas are also located in the City, the Anaheim Plaza in West-Central Anaheim and The Festival in the Hill and Canyon Area. Office uses are generally dispersed throughout the City along arterial corridors and adjacent to its freeways, with small concentrations of larger-scale office buildings found in The Platinum Triangle and Downtown areas.

Entertainment/Lodging
Anaheim is known worldwide for its tourist attractions and sports/entertainment venues. These uses are concentrated in two adjacent areas separated by the Santa Ana (I-5) Freeway: The Anaheim Resort®, comprised of the Anaheim Convention Center, the Disneyland Theme Park, Disney's California Adventure Theme Park, Downtown Disney, and numerous hotels; and The Platinum Triangle, which includes the Arrowhead Pond and Angel Stadium of Anaheim. The Platinum Triangle is also home to a variety of restaurants, hotels and the Grove of Anaheim.

Industrial/Manufacturing
A critical component of Anaheim's economic base, manufacturing and industrial uses comprise a significant portion of Anaheim's land area. Much of Anaheim's manufacturing and lighter industrial uses are concentrated in The Canyon and in areas north of Angel Stadium of Anaheim. Some of the City's older and heavier industrial uses are concentrated in the North Central Industrial Area, generally located south of the Riverside (SR-91) Freeway between Lemon Street and Raymond Avenue, and in the southeastern portion of Downtown along the Metrolink railway. Consistent with the Anaheim Vision and General Plan Land Use Map, many of the Downtown industrial areas are transitioning to residential uses. Additional industrial uses are found in other areas of the City, particularly along freeways and railroads.

Quasi-Public/Governmental
Quasi-public and governmental uses include a wide range of uses: governmental office buildings, fire and police stations, hospitals, utility buildings and substations, community centers, assembly areas and libraries

and schools, among others. Their locations are found throughout the City in order to effectively serve the public. Quasi-public and governmental uses account for a relatively small portion of the City's total land area.

Parks/Open Space
Anaheim's parks and open space account for approximately 6% or just over 1,500 acres of the City's total land area. These areas include sports fields, playgrounds, nature preserves, golf courses, and other passive and active recreational uses.

Water Uses/Waterways
The Santa Ana River is the most prominent water feature in Anaheim. It runs through the Hill and Canyon Area and The Canyon alongside the Riverside (SR-91) Freeway and along the eastern edge of The Platinum Triangle. The river provides a scenic and recreational resource for the entire region. It also serves as the City's primary drainage and flood control facility, as well as the primary source for groundwater recharge in the City. Two smaller, yet important drainage and flood control facilities in western Anaheim are the Carbon Creek Channel and the Anaheim/Barber City Channel. Another major water-related facility includes the 920-million gallon Walnut Canyon Reservoir, located in the Hill and Canyon Area.

Agriculture/Vacant Lands
Although nearly 3,400 acres of land in Anaheim is utilized for agricultural purposes or is vacant, very little remains that is not already entitled for future development. The primary exceptions are the many utility easements that are envisioned to serve as trail connections, passive open space or low intensity commercial uses. The largest portion of vacant land is found in the Mountain Park Specific Plan area on the eastern edge of the City. The area includes 3,169 acres and is planned for a mix of residential uses, a park, a school, a fire station and open space.

TABLE 2.1: EXISTING AND GENERAL PLAN LAND USES

	2002 Existing Land Use	Potential General Plan Buildout	Remaining Buildout Potential
Single Family Dwelling Units	45,807	55,463	9,656
Multi Family Dwelling Units	55,979	73,697	17,718
Total Dwelling Units	101,786	129,159	27,373
Population	337,700	403,773	66,073
Commercial Square Footage	9,029,400	14,885,342	5,855,942
Office Square Footage	7,775,167	15,021,049	7,245,882
Industrial SF	44,467,380	30,614,730	-13,852,650
Total SF	61,271,947	60,521,121	-750,826
Commercial Employment	25,829	95,453	69,624
Office Employment	25,569	58,793	33,226
Industrial Employment	121,189	63,292	-57,897
Other Employment	29,793	33,858	4,065
Total Employment	202,378	251,397	49,018

Notes:

- The figures contained herein are based on GIS mapping data prepared as part of the General Plan and Zoning Code Update.
- 2002 existing dwelling unit data and non-residential square footage provided by the City of Anaheim.
- Dwelling unit projections assumes 50-50 split of SF and MF dwelling units in the Low Medium Density and Hillside Low Medium Density categories.
- 2002 population source: California Department of Finance (January 2002)Center for Demographic Research (2002)
- Population projections assume average household size of 3.3 for non-mixed-use designations and 1.5 for mixed-use designation.
- 2002 employment data provided by Parsons Brinckerhoff. Employment is based on existing square footage of employment generating land uses and traffic trips.
- Hotel rooms are included in the Commercial square footage.
- Open space acreage is not shown.

The Formation and Development of Anaheim

Anaheim, now the tenth largest city in California, began in 1857 as a colony of German farmers and vintners grounding the City's initial development for agriculture. Among the crops for the first few decades were grapes grown for wine. However, a plague in the 1870's wiped out the vineyards and in their place, groves of citrus trees were planted.

The city was incorporated in 1876 with a population of 881. The rural, agricultural community grew slowly, but steadily for the next several decades. In 1887, the construction of the Santa Fe depot linked Anaheim's citrus growers with the East, providing vital markets for their golden crops. By 1920, the population had risen to 5,526.

The economic and industrial boom that followed World War II sparked the third wave of growth in Southern California, including Anaheim. From downtown Los Angeles, development grew in all directions, giving birth to a patchwork skyline of two-and three-story buildings as far as the eye could see. New businesses and rows of tract homes sprung up by the thousands in once remote suburban areas.

As Anaheim's reputation as a good place to live, work or run a business grew, City government rushed to meet the demand, creating an environment in which these tremendous changes could flourish. The City annexed 1,493 acres in 1953 to accommodate new development. The following year, an additional 2,700 acres were annexed. In 1955, the year Disneyland opened, 3,300 more acres were included within the city limits. By the end of that year, Anaheim was four times the size it was in 1953.

Convention Center

The original Convention Center boasted 400,000 square feet, including a 9,100-seat arena, when it opened in July 1967. That year, the center hosted 45,000 delegates and had to turn away many more for lack of adequate space. Twenty years later, the facility attracted almost 6 million guests and was still turning away business

The latest phase of expansion activity was completed in December of 2000 and today the Convention Center is the largest convention center on the West Coast hosting approximately one million attendees annually. Its total facility area is 1.6 million square feet; exhibit space is 815,000 square feet; with 130,000 square feet dedicated to meeting space.

Freeway

In the 1960's, an attempt to annex Yorba Linda was abandoned and attention turned to developing an "industrial corridor" stretching along the Santa Ana River and the newly built Riverside Freeway.

The corridor extended along the base of Anaheim Hills, a new master-planned community beginning to take shape to the east. Interest in the development of this primarily rural area mounted as the business parks of the industrial corridor below filled with tenants. City planners saw development of the Hills as a natural extension of the expanding business community, providing a growing workforce with nearby housing.

Railways

Approximately two hundred Burlington Northern Santa Fe railway, Metro link, and AMTRAK trains pass through the County of Orange each day. It is established by the year 2010, 265 trains will be entering the County for destinations located around the U.S. 100 passenger and 165 freight. By 2025, it is estimated the total number of trains entering the County will increase to 390, 140 passenger and 250 freight. From the west, the railroad enters the County from Los Angeles and separates into two directions. One railway follows and east-west direction to the county of Riverside. The other line follows a southeast direction to the County of San Diego. The railway lines entering the County from Los Angeles originate from the ports of Long Beach and Los Angeles. In year 2000, the two ports handled 9.5 million twenty-foot equivalent unites (TEUs) of cargo, by 2020 that number will be 36 million, a 280% increase.

Rivers
Anaheim's name is loosely derived from the German "Heim" meaning home and "Ana" indicating the Santa Ana River. Anaheim is thus a home by the river. The Santa Ana River traveling through the Santa Ana Canyon flows along the northeastern portion of Anaheim and then traverses in a southerly direction in the central part of Anaheim paralleling both the 57 freeway and City of Orange. The Santa Ana River is controlled primarily by the Orange County Flood Control District with portions of the river owned by the Orange County Water District.

Climate
The climate of Orange County is typified by warm temperatures and light winds. The average monthly temperatures range from about 52^{o} Fahrenheit (F) in the coastal areas in January, to 72^{o} F in the inland areas of the coastal plain in August. The average rainfall across the County is 14 inches, typically occurring in the winter months. The County's rainfall also exhibits characteristically wide variations annually, from a low of 3.6 inches in 1961 to a high of 32.1 inches in 1940.

Significant Geologic Features
The City of Anaheim is situated in the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin, south to the southern tip of Baja California (Norris and Webb, 1990). The province varies in width from approximately 30 to 100 miles.

In general, the province consists of a northwest-southeast oriented complex of blocks separated by similarly trending faults. The basement bedrock complex includes Jurassic age metavolcanic and metasedimentary rocks, and Cretaceous age igneous rocks of the southern California batholith.

Anaheim extends from the southerly portion of the Los Angeles Basin easterly into the northern portions of the Santa Ana Mountains. The western portions of Anaheim are located within the Central Block of the Los Angeles Basin (Nonis and Webb, 1990). The Central Block is characterized by thick sequences of alluvium overlying predominantly sedimentary rock of Pleistocene through Cretaceous age. The depths to crystalline basement rocks are known from petroleum well logs and geophysical data. The total thickness of the sedimentary section is roughly 13,000 feet near the southern end of the Los Angeles Basin.

The eastern portions of the City extend along the Santa Ana River and the northern portions of the Santa Ana Mountains. The Santa Ana Mountains form a dominant feature of the northern Peninsular Ranges. The general cross section of the Santa Ana Mountains consists of an anticlinal fold across the Whittier-Elsinore fault zone (Schoellhamer, et at., 1981). The crest of the fold parallels the mountain ridgeline with a gently dipping southwestern flank and a steep, down-faulted northeastern limb. Additional intermediate folding has been superimposed on the major anticlinal feature. The Santa Ana River generally follows the axis of a syncline that plunges westerly. The southern flanks of the syncline form the Peralta Hills, which merge with the Santa Ana Mountains to the east. Tertiary through Cretaceous age sedimentary rock units are exposed in the hillside areas south of the river. The distribution of sedimentary rocks in the hillside areas of Anaheim reflects the geologic structure of the syncline, as well as numerous discontinuous faults.

In general, the younger rock units are exposed in the western and northwestern portions of the hillside areas becoming progressively older to the east and southeast. The Cretaceous age rock units are generally limited to the eastern portions of the City.

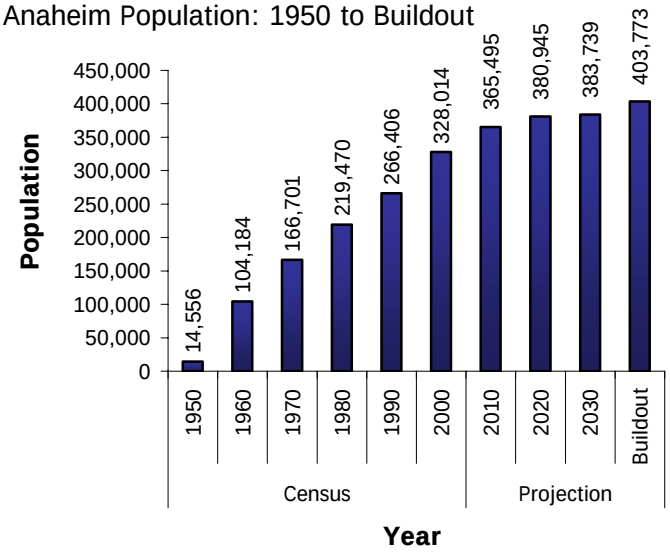
Population and Demographics
According to the U.S. Census Bureau's 2000 Census, Anaheim's population reached 328,014 as of April 1, 2000. This represented an addition of 61,608 residents since the 1990 U.S. Census and continues the growth trend that the City has experienced since its incorporation. Statewide, Anaheim ranks as the 10th largest city in California for population. Nationally, Anaheim's population ranks 56th and is similar in size to such cities as Tampa, FL; Toledo, OH; Cincinnati, OH; Arlington, TX; Pittsburgh, PA; Wichita, KN; and St. Louis, MO.

The State of California, Department of Finance estimates Anaheim's population to be 343,046, a growth of over 15,000 people since the Census was taken in 2000. Population is anticipated to reach 383,739 by 2030 and 403,773 at buildout. While growth has been rapid since 1950, the rate is expected to slow in the future as the growth in housing units slows due to lack of available vacant land for new development.

Anaheim's population is overall younger than Orange County and the State of California at 33.3 years. According to the 2000 Census, Anaheim has a growing youth and senior population, which follows trends in the Southern California region. Anaheim's youth population, 0 to 17 years, grew by 43% from 1990 to 2000 from 68,995 to 98,964. The 5 to 9 years age group is the largest group of youths, 30,282, representing 9.2% of Anaheim.s total population. Similar to the youth population, the

Senior population is growing. There has been a 13% increase since 1990 in family households where the householder is 65 years or older. In fact, 19% of all the City's households have at least one person 65 years or older.

Figure 2.2
Anaheim Population: 1950 to Buildout



Land and Development

The City of Anaheim is located in Central Orange County, 35 miles southeast of downtown Los Angeles and 7 miles northwest of Santa Ana. At the time of its incorporation in 1876, Anaheim was 2.6 square miles. Today, the city encompasses 50 square miles of land. Development prior to the 1950's was primarily to serve the regions agricultural industry and the people who worked in the industry. Since the 1950's, development has transitioned into a suburban environment with little agriculture. Additionally, Anaheim has a significant amount of development supporting the tourist and sports industry including Disneyland, the California Adventure, the Anaheim Stadium, the Pond, and the Anaheim Convention Center. These developments have required significant amounts of area to be devoted to the support of these industries and includes areas for restaurants, hotels, and other support services.

Table 2.2: CITY OF ANAHEIM APPROVED SPECIFIC PLANS

Number	Plan Name
87-1	The Highlands at Anaheim Hills (2,168 dwelling units)
88-1	Sycamore Canyon (1,204 dwelling units)
88-2	The Summit of Anaheim Hills (2,139 dwelling units)
88-3	Pacificenter Anaheim
90-1	The Anaheim Hills Festival (259 dwelling units)
90-2	East Center Street Development (390 dwelling units)
90-4	Mountain Park
92-1	The Disneyland Resort
92-2	The Anaheim Resort®
93-1	Hotel Circle (390 dwelling units)
94-1	Northeast Area (Anaheim Canyon Business Center)

Housing and Community Development

Anaheim's housing was reported to be 99,719 units by the 2000 Census. This was an increase of over 6,500 housing units since the 1990 Census. Although Anaheim has remained a growth leader in housing throughout Orange County, the increase in units between 1990 and 2000 was the smallest in the past five decades, due primarily to decreasing supplies of vacant, developable land. As of January 1, 2004, the California Department of Finance estimated that the total number of units grew to 101,527 units. Also reflective of the decrease in the number of new units, the vacancy rate in existing units also decreased from 6.0% in 1990 to 2.8% in 2000 and the number of persons in each household increased from 2.7 in 1990 to 3.3 in 2000. In addition to the changes above, Anaheim experienced a change in the ownership of units. Between 1990 and 2000, owner-occupied housing increased from 49.2% of households to 50% of households while renter occupied decreased from 50.8% to 50%.

Employment and Industry

Anaheim's population works in various industries both within the City and in the region. In the 2000 Census, the largest group (20.2%) of the civilian labor force in Anaheim identified themselves as part of the manufacturing industry. This was followed by the educational, health, and social services industry (14.2%) and retail trade (11.5%). A full listing of the industries worked in by Anaheim's residents is listed in the table below.

Table 2.3: Employment by Industry in Anaheim (2000 Census)

	Anaheim	
Industry	**Number**	**Percent**
Agriculture, forestry, fishing, hunting, mining	411	0.3%
Construction	9,714	6.8%
Manufacturing	28,854	20.2%
Wholesale trade	7,522	5.3%
Retail trade	16,409	11.5%
Transportation, warehousing, utilities	5,307	3.7%
Information	3,539	2.5%
Finance, insurance, real estate, rental and leasing	10,414	7.3%
Professional, scientific, management, administrative, waste mgmt	14,511	10.2%
Educational, health, social services	20,252	14.2%
Arts, entertainment, recreation, accommodation, food service	14,691	10.3%
Public administration	3,915	2.7%
Other services	7,286	5.1%
Total	**142,825**	**100.0%**

Mitigation activities are needed at the business level to ensure the workers safety and limit damage to industrial infrastructure. Employees are highly mobile, commuting from surrounding areas to industrial and business centers. This creates a greater dependency on roads, communications, accessibility and emergency plans to reunite people with their families. Before a natural hazard event, large and small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Transportation and Commuting Patterns

Transportation is dominated by the seven interstate and state routes that traverse the 50 square miles of Anaheim. Four freeway-to-freeway interchanges and 35 bridge crossings of freeways and arterials are a part of our transportation network. Nearly 40 centerline miles of freeway carry more than one million vehicles per day. Carpool lanes are provided along all but three miles of freeway through Anaheim. Poor levels of service ("LOS" E and F) are routine during peak periods of the day.

Commute patterns involve heavy demands westbound and southbound in the morning peak periods and eastbound and northbound in the afternoon peak periods. Traffic commonly re-routes from congested

freeways onto parallel arterials, including La Palma Avenue, Santa Ana Canyon Road, and State College Boulevard.

Alternative transportation modes are becoming more available. Metrolink commuter rail has two stations in Anaheim: Anaheim Canyon station and Anaheim Angel Stadium station. In the near term, trains will arrive from each direction approximately every thirty minutes. The Angel Stadium station is also served by AMTRAK. The Orange County Transportation Authority (OCTA) bus system provides over seven percent of the home based-work trips.

The City, through its Commuter Services office, continues to work with the South Coast Air Quality District in an effort to increase shared or alternative commuting options and to educate employees of the benefits of ridesharing both from the financial prospective and for the health of our environment.

Part One

Chapter Three
Risk Assessment

Overview of the Risk Assessment Process

Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Specifically, the levels of a risk assessment are as follows:

Hazard Identification

The City identified eight major hazards that may affect this geographic area. These hazards include: flood/storm, urban/wildland fires, earthquakes, dam failure, epidemic, high winds/Santa Ana winds, vector issues, and mud/landslides. They were identified through an extensive process that utilized input from the Emergency Response Plan, General Plan and its Environmental Impact Report, and the Hazard Mitigation Task Force. The geographic extent of many of the identified hazards has been identified through use of the City's Geographic Information System (GIS) using the best available data, and is illustrated by the charts/maps listed in Appendix C of this plan.

Profiling Hazard Events

The profiling process describes the causes and characteristics of each hazard, how it has affected the City of Anaheim in the past, and what part of the City's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard section.

Vulnerability Assessment and Inventorying Assets

The City underwent a combination of hazard identification with an inventory of the existing (or planned) property development(s) exposed to a hazard. 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 functions. The critical facilities have been identified, documented, and mapped. Due to the sensitive nature of listing these critical facilities, a description of these critical facilities may be requested through the Anaheim Fire Department. In addition, the plan includes a community issues summary in each hazard section to identify the most vulnerable and problematic areas in the City.

Risk Analysis

Estimating potential losses involves assessing the damage, injuries, and financial costs likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are magnitude of the harm that may result and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the City and the State with a common framework in which to measure the effects of hazards on assets. For each hazard where data was available, quantitative estimates for potential losses are included in the hazard assessment.

Assessing Vulnerability and Analyzing Development Trends

This step provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use decisions.

Critical Facilities and Infrastructure

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include: 911 centers, emergency operations centers, police and fire stations, public works facilities, communications centers, sewer and water facilities, hospitals, bridges and roads and shelters. Facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." A hazardous material facility is one example of this type of critical facility.

Critical and essential facilities are those facilities vital to the continued delivery of key government services or that may significantly impact the public's ability to recover from the emergency, for example, jail, or law enforcement centers

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR part 201 include a requirement for risk assessment. The risk assessment requirement is intended to provide information that will help communities to identify and prioritize mitigation activities that will reduce losses from the identified hazards. The Federal criteria for risk assessment and information on how the City's Natural Hazard Mitigation Plan meets those criteria are outlined in Table 3.1 below.

Table 3.1: Federal Criteria For Risk Assessment

Section 322 Plan Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes an inventory of the best available data sources that identify hazard areas. To the extent GIS data is available, the City developed maps identifying the location of the hazard in the City. The Executive Summary and the Risk Assessment sections of the plan include a list of the hazard maps.
Profiling Hazard Events	Each hazard section includes the documentation of the history, causes, and characteristics of the hazard in the City.
Assessing Vulnerability: Identifying Assets	Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section provides a Community Issues section that identifies information on vulnerable areas in the City. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses	The Risk Assessment Section of this mitigation plan identifies key critical facilities and lifelines in the City and includes a map of these facilities. Vulnerability assessments have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available.
Assessing Vulnerability: Analyzing Development Trends	The Profile section of this plan provides a description of the development trends in the City including the geography and environment, populations and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Hazard Identification

The past history of Anaheim indicates three specific natural hazard threats for the area. These three have occurred with more frequency than other potential events, and thus these three are ranked the highest with regard to mitigation actions.

The City completed a hazard analysis and ranked the following natural hazards accordingly.

Table 3.2
Natural Hazard Analysis

Planning Priority	Risk	Chance of Occurrence*	Effect**
1	Earthquake/Landslides	10	5
2	High Wind/Santa Ana Wind	10	5
3	Urban/Wildland Fire	7	5
4	Flood/Storm	5	5
5	Dam Failure	5	5
6	Vector	5	5
7	Epidemic	5	5
8	Tornado	1	10

Chance of Occurrence and Effect numbers are rated from one to ten (1 to 10). Higher numbers signify greater chance of occurrence and greater effect.

* Chance of Occurrence is based on Anaheim history and potential.

** Effect is the worst-case scenario

Profile of Hazard Events

Summary

Hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities.

Flood: Storm and Dam Inundation

The following discussion addresses the threat of storm-related flooding and has been updated from material found in the Safety Element of the City's General Plan and from information in the City's Emergency Response Plan.

General Situation

The potential for flooding is a safety concern that Anaheim addresses through a citywide flood program and coordination with County and State agencies in any flood event. The Federal Emergency Management Agency (FEMA) has determined that, with the exception of fire, floods are the most common and widespread of all natural disasters affecting the United States. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow thaws.

Congress developed the National Flood Insurance Program (NFIP) in 1968 to respond to the elevating cost of taxpayer-funded disaster relief for flood victims and the increasing level of damage that was caused by flooding. According to FEMA, approximately 20,000 communities across the United States, including Anaheim, participate in the NFIP through the adoption and enforcement of floodplain management ordinances. These ordinances help to reduce future flood damage, and in return, the NFIP makes Federally backed flood insurance available to homeowners, renters, and business owners in participating communities.

Local Profile

Since Anaheim is partially located in an alluvial plain, drainage stemming from the mountains to the north and east must cross Anaheim to reach the coast. The Santa Ana River flows through the eastern part of the City entering from Riverside County and the Prado Flood Control Basin. Drainage through the City is controlled and directed via storm drains, channels and the Santa Ana River.

Figure 3.1 identifies areas within the City that have the potential to be impacted in the event of a 100-year or 500-year flood. Due to the elevated topography of the eastern portion of the City, the majority of the City south of Santa Ana Canyon Road is outside of the 500-year flood zone. FEMA's Flood Insurance Rate Maps (FIRMs) provide more detailed flood hazard map information and current maps are available in the Planning Department and the City's Main Library.

In addition to the Santa Ana River, the City is at risk for flooding due to surface drainage through the streets and storm drains. The drainage pattern in the City varies and most runoff is conveyed on street surfaces and local storm drain facilities, which convey runoff to the regional facilities owned and maintained by the Orange County Flood Control District. The topography of the City is relatively flat, with the exception of the eastern area of the City and its sphere-of-influence (south of SR-91), which is comprised of hills and canyons. The existing storm drain system is illustrated in Figure 3.1.

The storm water facilities in the City are divided into three categories:

- Regional facilities: Santa Ana River and major channels
- Intermediate Facilities: Lesser channels and detention facilities
- City Facilities: Local storm drains and appurtenant facilities

Most regional facilities are owned and maintained by the Orange County Flood Control District (OCFCD). The largest facility, the Santa Ana River, however is owned and operated by the U. S. Army Corps of Engineers, but is supplemented by the following major channels owned by OCFCD:

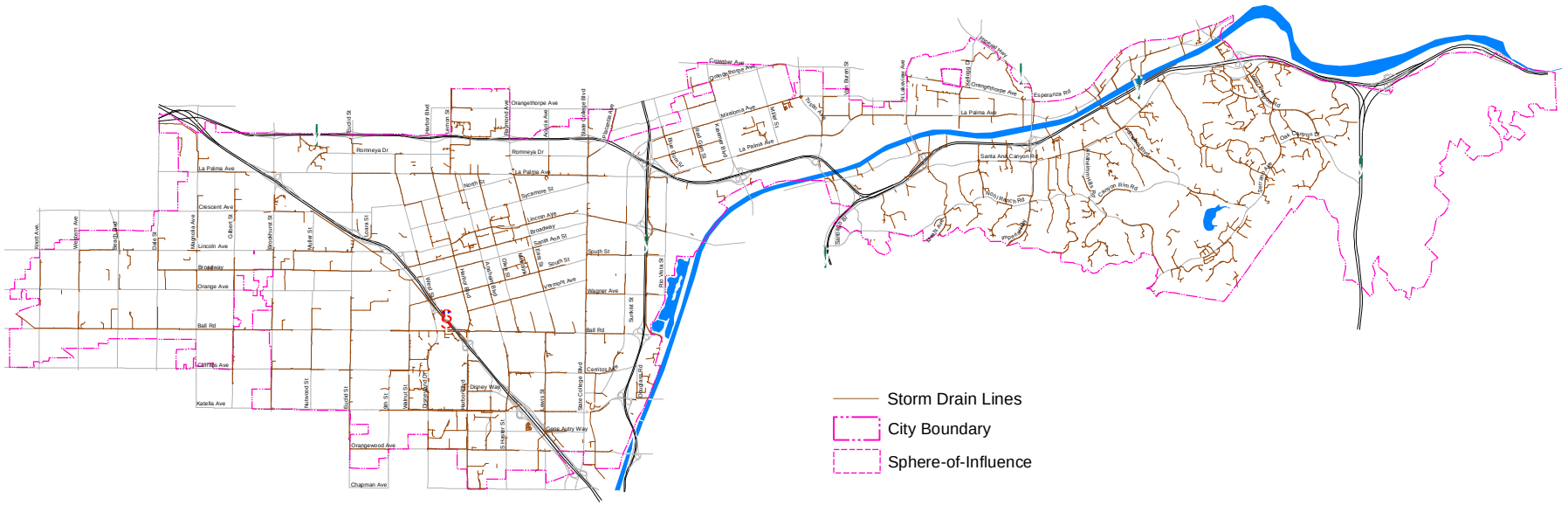
- Carbon Creek Channel
- Anaheim-Barber City Channel
- East Garden Grove-Wintersburg Channel

The following lesser channels (Intermediate Facilities) are also owned and maintained by the OCFCD:

- Carbon Canyon Diversion Channel
- Carbon Canyon Channel
- Atwood Channel
- Richfield Channel
- Southeast Anaheim Channel
- Esperanza Channel
- Gypsum Creek Channel
- Walnut Canyon Storm Drain
- Deerfield Storm Channel
- Chantilly Storm Channel
- West Anaheim Storm Drain

Historically, all local streets and arterial highways in Orange County, including Anaheim, functioned as drainage conveyances, in addition to their primary function of transportation. However, with the urbanization of the area, the need for drainage systems became more apparent and storm drain construction began in the late 1950s and early 1960s.

Storm Drain System



Drainage Standards and Criteria

The following is a summary of existing storm design frequency requirements within the City based on the City's Drainage Design Manual:

- 100-year design storm shall be used for arterial highways in hillside areas and storm drains connecting to the Santa Ana River.
- 25-year design storm shall be used for arterial highways in flatland areas, local streets in hillside areas, and all storm drains in sump conditions.
- 10-year design storm shall be used for local streets in flatland areas, and onsite private drainage systems.

The County of Orange's minimum criteria for County channels is to provide at least a 20-year channel capacity, provided that buildings are protected from inundation for a 100-year storm event. Major regional drainage facilities such as the Santa Ana River are designed to provide protection against major loss of life and property for a 100-year event. It is the goal of the County of Orange and the Orange County Flood Control District (OCFCD) to provide 100-year flood protection for all buildings. To provide for this goal, OCFCD attempts to design facilities to convey 100-year flows where feasible. Several OCFCD's facilities are a mixture of segments built at different times. Improvements of deficient OCFCD facilities are programmed in OCFCD's Seven-Year Flood Control Projects Plan subject to annual review and revision based on Countywide prioritization. The County recommends that cities condition developments located adjacent to flood control channels to participate in funding to implement improvements to OCFCD's deficient flood control channels so that the needed protection for the proposed developments may be provided.

With the exception of the South Central Anaheim area, which drains into the Anaheim-Barber City Channel, a 25-year storm design standard should be used for all other City-owned and maintained channels (and their tributary areas) within the City. Because the Anaheim/Barber City Channel can only convey the maximum flow of a 10-year storm, the facilities that are tributary to the channel are master planned to accommodate only a 10-year storm.

Local Drainage Facilities

In 1973, a Master Plan of Drainage was developed for the entire City. In this Master Plan, the City was divided into 44 distinct watershed areas, designated as Districts. Storm drain deficiencies and the needed drainage facilities were also identified. Since then, significant improvements to the system of drainage facilities have occurred. Due to changes in drainage patterns development conditions and hydrologic criteria in certain areas of the City since 1973, updated Area Master Plans of Drainage have been prepared and approved. These Area Master Plan Revisions, which revised the 1973 Master Plan for selected areas of the City are: District 27, South Central Area and Northeast Industrial Area. The discussion of drainage conditions has been organized according to seven geographic areas of the City. The areas and the encompassing Drainage Districts from the City's Master Plan of Drainage are illustrated in Table 3.4. The location of each of the districts can be found on Figure 3.1, *Existing Storm Drain System Map*, found earlier in this chapter.
Source: City of Anaheim General Plan EIR

TABLE 3.3: DRAINAGE DISTRICTS

Geographic Area	***Drainage Districts***
West Anaheim	Districts 1 through 14
North Central Anaheim	Districts 15 through 17 and 28
South Central Anaheim	Districts 18 through 26
Northeast Industrial	Districts 29 through 35
The Platinum Triangle	District 27
Hill and Canyon Area	Districts 36 through 43
East Anaheim Undeveloped Hills and Canyons	District 43 and Districts 98 and 99 (Gypsum and Coal Canyons)

Source: PSOMAS City of Anaheim General Plan Update Drainage Report: Baseline Conditions, Opportunities and Constraints (December 2001).

Condition of Existing Drainage Facilities

Statistical techniques, through a process called frequency analysis, are used to estimate the probability of the occurrence of a given precipitation event. The recurrence interval is based on the probability that the given event will be equaled or exceeded in any given year. For example, a 100-year storm event has a 1% chance that it will be equaled or exceeded in any given year, or a 100% chance that it will occur within 100 years. Therefore, a 100-year storm event will have a larger peak flow than a 10-year storm event or a 25-year storm event. The estimated storm runoff for 10-, 25-, and 100-year storms were computed for the 12 districts within the City, for which post-1986 studies or master plans were not available. Results from the hydrologic analysis are summarized in Table 3.4.

TABLE 3.4: SUMMARY OF HYDROLOGIC RESULTS (PEAK FLOWS)

District	***Tributary Area (acres)***	***Q-10 (cfs 1)***	***Q-25 (cfs)***	***Q-100 (cfs)***
5	371	300	380	503
9	319	212	278	379
14	622	587	707	944
28	956	770	986	1,340
36	448	709	875	1,150
	332	333	422	568
37	307	551	678	893
	371	660	813	1,072
	286	563	691	908
38	683	1,146	1,415	1,871
39	1,639	2,233	2,791	3,683
40	536	802	991	1,300
	184	346	425	558
41	940	1,519	1,876	2,478
43	1,326	2,379	2,896	3,780
	143	328	400	525
	311	614	759	1,001

Source: PSOMAS City of Anaheim General Plan Update Drainage Report: Baseline Conditions, Opportunities and Constraints (December 2001).

[1] cfs = cubic feet per second.

Existing storm drain system capacities within the City (for all areas except for the area tributary to the Anaheim-Barber City Channel) were evaluated relative to 25-year flows. Drainage areas tributary to the Anaheim-Barber City Channel were evaluated relative to 10-year flows. Table 3.6 presents a summary of local (City) facility baseline drainage conditions. Figure 5.7-2, *Existing Storm Drain Conditions Map*, provides an overview of the condition of existing City-owned and maintained drainage systems within the City.

TABLE 3.5
LOCAL FACILITY BASELINE CONDITIONS SUMMARY

Geographic Area	**Conditions Summary**
West Anaheim (Districts 1-14)	The majority of the storm drain system within each of the Districts in this area appears to be inadequate.
North Central Anaheim (Districts 15-17 and 28)	Most of the systems appear to be adequate except for small segments in the westerly portion of Districts 16 and 17.
South Central Anaheim (Districts 18-26)	The majority of the main collector facilities in the north and central portions of the area appear to be inadequate. The remaining areas appear to have generally adequate drainage systems, except for limited segments.
Northeast Industrial (Districts 29-35)	The majority of the systems in this area appear to be inadequate.
The Platinum Triangle (District 27)	Most of the storm drains in this District appear to be inadequate.

Geographic Area	Conditions Summary
Anaheim Hills/Santa Ana Canyon (Districts 36-43)	The majority of the systems appear to be adequate. Districts 37, 41, 42, and 43 appear to be in the best condition.
East Anaheim Undeveloped Hills and Canyons (Gypsum and Coal Canyons)	This area is mostly undeveloped and consequently there are no existing drainage improvements in the area. Caltrans does have a box culvert located near Gypsum Canyon and the SR-91 Freeway.

Source: PSOMAS City of Anaheim General Plan Update Drainage Report: Baseline Conditions, Opportunities and Constraints (December 2001).

Various goals and policies contained in the General Plan direct the City to maintain and improve the City's storm water drainage systems to keep pace with growth. Current deficiencies will be mitigated through on-going capital improvements, implementation of applicable General Plan Goals and Policies and the mitigation measures contained in EIR No. 330 (adopted in conjunction with the General Plan Update).

Flood Hazards

As part of the National Flood Insurance Program (NFIP), floodplain studies have been performed for various communities in Orange County including the City of Anaheim. In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of floodplain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. The results of these studies are presented in the Flood Insurance Rate Maps (FIRMs). These maps contain official delineation of flood insurance zones and base flood elevation lines.

The Federal Emergency Management Agency (FEMA) prepares Flood Insurance Rate Maps (FIRMs) that show the extent of Special Flood Hazard Areas (SFHAs) and other thematic features related to flood risk assessment. Flood areas are illustrated in Figure 3.2, *Flood Hazard Areas.*

SFHAs are areas at or below a flood elevation that have a 1% or greater probability of being equaled or exceeded during any given year (this is also known as a 100-year flood event). This flood, which is referred to as the base flood, is the national standard on which the floodplain management and insurance requirements of the National Flood Insurance Program (NFIP) are based.

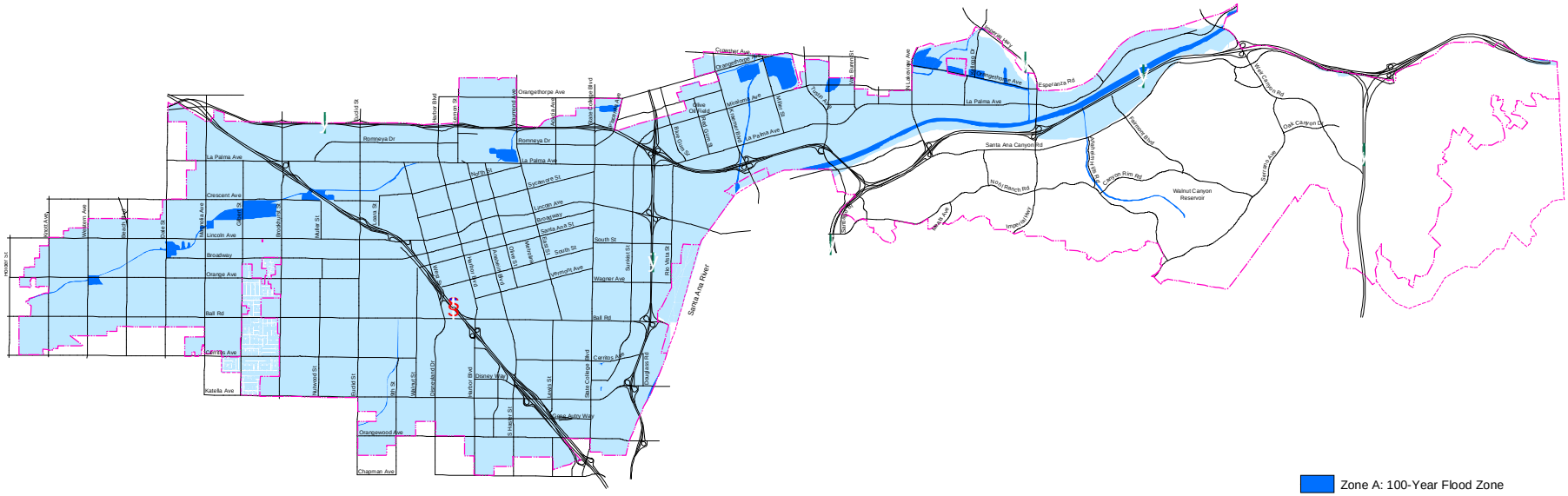
The flood hazard zones within the City of Anaheim include Zone A (Including AH, A99, and AO), Zone X 500 (shaded) and Zone X (unshaded). The following is a brief overview of constraints in each zone:

- **Zone A:** Special flood hazard areas inundated by the 100-year flood. Zone A identifies where no base flood elevations have been determined. Base flood elevations have been determined for Zones AH, A99, and AO. Any mandatory flood insurance purchase requirements apply.
- **Zone X 500 (shaded):** Land that has the potential to be flooded in a storm that has a 0. percent chance of occurring every year and areas of 100-year flood with average depths less than one foot or with drainage areas less than one square mile; and areas protected by levees from a 100-year flood.
- **Zone X (un-shaded):** Areas determined to be outside the 500-year floodplain.

References

In addition to the City's Emergency Response Plan (ERP), the City of Anaheim General Plan contains a specific goal and set of policies addressing potential flooding in the City. This goal is:

Flood Hazard Areas



Source: FEMA, February 18, 2004

Safety Element, Goal 3.1

Reduce, to the greatest extent possible, the risk to life, property, public investment, and social order created by flood hazards.

Policies:

1. Evaluate all development proposals located in areas that are subject to flooding to minimize the exposure of life and property to potential flood risks.
2. Provide appropriate land use regulations and site development standards for areas subject to flooding.
3. Encourage new development to maintain and enhance existing natural streams, as feasible.
4. Continue to participate in the National Flood Insurance Program.
5. Continue to comply with the Cobey-Alquist Floodplain Management Act requirements and State of California Model Ordinance.
6. Continue to work with the Orange County Flood Control District and the United States Army Corps of Engineers to receive and implement updated flood control measures and information.
7. Utilize flood control methods that are consistent with Regional Water Quality Control Board Policies and Best Management Practices (BMPs).

Additionally, the following policies in other sections of the General Plan are applicable:

- Cooperate with surrounding jurisdictions and the County of Orange to provide adequate storm drainage facilities. (Green Element, Goal 7.1, Policy 3)
- Improve the City's storm drain system to address current deficiencies as well as long-term needs associated with future development to minimize flood damage and adequately convey rainfall and subsequent runoff from a 25-year frequency storm. (Public Services and Facilities Element, Goal 6.1, Policy 1)
- Minimize the amount of impervious surfaces in conjunction with new development. (Public Services and Facilities Element, Goal 6.1, Policy 3)

Two mitigation measures were adopted as part of the Environmental Impact Report for the General Plan and are currently being implemented by the City:

5.7-1 The City shall work with the Orange County Flood Control District (OCFCD) to ensure that flood control facilities are well maintained and capable of accommodating, at a minimum, future 25-year storm flows for City-owned and maintained facilities, and 100-year storm flows for County facilities. Where improvements to local drainage facilities have the potential to increase discharges to County facilities, the City shall analyze potential impacts to County facilities in consultation with the Manager, County of Orange Flood Control Division. Encroachment Permits shall be obtained from the County's Public Property Permits Section for any activity performed within OCFCD's right of way.

5.7-2 The City shall require that new developments minimize stormwater and urban runoff into drainage facilities by incorporating design features such as detention basins, on-site water features, and other strategies.

Finally, the City of Anaheim, through its participation in the Community Rating Survey (CRS) program, undertakes several public outreach projects each year to educate the general public, as well as those in the floodplain, about the dangers of flooding, safety measures, emergency preparedness, and the availability of flood insurance.

History of Flooding

Flood history and potential

In the past 100 years, the 1938 flood was probably the largest one on the Santa Ana River in terms of peak flow, which was about 100,000 cubic feet per second (cfs). The rainfall that week in the Santa Ana Basin was about 10 inches toward the end of a long wet winter. If that flood occurred today with Prado Reservoir in place, the reservoir would catch the flood without any large uncontrolled spillway flow. There would be only a moderate flow down the canyon similar to releases occurring in 1969, 1978, and early 1980. In 1938 we had about 100,000 cfs entering Orange County, but today it would take about a 150-year flood to have that kind of flow across Orange County. If this did happen, it would cover about 80,000 acres and the damages would be about $6 billion. It would approach the severity of a standard project flood (200-year flood).

In early 1969, there was about 6 inches of rain in 3 days on January 24 through 26. Prado Reservoir filled to about one quarter full. The reservoir had not completely emptied when another severe storm came a month later. There was again about 6 inches of rain in 3 days from February 23rd to February 25. This time the reservoir filled to over half full, the highest level it had ever risen to since the dam was completed in 1941. The peak flow in the river was not nearly as great as it was in March 1938, only about 70,000 cfs, but the volume of water entering into the reservoir was much greater, about 130,000 acre-feet in a few days in late February.

The next medium to large flood occurred early in 1978 with the peak inflow coming about 4 March. There was enough volume of water to fill the reservoir to over 40% full; however, the peak inflow of the streams into the reservoir was not notoriously high, only about 35,000 cubic feet per second. The rainfall was about 5 inches from March 3 to March 5.

In early 1980, the worst flooding occurred from February 15 through the 18. The inflowing river did not rise to any high peak, only about 40,000 cfs, but the flow continued at a fairly high level for many hours. The reservoir rose to its highest level ever, 528 feet elevation, which was a little higher than the previous record set in February 1969. The rainfall averaged about 8 inches above Prado Basin during the worst 4 days. The reservoir released outflows at a rate somewhat faster than in 1969 or else the water level would have been even higher.

A standard project flood is a theoretical flood computed by transposing the largest storm of record in the vicinity to the actual drainage area being studied under the assumption the ground is well soaked beforehand. In the drainage area above Prado Reservoir it is assumed that there would be an average rainfall of about 12 inches with up to twice that amount in the high mountain areas and a little less in the low valley areas. For the Santa Ana River, it is estimated that such a flood has about one chance in 200 of occurring in any given year.

The flood of January 1862 had the highest known peakflow of 317,000 cubic feet per second, near Riverside, California. There is little known about volumes but the peak flow was determined from an analysis of historical data on high water levels. There were continuous rains for about 15 days in January 1862, with one day having a continuous severe downpour. This flood is considered to be on the same order of magnitude as the standard project flood.

In January 1916, there was an average of about 11 inches of rain above Prado Dam site in the worst 5 days. The peak flow of the river was about 40,000 cfs near San Bernardino.

Anaheim Flood History

1862 The flood of 1862, called the ‘Aqua Mansa,” was probably considered to be the largest of numerous floods that have occurred as a result of the Santa Ana River. Its estimated peak discharge was 320,000 cubic feet per second (cfs). Documented accounts have shown that the gentle Santa Ana River turned into a raging torrent damaging everything in its path. (Flood Plain Information, June 1971)

1916 January and February brought the greatest flood since 1862. The estimated average of rain was 11 inches. The peak flow over a five-day period was 40,000 cfs, and occurred near San Bernardino.

Bridges were destroyed throughout Southern California. The estimated cost of damages was $7,600,000 (figures taken from 1916, today this amount could be anywhere from 10 to 20 times the amount today). (Friis, Placentia)

1938 Heavy rainfall between February 27th through March 3rd produced the largest recorded flood by the Santa Ana River since 1862. Damages were estimated at $14,000,000 (1938 price levels). The death toll was 58 lives. The following are fact/figures about the floods consistency:

> Midnight March 1, produced a flow of 2000 cfs; 10 P.M. March 2, the flow increased to 8,000 cfs; March 3rd showed a peak flow of 25,000 cfs; 12:15 A.M. March 3, showed a peak of 94,000 cfs; 6 A.M. March 3, the flow had dropped to 50,000 cfs and continued to drop steadily thereafter. The peak discharge was 100,000 cfs.

Flood waters covered 50.5 miles of paved and oiled streets, 19 miles of paved and oiled alleys, and rushed through 36.5 miles of domestic sewer lines.

- Fire trucks pumped 920,000 gallons of water from the basement of the telephone company.
- 140 pipe lines were broken and 350 meters flooded.
- La Palma Park, which was a new development, completed three months previously; lost six inches to two feet deep of dirt and fourteen palm trees.

1952 Rainfall in the latter part of 1952 resembles the storm that hit the City in 1938. Rain fell for a consecutive three day period ending at 8:00 A.M. January 18, 1952. The three day total was 6.39 inches of rain with the seasonal total at 15.92 inches.

Most of Anaheim was able to shed water, however, residents of the northern section were not. Northern streets (North Street at Clementine Street, East Pauline Street and North La Palma Ave.) turned into veritable rivers. (Anaheim Bulletin, January 18, 1952)

1969 In the months of January and February 1969, southern California was ravaged by two major floods, the worst since the great flood of March 1938. These two floods caused more than $213 million in damage to property according to the U.S. Army Corps of Engineers. Seven Southern California counties were declared national disaster areas by the President of the United States.

January 18th brought the first large rainstorm. This rainstorm was generated by the front of a highly developed low pressure system that ushered in severe storm conditions over most of Southern California. On January 19th, the rain lessened, but soon afterwards a second front passed through the area bringing heavier rainfall which continued into January 20th. Precipitation again began to diminish when a front rolled in with more rain that continued into the daylight hours of January 21st. Finally a break occurred, and this was the first of two phases in the January flood storm that came to an end.

The second phase of rain began only two days later on January 23rd, when a new stationary low system triggered a new rain. The rain increased in intensity on the 24th, became moderate to heavy on the 25th, and continued to midday of January 26th. Precipitation decreased by the 27th, and as clouds cleared the area, intermittent showers occurred. The final day of the January flood was January 27th.

The second flood of 1969 began during the night of February 21st; less than four weeks after the end of the January storm. At first the rainfall was light, being produced by a fast-moving frontal low pressure system. This rainfall subsided on February 22, but midday of the 23rd, a second front moved in and brought with it nearly continuous heavy rainfall until the morning of the 24th. The heavy rain started again and continued until the following day. At this point, the major strength of the storm had been spent. Showers occurred through the 26th as the storm trailed out of the area. (Kern, John. The 1969 Floods in Oranue County)

In Orange County, these two floods were the most destructive in history. The Corps of Engineers estimated a total of 22 million dollars of property damage in Orange County. No lives were lost as a direct result of the flood, however, seven people were killed by a mudslide and one 16-year old Anaheim drowned during a rafting trip in the Santa Ana River with three of his friends. Of the total property loss in the County, the federal and state governments furnished financial assistance for emergency and restorative work in excess of 5 million dollars and the federal government furnished more than 2 million dollars in direct assistance. Agricultural loss was quoted at $685,080. The damage occurred to 200 acres of citrus groves and fruit, stream banks, other agricultural land, and irrigation lines due to sediment, flooding and erosion caused by release flows from Prado Dam storage.

The flood of 1969 had a velocity of 75,000 cfs. The releases from the Prado Dam, however, were limited to 5,000-6,000 cfs, and water behind the dam rose to within 16 feet of the spillway or 60% full. The release from the Prado Dam during this period was limited in order to minimize downstream damage. However, if additional flooding were to have occurred the Corps would have had to increase the discharge considerably. (City Council Memo, October 1970)

1980- Mid February 1980 brought flooding along the Santa Ana River. Rainfall averaged about 8 inches above the Prado Basin during the four-day period of February 15th through the 18th. The flood had a velocity of 40,000 cfs and continued at a fairly high level for many hours. The reservoir rose to its highest level ever, 528 feet of elevation, which was a little higher than the previous record set in February 1969. The reservoir released outflows at a rate somewhat faster than in 1969 or else the water level would have even been higher.

1982- On November 30, 1982, a heavy wind and rainstorm lashed out at 60 miles per hour causing the flooding of several intersections as well as freeway crossings. In certain areas of Orange County, 82 homes were flooded, high tides caused the beaches to spill over with 7-foot tides. Heavy wind and rain caused two 64,000-volt transmission lines to break down. Also, the storm caused more than 45% of Anaheim Public Utilities' 88,000 customers to lose electricity.

Other storm related catastrophes took place, such as the dozens of trees that were up rooted causing traffic problems. Several small fires ignited due to power line breakage and a chemical spill forcing people to evacuate their homes. (Anaheim Bulletin, December 1, 1982)

1983- A powerful coastal rainstorm caused by El Nino flooded 1,100 homes in Orange County and caused $160 million in damage on March 1, 1983. Four inches of rain fell in six hours in the County, which was the most concentrated ever recorded. The rain closed the Santa Ana Freeway(Interstate 5) for 20 hours.

1995- In January, a storm caused significant damage throughout the City. During a storm event, water spilled out of the Carbon Creek control channel and flood basins at Brookhurst and Euclid Streets and flooded the immediate area. Debris clogged some storm drains in the City, exacerbating the flooding problems. Basements, parking garages, and City streets were flooded and forced to close. Several underpasses were flooded. The basement at Anaheim Memorial Hospital was flooded and estimates placed the cost at $200,000. Additionally, flooding occurred at an apartment building and the basement of Anaheim General Hospital, the basement of the City Hall. The roof of a commercial building also collapsed. The City estimated that damages to City facilities was $750,000.

1997- A severe storm in October 1997 caused flooding throughout Orange County and prompted the City's Public Works Department to distribute sandbags to residents and businesses. Flood damage was concentrated outside of Anaheim.

Flood Risk Factors

El Nino

El Niño is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences. Among these consequences are increased rainfall across the southern tier of the US and in Peru, which has caused destructive flooding, and drought in the West Pacific, sometimes associated with devastating brush fires in Australia. Observations of conditions in the tropical Pacific are considered essential for the prediction of short term (a few months to 1 year) climate variations.

El Niño (Spanish name for the male child), initially referred to a weak, warm current appearing annually around Christmas time along the coast of Ecuador and Peru and lasting only a few weeks to a month or more. Every three to seven years, an El Niño event may last for many months, having significant economic and atmospheric consequences worldwide. During the past forty years, ten of these major El Niño events have been recorded, the worst of which occurred in 1997-1998. Previous to this, the El Niño event in 1982-1983 was the strongest. Some of the El Niño events have persisted more than one year.

Table 3.6 El Nino Storm Event Years

El Niño Years			
1902-1903	**1905-1906**	**1911-1912**	**1914-1915**
1918-1919	**1923-1924**	**1925-1926**	**1930-1931**
1932-1933	**1939-1940**	**1941-1942**	**1951-1952**
1953-1954	**1957-1958**	**1965-1966**	**1969-1970**
1972-1973	**1976-1977**	**1982-1983**	**1986-1987**
1991-1992	**1994-1995**	**1997-1998**	

Urbanization

Urbanization is the degree of or increase in *urban* character or nature. It may refer to a geographical area combining urban and rural parts, or to the transformation of an individual locality from less to more urban.

In terms of a geographical place, urbanization means increased spatial scale and/or density of settlement and/or business and other activities in the area over time. The process could occur either as natural expansion of the existing population (usually not a major factor since urban reproduction tends to be lower than rural), the transformation of peripheral population from rural to urban, incoming migration, or a combination of these.

The increase in spatial scale is often called "urban sprawl". It is frequently used as a derogatory term by opponents of large-scale urban peripheral expansion especially for low-density urban development on or beyond the city fringe. Sprawl is considered unsightly and undesirable by those critics, who point also to diseconomies in travel time and service provision and the danger of social polarisation through suburbanites' remoteness from inner-city problems.

Debris in the storm drains

Stormwater pollution is urban runoff water that has picked up pollutants as it flows through the storm drain system-a network of channels, gutters and pipes that collect runoff from city streets, neighborhoods, farms, construction sites and parking lots-and empties directly into local waterways.

Unlike sewage, which goes to treatment plants, urban runoff flows untreated through the storm drain system. Anything thrown, swept or poured into the street, gutter or a catch basin-the curbside openings that lead into the storm drain system-can flow directly into our channels, creeks, bays and ocean. This includes

pollutants like trash, pet waste, cigarette butts, motor oil, anti-freeze, runoff from pesticides and fertilizers, paint from brushes and containers rinsed in the gutter and toxic household chemicals.

Contaminated urban runoff is an uncontrolled nonpoint source of pollution into local waters, and may contribute to beach closures. Litter, leaves and other debris clog catch basins, causing flooding when it rains.

Stormwater pollution may contribute to beach closures, which hurt local businesses, tourism and Orange County's image as a desirable place to live and work. It is illegal for businesses without a permit to discharge wastewater or other materials into the storm drain system.

Everyone in Anaheim can help prevent stormwater pollution. It is often caused by everyday behavior that you may not realize contributes to the problem. Simple behavior changes are all it takes to prevent stormwater pollution, if we all do our part. Find out how.

Dam Failure/Inundation

General Situation
Dam failures can result from a number of natural or man-made causes such as earthquakes, erosion of the face or foundation, improper sitting, rapidly rising floodwaters, and structural/design flaws. A dam failure will cause loss of life, damage to property, and other ensuing hazards, as well as the displacement of persons residing in the inundation path. Damage to electric generating facilities and transmission lines could also impact life support systems in communities outside the immediate hazard areas.

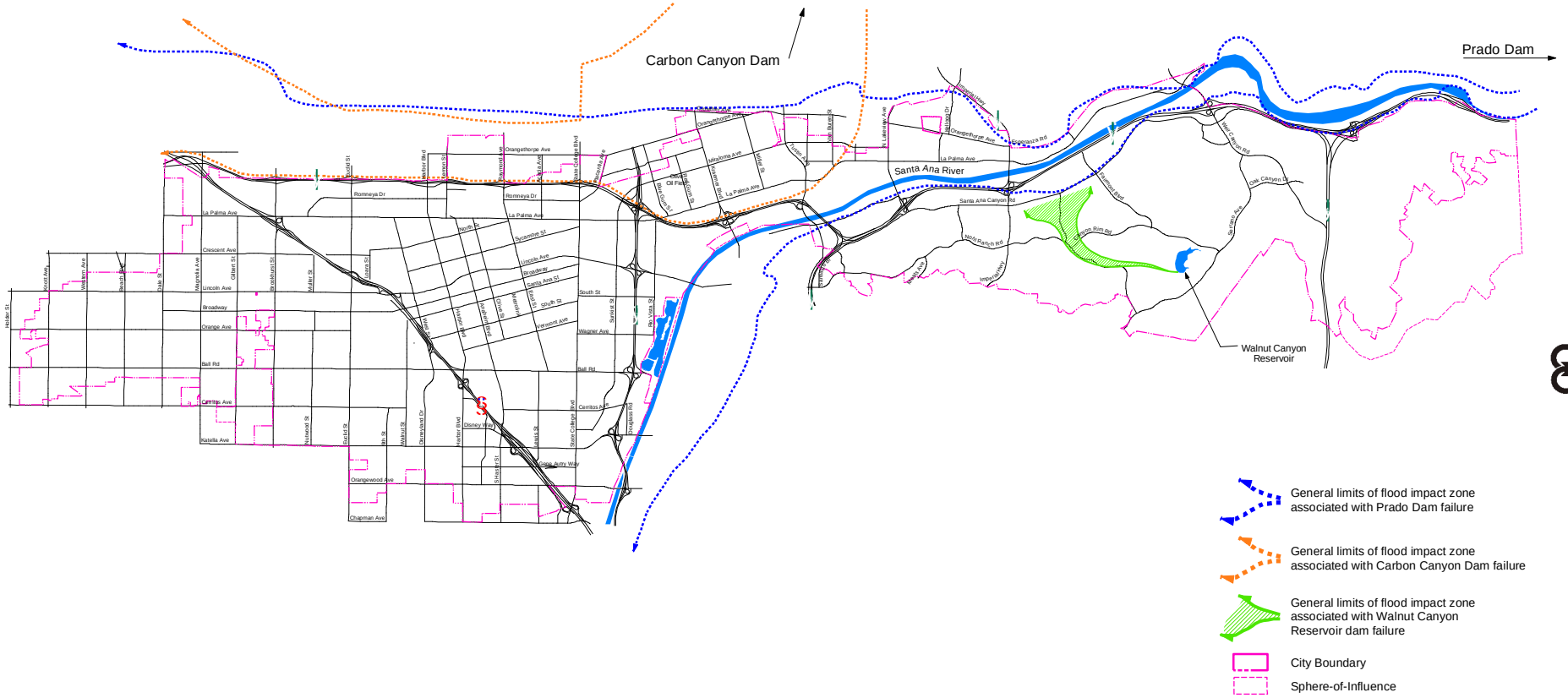
Governmental assistance could be required and may continue for an extended period. These efforts would be required to remove debris and clear roadways, demolish unsafe structures, assist in reestablishing public services and utilities, and provide continuing care and welfare for the affected population including, as required, temporary housing for displaced persons.

Local Profile
There are a total of 32 dams in Orange County. The ownership ranges from the Federal government to Home Owners Associations. These dams hold billions of gallons of water in reservoirs. The major reservoirs are designed to protect Southern California from floodwaters and to store domestic water. Their sizes range from 18 acre-feet to 196,235 acre-feet (Prado Dam) holding capacity. Three of the 34 dams may impact the City of Anaheim: the Walnut Canyon Reservoir, the Carbon Canyon Dam, and the Prado Dam. General limits of flood hazard due to dam failure are shown on Figure 3.3, Dam Inundation Map. Seismic activity can compromise the dam structures, resulting in catastrophic flooding. The following is a list of the reservoirs and dams that could impact Anaheim:

Name of Facility	**Owner**
Walnut Canyon Reservoir	City of Anaheim
Carbon Canyon Dam	U. S. Army Corps of Engineers
Prado Dam	U. S. Army Corps of Engineers

References
Loss of life and damage to structures, roads, and utilities may result from a dam failure. Economic losses can also result from a lowered tax base and lack of utility profits. These effects would certainly accompany the failure of one of the major dams affecting the City of. Because

Dam Inundation Map



Note: All dimensions, directions and locations are approximate.

Source: Ninyo and Moore

dam failure can have severe consequences, FEMA and the California Office of Emergency Services require all dam owners develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions. Although there may be coordination with City officials in the development of the EAP, the responsibility for developing potential flood inundation maps and facilitation of emergency response is the responsibility of the dam owner. For more detailed information regarding dam failure flooding, and potential flood inundation zones for a particular dam in the county, refer to the City of Anaheim, Emergency Response Plan (ERP).

Prado Dam
Prado Dam and reservoir are owned and operated by the Los Angeles District, Corps of Engineers, and were completed in 1941 and was intended to provide flood protection to the Lower Santa Ana River Basin. The dam and reservoir are located approximately 2.5 miles east of Anaheim in Riverside County. Installation of the Seven Oaks Dam in San Bernardino County has lessened the impact of a Prado Dam failure. The existing 9,000 cubic feet per second (cfs) limit on controlled releases from the Prado Dam is based upon the original non-damaging capacity of the downstream channel. The recently completed downstream channel improvements that were part of the United States Army Corps of Engineers' Santa Ana River project dramatically increase the downstream channel capacity to over 30,000 cfs. Plans are also underway to improve Prado Dam to increase its storage and release capacities. These improvements will enable the dam to take full advantage of the improved channel capacity downstream and will increase the level of flood protection to communities within the Santa Ana River floodplain. (Source: United States Army Corp of Engineers Website)

Alerting: In the event that downstream interests need to be alerted, the Corps of Engineers will contact the following:

- Orange County Sheriff's Department Control One
- Riverside County Disaster Preparedness
- California Office of Emergency Services, Sacramento

Once contacted, the above agencies will notify all pertinent Federal, state, county and local agencies through the state's National Warning System hookup (fan out communication system).

Carbon Canyon Dam
The Carbon Canyon Dam is located three quarters of a mile south of Carbon Canyon Road (Route 142) and an eighth of a mile northeast of Rose Drive in the City of Brea. Construction of the dam was completed in 1961. Carbon Canyon Dam is an earth-filled dam, 2,600 feet in length and 99 feet in height, designed to hold 12,000 acre feet of water, with spillways approximately 125 feet in width. The dam is owned and operated by the US Army Corps of Engineers.

As indicated in the City's Emergency Response Plan (ERP), should a breach of Carbon Canyon Dam occur, the water released would flow in a southerly direction to Carbon Canyon Creek. The potential flood zone, including the full width of the alternate flood zone, would be west to Imperial Highway, and east to Richfield Road and Orangethorpe Avenue. Travel time would be approximately 15 minutes. The easterly flow would continue south to SR-91 remaining west of Richfield Road. The westerly flow would continue between Commonwealth Avenue on the north and Riverside (SR-91) Freeway on the south reaching the Orange (SR-57) Freeway in approximately 30 minutes. The inundated area would widen north to Malvern (Fullerton), west past Beach Boulevard, the flow westerly between Artesia Boulevard on the north, and SR-91 on the south and empty into Coyote Creek just west of La Palma. Areas in the City that are potentially affected by a Carbon Canyon Dam failure appear to be north of SR-91.

Walnut Canyon Dam
Walnut Canyon Reservoir is located in the Hill and Canyon Area of the City. The reservoir became operational in 1963, has a capacity of approximately 920 million gallons, and is man-made with earthen dams. The Walnut Canyon Reservoir is an enclosed body of water in the Hill and Canyon Area, which could be subject to relatively strong earthquake ground shaking. There is a low to moderate potential for seiche hazards affecting properties adjacent to the reservoir.

Physical and Hydrological Description of the Watershed
Walnut Canyon Reservior (WCR) is located in Anaheim, California at 33.84^{o} north latitude and 117.75^{o} west longitude. Construction of this uncovered reservoir began in 1965 and was completed in 1967 by installing an earthen-dam within a canyon. The top of the dam is 849 feet above mean sea level with the normal full level at 840 feet and the bottom of the reservoir at 740 feet. The reservoir has a capacity of 920 million gallons (2,825 acre feet) and a surface area of about 48 acres. The bottom of the reservoir is lined with a five-foot layer of siltstone (to minimize seepage) and portions of the slopes are lined with ½" asphalt planks.

The WCR watershed consists of residential housing and undeveloped annual grass/scrub-brush foothills. The highest point in the watershed is 1257 feet above mean sea level and the natural drainage area includes about 235 acres, however, most stormwater runoff from the area is captured by the municipal storm drain system. The only runoff into the reservoir occurs from the minimal area directly above the reservoir or when large storms overflow the storm drain system.

There is a 22-foot wide asphalt road surrounding the reservoir that is used for maintenance access. The road contains a berm that directs runoff away from the reservoir. Public vehicle access is prohibited and the site has a locked gate and chain link fence. The public may enter the facility through a pedestrian access gate and the site is used as a walking/jogging path. A second fence surrounds the water to prevent public contact.

The water used to fill Walnut Canyon Reservoir is obtained from Lake Mathews, a Metropolitan Water District of Southern California (MWD) reservoir which receives water from the Colorado River. Water is transported from Lake Mathews to WCR via the Santiago Lateral water pipeline. MWD has prepared watershed sanitary surveys for the Colorado River and Lake Mathews (Attachment A), therefore this report only covers WCR.

The untreated water flows into WCR via Anaheim's South Inlet Structure which was upgraded in 1990 with new 24-inch concrete cylinder pipe (CCP) that has a design capacity of 18,000 gpm. The North Inlet, built when the reservoir was first constructed, now serves as the back-up. It is capable of delivering 2,200 gpm and is served by a 14 inch CCP.

Water from the reservoir flows into the Lenain Water Treatment Plant (WTP) via a 36-inch CCP. Inlet valves allow operators to obtain water from up to four different depths (821, 797, 773 and 742 feet above mean sea level), either as a mixture or from a single depth. Lenain WTP is a conventional treatment plant that includes ozonation.

Seiche Potential

General Situation
A seiche is an earthquake generated wave occurring in an enclosed body of water, such as a lake, reservoir, or harbor. The period of oscillation is dependent on the characteristics of the containing basin’s physical dimensions, such as surface shape and subsurface geometry. Oscillation periods may range from a few minutes to an hour or more. A seiche may be caused by earthquake ground shaking. The magnitude of a seiche is related, in part, to the magnitude of the earthquake. A seiche can result in waves and flooding to properties along the shores of lakes, reservoirs, or harbors.

Wildland/Urban Fire
Much of the following, which addresses the threat of fire to urban areas, wildlands and the wildland/urban interface has been extracted from the information prepared in the City of Anaheim Environmental Impact Report, Emergency Response Plan and General Plan.

General Situation
Fires can occur in urban environments and can also impact unpopulated areas that may contain brush or grasslands. The central and western portions of Anaheim are highly urbanized and relatively built out, and the Hill and Canyon Area is approaching its build out potential. As a result, the City must continue to address the growing need to defend both persons and property from urban and wildland fires.

In urban areas, the effectiveness of fire protection efforts is based upon several factors, including the age of structures, efficiency of circulation routes that ultimately affect response times and availability of water resources to combat fires. In wildland areas, taking the proper precautions, such as the use of fire resistant building materials, a pro-active Fire Prevention inspection program, and the development of defensible space around structures where combustible vegetation is controlled, can protect developed lands from fires and, therefore, reduce the potential loss of life and property.

Other factors contribute to the severity of fires including weather and winds. Specifically, winds commonly referred to as Santa Ana winds, which occur during fire season (typically from June to the first significant rain in November) are particularly significant. Such "fire weather" is characterized by several days of hot dry weather and high winds, resulting in low fuel moisture in vegetation.

California experiences large, destructive wildland fires almost every year, and Orange County is no exception. Wildland fires have occurred within the county, particularly in the fall of the year, ranging from small, localized fires to disastrous fires covering thousands of acres. The most severe fire protection problem in the area is wildland fire during Santa Ana wind conditions.

Local Profile
Fire hazards threaten lives, property, and natural resources, and impact vegetation and wildlife habitats. A fire defense analysis (see Appendix D) was completed for the Hill and Canyon Area of the City. According to the analysis, the Hill and Canyon Area can be divided into two sections, developed and undeveloped, with each section maintaining its own fire hazard classification. The developed area is generally bordered by SR-55 on the west, SR-91 on the north, and the eastern Transportation Corridor (SR-241) on the east, and is classified as a "Special Protection Area" by the Fire Department. The undeveloped land located east of the SR-241 is classified as a "Very High Fire Hazard Severity Zone." The current structural fire risk (the risk of a fire occurring within a structure) in the Hill and Canyon Area (developed portion) is estimated to be a low probability/moderate consequence event. Relatively few fires occur in well-maintained, upscale communities with mostly owner occupied homes having relatively few occupants compared to the size of the structure. When a fire does occur, it is usually confined to one room and does not spread beyond the structure of origin. In Anaheim, a structure fire occurs approximately every five days.

The current vegetation risk in the undeveloped portions of the Hill and Canyon Area is estimated to be a moderate probability/high consequence event. Major fires have occurred in the area and will likely continue to occur. The fire spread modeling data indicates the potential for a major fire is likely to occur by the year 2014.

There are a number of natural conditions, which might increase the possibility of wildland fires. Three such conditions are weather elements, the topography of the area, and the type and condition of wildland vegetation.

1) Weather
Weather conditions have many complex and important effects on fire intensity and behavior. Wind is of prime importance; as wind increases in velocity, the rate of fire spread also increases. Relative humidity (i.e., relative dryness of the air) also has a direct effect, the drier the air, and the drier the vegetation and the more likely the vegetation will ignite and burn. Precipitation (annual total, seasonal distribution and storm intensity) further affects the moisture content of dead and living vegetation, which influences fire ignition and behavior.

Many wildland fires have been associated with adverse weather conditions. In the 1982 Gypsum Canyon Fire, 17 homes were lost and 18,000 acres burned, leaving an estimated $16 million in damage. The Santa Ana winds during the time of the fire were approximately 50-55 mph, making the fire difficult to contain.

In addition to winds, structural development within or adjacent to wildland exposures represents an extreme fire protection problem due to flying embers and the predominance of combustible roof coverings.

2) Topography
Topography has considerable effect on wildland fire behavior and on the ability of firefighters and their equipment to take action to suppress those fires. Simply because of topography, a fire starting in the bottom of a canyon may expand quickly to the ridge top before initial attack forces can arrive. Rough topography greatly limits road construction, road standards, and accessibility by ground equipment. Steep topography also channels airflow, creating extremely erratic winds on lee slopes and in canyons. Water supply for fire protection to structures at higher elevations is frequently dependent on pumping units. The source of power for such units is usually from overhead distribution lines, which are subject to destruction by wildland fires.

3) Vegetation
A key to effective fire control and the successful accommodation of fire in wildland management is the understanding of fire and its environment. Fire environment is the complex of fuel, topographic, and air mass factors that influence the inception, growth, and behavior of a fire. The topography and weather components are, for all practical purposes, beyond man's control, but it is a different story with fuels, which can be controlled before the outbreak of fires. In terms of future urban expansion, finding new ways to control and understand these fuels can lead to possible fire reduction.

Of these different vegetation types, coastal sage scrub, chaparral, and grasslands reach some degree of flammability during the dry summer months and, under certain conditions, during the winter months. For example, as chaparral gets older, twigs and branches within the plants die and are held in place. A stand of brush 10- to 20-years of age usually has enough dead material to produce rates of spread about the same as in grass fires when the fuels have dried out. In severe drought years, additional plant material may die, contributing to the fuel load. There will normally be enough dead fuel accumulated in 20- to 30-year old brush to give rates of spread about twice as fast as in a grass fire. Under moderate weather conditions that produce a spread rate of one-half foot per second in grass, a 20- to 30-year old stand of chaparral may have a rate of fire spread of about one foot per second. Fire spread in old brush (40 years or older) has been measured at eight times as fast as in grass, about four feet per second. Under extreme weather conditions, the fastest fire spread in grass is 12 feet per second or about eight miles per hour.

The 2003 Southern California Fires
The fall of 2003 marked one of the most destructive wildfire season in California history. 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 3.7 October 2003 Firestorm Statistics

County	Fire Name	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

Table 3.7 October 2003 Firestorm Statistics

County	Fire Name	Began	Acres Burned	Homes Lost	Homes Damaged	Lives Lost
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

The last major wildland fire was the "Greed Fire" in 2002 which burned 1,800 acres, however, there was no loss of homes. Prior to that in Anaheim Hills was the "Stagecoach Fire" in 1995. this fire burned 700 acres. In 1982, the Gypsum Canyon fire burned 16,800 acres (a major fire). In 1967, the Paseo Grand Fire, which began in Corona, burned through portions of this area, and also burned into Irvine, orange Park and Villa Park. Many homes were lost in that fire. 48,639 acres were burned. This was a major conflagration. In 1948, the Green River fire burned 47,000 acres. This fire history indicates a major fire occurs about every 15.6 years in or near to Anaheim Hills. The average acreage burned is 28,534. At this rate, the next major wildland fire in Anaheim Hills could occur within the next 10 years and could destroy 28,534 acres or more.

Wildfire Characteristics

There are three categories of interface fire: The classic wildland/urban interface exists where well-defined urban and suburban development presses up against open expanses of wildland areas; the mixed wildland/urban interface is characterized by isolated homes, subdivisions and small communities situated predominantly in wildland settings; and the occluded wildland/urban interface exists where islands of wildland vegetation occur inside a largely urbanized area. Certain conditions must be present for significant interface fires to occur. The most common conditions include: hot, dry and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation). Once a fire has started, several conditions influence its behavior, including fuel topography, weather, drought and development. Southern California has two distinct areas of risk for wildland fire. The foothills and lower mountain areas are most often covered with scrub brush or chaparral. The higher elevations of mountains also have heavily forested terrain. The lower elevations covered with chaparral create one type of exposure. The higher elevations of Southern California's mountains are typically heavily forested. The magnitude of the 2003 fires is the result of three primary factors: (1) severe drought, accompanied by a series of storms that produce thousands of lightning strikes and windy conditions; (2) an infestation of bark beetles that has killed thousands of mature trees; and (3) the effects of wildfire suppression over the past century that has led to buildup of brush and small diameter trees in the forests.

The Interface

One challenge Southern California faces regarding the wildfire hazard is from the increasing number of houses being built on the wildland/urban interface. Every year the growing population has expanded further and further into the hills and mountains, including forestlands. 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.

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 generally thought that fire occurs once every 65 years in coastal drainages and once every 30 to 35 years inland. “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 dieback 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 germination 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.”

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. After decades of fire suppression “dog-hair" thickets have accumulated, which enable high intensity fires to flare and spread rapidly.

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. 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.

Table 3.8- illustrates a rating system to identify wildfire hazard risk. Anaheim Fire Department has classified all portions of the Special Protection Area.

Table 3.8 Sample Hazard Identification Rating System

Category	Indicator	Rating
Roads and Signage	Steep; narrow; poorly signed	High
	One or two of the above	Medium
	Meets all requirements	Low
Water Supply	None, except domestic	High
	Hydrant, tank, or pool over 500 feet away	Medium
	Hydrant, tank, or pool within 500 feet	Low
Location of Structure	Top of steep slope with brush/grass below	High
	Mid-slope with clearance	Medium
	Level with lawn, or watered groundcover	Low
Exterior Construction	Combustible roofing, open eaves, Combustible siding	High
	One or two of the above	Medium
	Non-combustible roof, boxed eaves, non-combustible siding	Low

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 use of Geographic Information System (GIS) technology in recent years has been a great asset to fire hazard assessment, allowing further integration of fuels, weather and topography data for such ends as fire behavior prediction, watershed evaluation, mitigation strategies and hazard mapping.

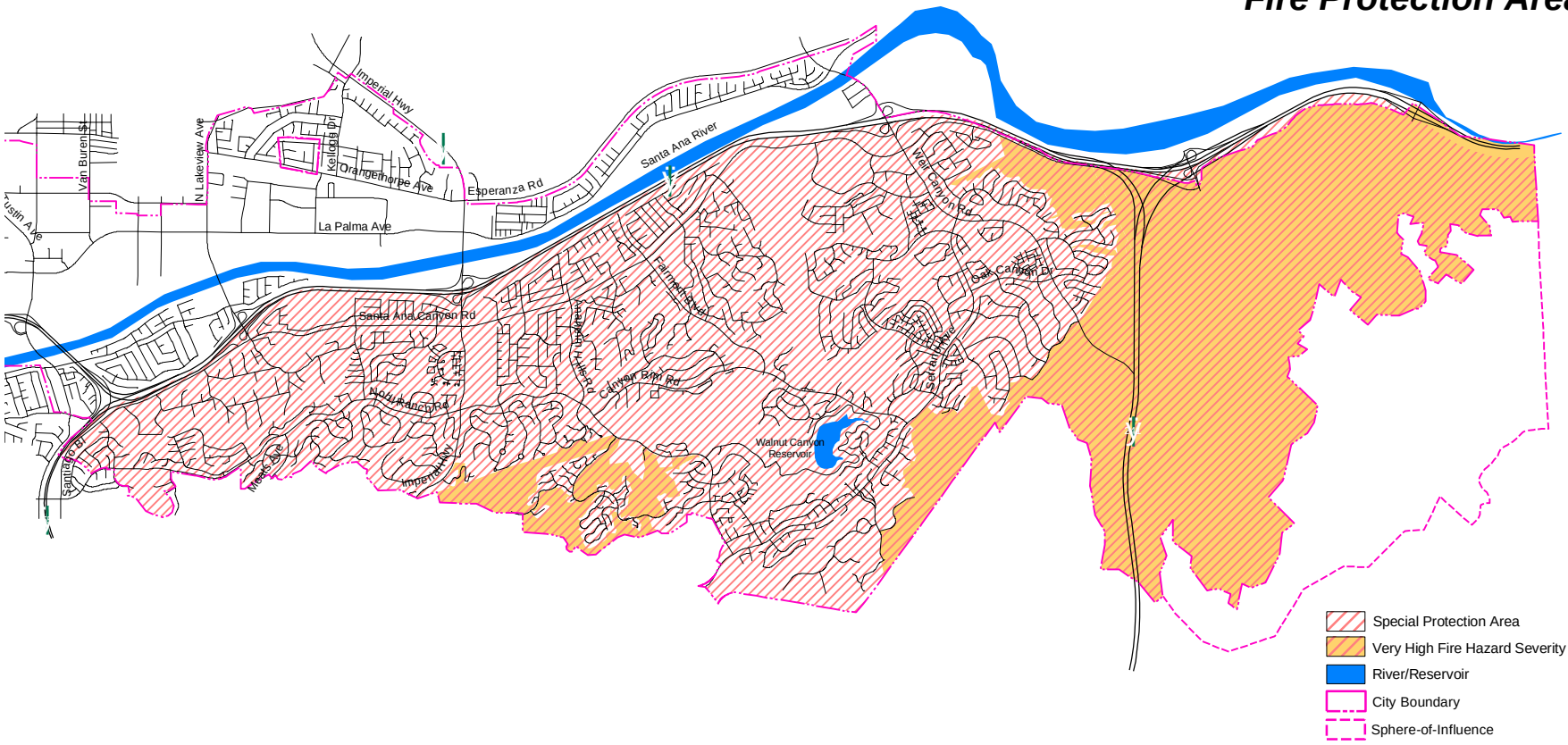
Vulnerability and Risk
The structural fire risk in the Hill and Canyon Area is estimated to be a low probability/moderate consequence event. This means that relatively few fires occur in well-maintained communities with a majority of owner-occupied homes having relatively few occupants compared to the size of the structure. When a fire does occur, it is usually confined to one room (kitchen or bedroom) and does not spread beyond the structure of origin.

Wildland fires would continue to pose a significant threat to the people and structures of Anaheim. The central and western portions of Anaheim are highly urbanized and relatively built out; however, the Hill and Canyon Area is more susceptible to wildland fires as a result of its larger proportion of vegetation and open space.

Susceptibility to Wildfire

The City has identified properties within Very High Fire Hazard Severity Zones. As shown in Figure 3.4, Very High Fire Hazard Severity Zones include the ridgeline areas and undeveloped wildland areas located east of the Costa Mesa (SR-55) Freeway and south of the Riverside (SR-91) Freeway. In addition, there is a significant amount of undeveloped land east of the Eastern

Fire Protection Areas



Note:

Information is for general reference only; for more information, refer to Ordinance No. 5523 for the legal description of the Very High Fire Hazard Severity Zone, and Title 16, Section 16.08.270 of the Anaheim Municipal Code relative to the Special Protection Area.

Source:

Anaheim Fire Department, October, 1995.

Transportation Corridor (SR-241) to the Riverside County line. The Anaheim Fire Department has also classified this area as a Very High Fire Hazard Severity Zone.

All other areas within the City located east of the Costa Mesa (SR-55) Freeway, and south of the Riverside (SR-91) Freeway, are designated as a Special Protection Area. The City provides safeguards to prevent devastation from fires such as routine inspections of homes and the surrounding areas.

The Special Protection Area provisions emphasize the prevention and control of urban/wildland interface fires through the enforcement of fire regulations such as the removal of combustible vegetation, establishment of wet zones, and preventive building features such as spark arrestors on fireplaces.

The current vegetation risk in the Special Protection Area is estimated to be a moderate probability/high consequence event. The key to effective control of a vegetation fire is a rapid response by local fire units and providing defensible spaces for firefighters to fight fires. This is especially true during fire season, when fire units may be committed to other fires and are unavailable to respond. To ensure adequate fire protection in times of major fire events, the City participates in the Standardized Emergency Management System (SEMS), which enhances multi-agency coordination for local and regional emergencies. The National Incident Management System (NIMS) implementation will begin in 2005.

In Anaheim, this scenario highlights the need for fire mitigation activity in all sectors of the region, wildland/urban interface or not. Examples of actions homeowners can take to mitigate fires include:

- Define a defensible space of a 30-foot non-combustible buffer area around the house
- Reduce flammable vegetation, trees and brush around the house
- Remove or prune trees
- Cut grass and weeds regularly
- Relocate wood piles and leftover materials
- Keep it clean
- Install fire resistant roofing materials and spark arrestors on chimneys

Wildfire Mitigation Action Items

Protect the lives and property of residents, businesses owners, and visitors from the hazards of urban and wildland fires.
Policies:

1) Minimize the exposure of residents, business owners, and visitors to the impacts of urban and wildland fires.

2) For additional information regarding “Very High Fire Hazard Severity Zones” refer to Title 16.40 of the Anaheim Municipal Code

3) Continue to assess the need for additional greenbelts, fuel breaks, fuel reduction and buffer zones around communities to minimize potential losses.

4) Maintain a weed abatement program to ensure clearing of dry brush areas.

5) Continue to classify areas of varying fire hazard severity based upon the proximity to open wildland slope, grades, accessibility, water supply and building construction features.

6) Continue to conduct long-range fire safety planning, including enforcement of stringent building, fire, subdivision and other Municipal Code standards, improved infrastructure, and mutual aid agreements with other public agencies and the private sector.

7) Continue to refine procedures and processes to minimize the risk of fire hazards in the Special Protection Area including requiring new development to:

- Utilize fire-resistant roofing materials;
- Incorporate fire sprinklers as appropriate;
- Incorporate defensible space requirements;
- Comply with Anaheim Fire Department Fuel Modification Guidelines;
- Provide Fire Protection Plans; and,
- Implement a Vegetation Management Plan, which results in proper vegetation modification on an ongoing basis within the Special Protection Area.
- Develop fuel modification in naturalized canyons and hills to protect life and property from wildland fires, yet leave as much of the surrounding natural vegetation as appropriate.
- Require development to use plant materials that are compatible in color and character with surrounding natural vegetation.
- Provide wet or irrigated zones when required.
- Use selective trimming and obtain permits when necessary in designated areas to preserve environmentally sensitive native plants.
- Utilize reservoirs, tanks, and wells for emergency fire suppression water sources.

Defensible space can be created around structures by taking precautionary measures such as:
Thinning trees and brush within a minimum of 30 feet of a home. Beyond 30 feet, remove dead wood, debris and low tree branches. Keeping lawns trimmed, leaves raked, and the roof and rain-gutters free from debris such as dead limbs and leaves. Stacking firewood at least 30 feet away from a home. Storing flammable materials, liquids and solvents in metal containers outside the home at least 30 feet away from structures and wooden fences.

Earthquake

General Situation
Earthquakes are considered a major threat to the City of Anaheim due to the proximity of several fault zones, notably including the San Andreas Fault Zone and the Newport-Inglewood Fault Zone. A recent Southern California Earthquake Center (SCEC) report (SCEC, 1995) indicated that the probability of an earthquake of Magnitude 7 or larger in southern California before the year 2024 is 80 to 90%. A significant earthquake along one of the major faults could cause substantial casualties, extensive damage to buildings, roads and bridges, fires, and other threats to life and property. The effects could be aggravated by aftershocks and by secondary effects such as fire, landslides and dam failure. A major earthquake could be catastrophic in its effect on the population, and could exceed the response capability of the local communities and even the State.

Following major earthquakes, extensive search and rescue operations may be required to assist trapped or injured persons. Emergency medical care, food and temporary shelter would be required for injured or displaced persons. In the event of a truly catastrophic earthquake, identification and burial of the dead would pose difficult problems. Mass evacuation may be essential to save lives, particularly in areas below dams. Many families could be separated, particularly if the earthquake should occur during working hours, and a personal inquiry or locator system would be essential to maintain morale. Emergency operations could be seriously hampered by the loss of communications and damage to transportation routes within, and to and from, the disaster area and by the disruption of public utilities and services.

Extensive federal assistance could be required and could continue for an extended period. Efforts would be required to remove debris and clear roadways, demolish unsafe structures, assist in reestablishing public services and utilities, and provide continuing care and welfare for the affected population, including temporary housing for displaced persons.

In general, the population is less at risk during non-work hours (if at home) as wood-frame structures are relatively less vulnerable to major structural damage than are typical commercial and industrial buildings. Transportation problems are intensified if an earthquake occurs during work hours, as significant numbers of City residents commute to work to locations outside of the City. Similarly, a number of persons commute to work into the City. An earthquake occurring during work hours would clearly create major transportation problems for those displaced workers.

Hazardous materials could present a major problem in the event of an earthquake. The City has many firms that handle hazardous materials, and is estimated to produce more than 100 million gallons of hazardous waste per year. Orange County's highways, including those within the City of Anaheim, serve as hazardous materials transportation corridors, and Interstate 5 is the third busiest highway corridor in the country.

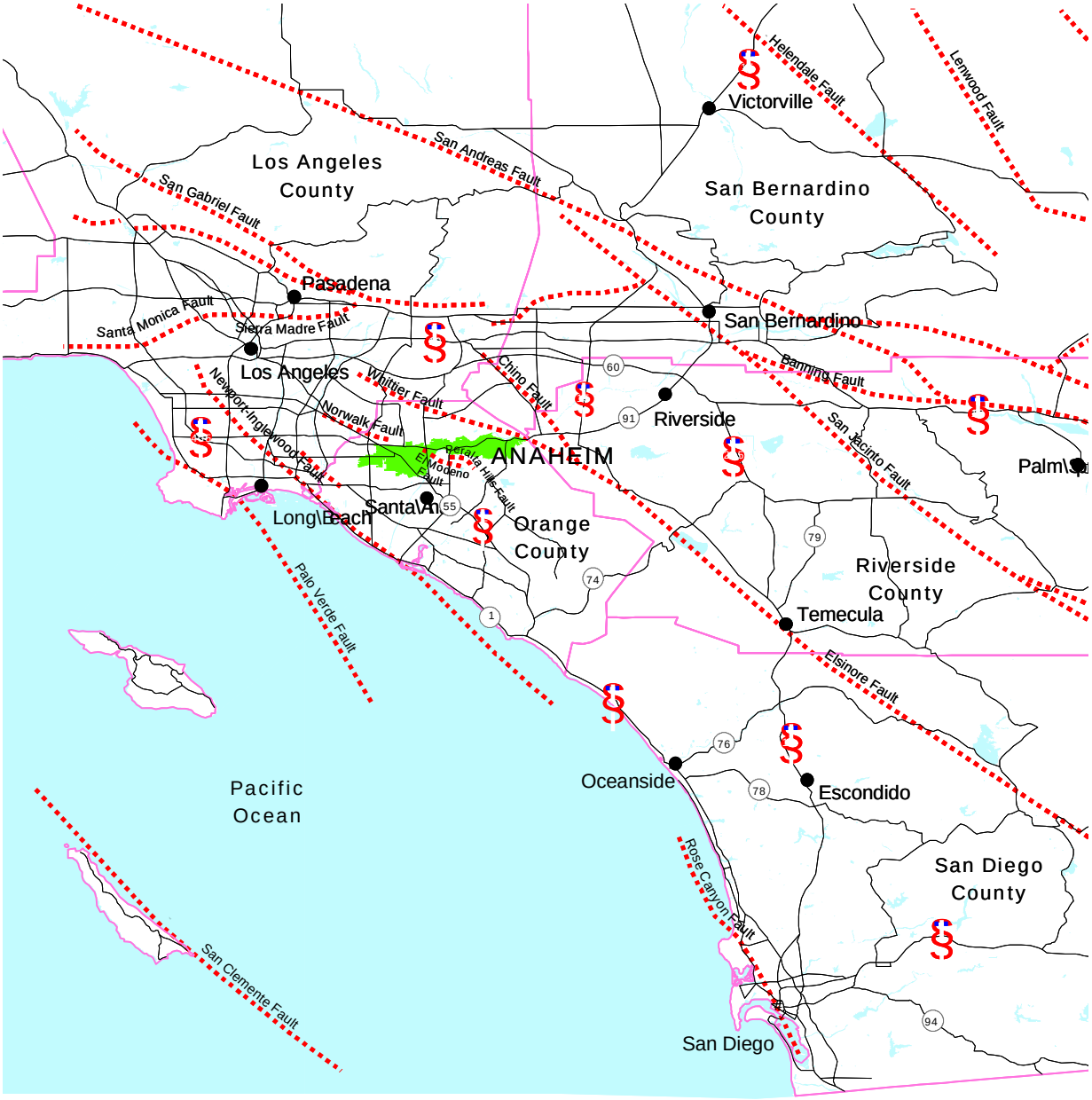
Much of the industrial base of Southern California, and Orange County in particular, consists of high-technology companies essential to the Nation's commerce, economy, and defense effort. A catastrophic earthquake could not only have a severe impact on the local industrial base, but also a major impact on the security of our nation. For example: census and Department of Defense data indicate that over 50 percent of the U.S. Missile and Space Vehicle business, about 75 percent of the domestic micro-chip industry, 40 percent of the U.S. semiconductor business, and more than 20% of the U.S. optical instrument business is located in California. Much of that capacity, including prime contractors, subcontractors or supply vendors, is located in Orange County. Approximately 5,000 defense contractors are located within 50 miles of the San Andreas Fault—including virtually all of Orange and Los Angeles Counties. In some cases, local defense contractors are the only source for some of the most critical defense systems used by our military departments.

In addition to the loss of production capabilities, the economic impact on the City from a major earthquake would be considerable in terms of loss of employment and loss of tax base. Also, a major earthquake could cause serious damage and/or outage to computer facilities. The loss of such facilities could curtail or seriously disrupt the operations of banks, insurance companies, and other elements of the financial community. In turn, this could affect the ability of local government, business and the population to make payments and purchases.

Local Conditions

Anaheim is located in an area considered to be seismically active, similar to most Southern California cities. Based on review of the referenced geologic and seismic literature, there are no known Alquist-Priolo Earthquake Fault Zones within the City limits. Figure 3.5 shows known regional earthquake faults in relation to the City boundaries. (A fault map of all of Southern

Regional Fault Location Map



Fault Line

County Boundaries

City of Anaheim

Source: Modified from California Department of Mines and Geology, Preliminary fault activity map of California, dated 1994.

Note: All fault locations and dimensions are approximate and not all fault locations are shown.

0 5 10 20
Miles

N

California developed by the Southern California Earthquake Center (SCEC) can be found at http://www.scec.org/faultmap.html.

Major active fault zones are located southwest and northeast of the City. Active and potentially active faults arc located close to Anaheim. According to the 1997 UBC and the 1998 CBC, the City of Anaheim is within Seismic Zone 4.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Major fault systems include the active San Andreas, San Jacinto, Whittier-Elsinore, and Newport-Inglewood fault zones. These major fault systems form a regional tectonic framework comprised primarily of right-lateral, strike-slip movement.

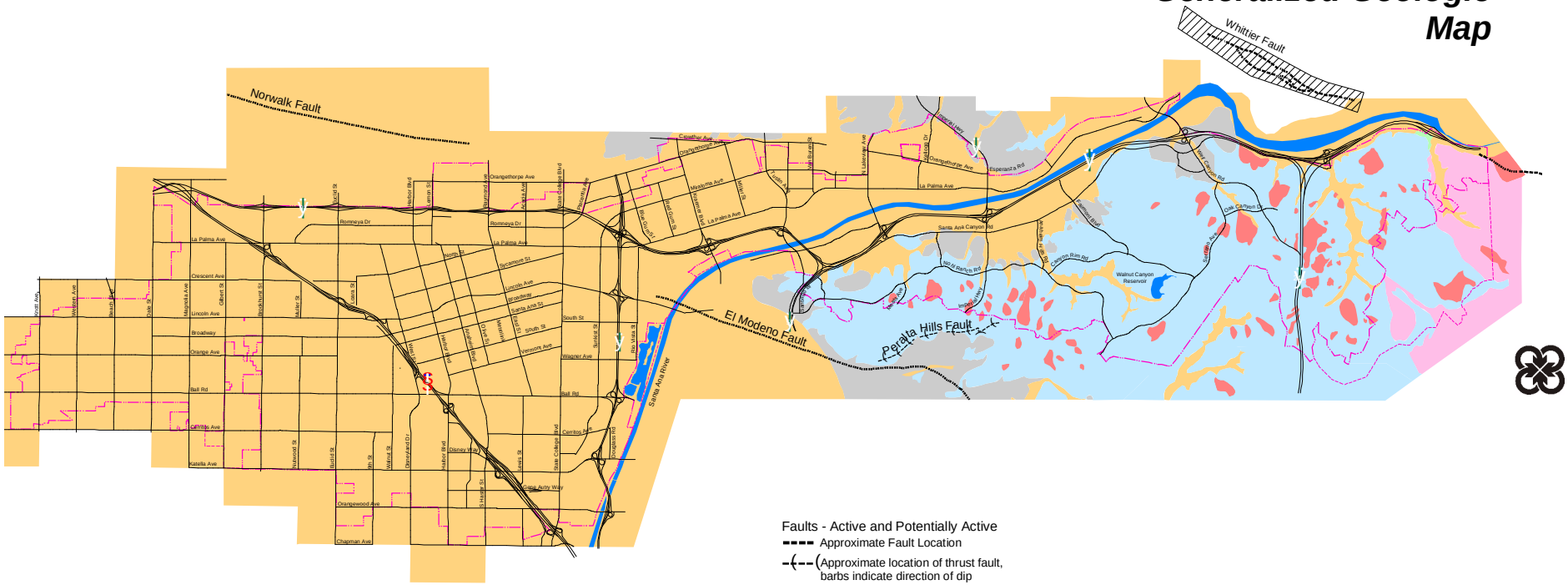
The City of Anaheim is situated between two major, active fault zones; the Newport-Inglewood fault zone located to the southwest and the Whittier-Ellsinore fault zone located to the northeast (Figure 3.6 Generalized Geologic Map). Other potentially active faults in close proximity to the study area are the El Modeno, Peralta Hills, and Norwalk faults. A brief description of these local faults is presented below.

Newport-Inglewood Fault Zone
The Newport-Inglewood fault zone, source of the 1933 Long Beach earthquake (M 6.3), consists of a series of disconnected, northwest-trending fault segments which extend from Los Angeles, through Long Beach and Torrance, to Newport Beach (Figure 3.3). From Newport Beach, the fault zone continues offshore southeasterly past Oceanside and is known as the Offshore Zone of Deformation. The Newport-Inglewood fault zone passes within approximately 7 miles of the western limits of the City boundary. No historic (1769 to present) evidence exists for tectonic fault rupture along fault traces included in the Newport-Inglewood fault zone in Orange County. The most recent evidence for near surface movement during Holocene time is displacement of the Holocene Bolsa aquifer in the vicinity of Bolsa Chica Gap. Borehole evidence combined with groundwater pumping tests, piezometeric levels and geophysical data indicates that the North Branch and the Bolsa-Fairview traces of the Newport-Inglewood fault zone offset the base of the Bolsa aquifer by 20 feet and 10 feet (vertical separation) respectively. Although no onshore surface fault rupture has taken place in historic time (since 1769), the fault zone is considered capable of generating an earthquake of magnitude 6.9.

Whittier-Elsinore Fault Zone
The Whittier-Elsinore fault zone is the closest major fault system to the City and one of the largest in southern California. The Elsinore fault zone extends from near the United States-Mexico border northwesterly to the northern Santa Ana Mountains just east of the City limits. At the northern end the zone the mapped fault branches into two segments west and east, the Whittier fault and the Chino-Central Avenue fault.

The northern portion of the Elsinore fault zone is referred to as the Glen Ivy fault (CDMG, 1998). At its closest, the Glen Ivy fault is located approximately 1.3 miles southeast of the City. The Glen Ivy fault is zoned under the Alquist-Priolo Earthquake Fault Zone Act. Dominant movement along the fault is right-lateral strike-slip. The Glen Ivy fault could produce a maximum moment magnitude 6.8 earthquake (CDMG, 1998). From the northern end of the Glen Ivy fault the mapped zone of faulting is fragmented into a zone of discontinuous northwesterly trending faults along the eastern side of the Santa Ana Mountains in Riverside. The faults branch into the Whittier and Chino-Central Avenue faults near the Santa Ana River.

Generalized Geologic Map



Notes:

1) The information presented on this map is primarily intended for planning purposes and should not be construed as definitive data for a specific site. The information presented is a collection of readily available data at the time of completion. Since much of the information was transferred from maps of differing scales and datums, the accuracy cannot be confirmed. All boundaries and fault locations should be considered approximate.

2) Date of compilation August 2001. By Ninyo & Moore.

3) Landslide areas depicted on this map are based on published geologic literature, aerial photograph review, and field reconnaissance of selected localities. In areas of existing development, landslides may have been removed, buried, stabilized, or otherwise altered.

References:

Geologic data compiled from various sources including: "Geologic Map of Orange County, California, Showing Mines and Mineral Deposits", CDMG Bulletin 204 (Morton, Miller, and Tan, 1981), "Geology of the Northern Santa Ana Mountains," USGS Professional Paper 420-D (Shoellhammer, Vedder, Yerkes, and Kinney, 1981).

The Whittier fault zone extends approximately 24 miles from Whittier Narrows in Los Angeles County, southeasterly to Santa Ana Canyon where it merges with the Elsinore fault zone. The Whittier fault zone averages 1,000 to 2,000 feet wide and is made up of many sub-parallel and en echelon fault splays, which merge and branch along their course. The Whittier fault zone does not extend inside the City boundaries, but approaches to within less than approximately one mile of the northeastern corner of the City. Presently available information indicates that the Whittier fault zone is active and may be capable of generating an earthquake of magnitude 6.8 accompanied by surface rupture along one or more of its fault traces. The Whittier fault is zoned under the Alquist-Priolo Earthquake Fault Zone Act north of the City.

At its closest, the Chino-Central Avenue fault is located approximately 2 miles east of the eastern limits of Anaheim. The fault branches away from the Elsinore (Glen Ivy) fault and extends northwest for a distance of approximately 13 miles through the Prado Basin and into the Puente Hills (Jennings, 1994). Dominant movement along the fault is right reverse. The Chino fault could produce a maximum moment magnitude 6.7 earthquake (CDMG, 1998).

El Modeno and Peralta Hills Faults

The El Modeno and Peralta Hills faults are located south of the Peralta Hills area and generally outside the City. The El Modeno fault is a southwest dipping, north-south trending, normal fault that extends from the Peralta Hills area south into Santiago Creek in Villa Park to Peters Canyon Wash. The northern end of the fault has been projected beneath alluvium into the City limits and terminates between State Route 57 and the Santa Ana River (Morton and Miller, 1981). This fault is concealed for most of its length but is intersected by at least two oil wells. Subsurface information shows that this fault offsets the base of the La Habra Formation by approximately 1,500 feet (Willis, 1988).

The Peralta Hills fault is an approximately east-west trending, north dipping, thrust fault which has displaced the Miocene Puente Formation at least 40 feet over Quaternary terrace deposits. The fault has been studied by various consultants and its length and activity is subject to debate within the geologic community. One interpretation of the fault is that the westerly trace of the fault extends concealed beneath alluvium into the Corridor west of State Route 55 (Bryant and Fife, 1982). According to this interpretation, the northerly trace of the El Modeno fault either terminates at the Peralta Hills fault or continues beneath it to the north. Based on their own work and the work of others, Bryant and Fife have concluded that the Peralta Hills fault has ruptured the ground surface in Holocene time, and may be capable of generating an earthquake of moment magnitude in the range of 6.0 to 7.0. In addition, Bryant and Fife have recommended that the Peralta Hills fault be included under the Alquist-Priolo Earthquake Fault Zone Act.

The California Department of Mines and Geology (CDMG) present a different interpretation of faulting in the Peralta Hills. Published CDMG information suggests that it is the El Modeno fault that extends into the alluvial basin west of Slate Route 55 rather than the Peralta Hills fault as suggested by Bryant and Fife. This interpretation locates the westerly trace of the El Modeno fault within the City and the west end of the Peralta Hills fault outside of the Corridor. According to the CDMG, the Peralta Hills and El Modeno faults do not presently meet the criteria necessary to be zoned for special studies. The current position of the CDMG is that the El Modeno and Peralta Hills faults are not “sufficiently active” or “well defined” for zoning under the Alquist-Priolo Earthquake Fault Zone Act (Willis, 1988).

Norwalk Fault

The Norwalk fault is buried beneath Holocene alluvial deposits, but has been recognized from subsurface oil well and water well data. The Norwalk fault extends from Norwalk in Los Angeles County to the south edge of the West Coyote Hills just north of the City limits. The “Whittier” earthquake of 1929 was attributed to the Norwalk fault by Charles Richter; however, the offset of Holocene deposits or the presence of geomorphic features, which would suggest the fault is active,

have not been established. It should be noted that because the fault is buried, the data available regarding the location of the Norwalk fault is approximate, and in some areas inconclusive. The Norwalk fault is not currently zoned under the Alquist-Priolo Earthquake Fault Zone Act.

Why Are Earthquakes a Threat to the City of Anaheim?

The most recent significant earthquake event affecting Southern California was the 1994 Northridge Earthquake. At 4:31 A.M. on Monday, January 17, a moderate but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures.

Fifty-seven people were killed and more than 1,500 people seriously injured. For days afterward, thousands of homes and businesses were without electricity; tens of thousands had no gas; and nearly 50,000 had little or no water. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. 66,500 buildings were inspected. Nearly 4,000 were severely damaged and over 11,000 were moderately damaged. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Ground shaking caused extensive damage, but earthquake triggered liquefaction and dozens of fires also caused additional severe damage. This extremely strong ground motion in large portions of Los Angeles County resulted in record economic losses.

However, the earthquake occurred early in the morning on a holiday. This circumstance considerably reduced the potential effects. Many collapsed buildings were unoccupied, and most businesses were not yet open. The direct and indirect economic losses ran into the 10's of billions of dollars.

Historical and geological records show that California has a long history of seismic events. southern California is probably best known for the San Andreas Fault, a 400-mile long fault running from the Mexican border to a point offshore, west of San Francisco. “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.”

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 Verde’s 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.

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. Despite the progress, the majority of California communities remain unprepared because there is a general lack of understanding regarding earthquake hazards among Californians.

History of Earthquakes in Southern California and Anaheim

To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on those faults that are the sources of the earthquakes occurring in the Southern California region. Historical earthquake records can generally be divided into records of the pre-instrumental period and the instrumental period. In the absence of instrumentation, the detection of

earthquakes is based on observations and felt reports, and is dependent upon population density and distribution. Since California was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is relatively difficult. However, two very large earthquakes, the Fort Tejon in 1857 (7.9) and the Owens Valley in 1872 (7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. In more recent times two 7.3 earthquakes struck Southern California, in Kern County (1952) and Landers (1992). The damage from these four large earthquakes was limited because the occurred in areas which were sparsely populated at the time they happened. 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.

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. No community in Southern California is beyond the reach of a damaging earthquake. Table 3.9 describes the historical earthquake events that have affected Southern California.

Table 3.9: Earthquake Events In the Southern California Region

1769 Los Angeles Basin	1916 Tejon Pass Region
1800 San Diego Region	1918 San Jacinto
1812 Wrightwood	1923 San Bernadino 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 Bernadino 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 Bernadino Region	1999 Hector Mine
1910 Glen Ivy Hot Springs	2004 San Luis Obispo

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

Historically, the City of Anaheim has generally been spared a major destructive earthquake. However, based on a search of earthquake databases of the United States Geological Survey (USGS) - National Earthquake Information Center (NEIC), several major earthquakes (Magnitude 6.0 or more) have been recorded within approximately 100 kilometers of the project area since 1769. Table 3.10 summarizes the approximate magnitude and distance to these seismic events.

Table 3.10- Historical Earthquakes Near Anaheim

Date	Location	Maximum Magnitude (M)*	Approximate Epicenter Distance miles (km)
7/28/1769	Los Angeles Basin	6.0	10 (16)
11/22/1800	San Diego Region	6.5	52 (84)
12J8/1812	Wrightwood	7.0	41 (66)
7/11/1855	Los Angeles Region	6.0	40 (64)
12/16/1858	San Bernardino Region	6.0	23 (37)
7/30/1894	Lytle Creek Region	6.0	37 (60)
4/21/l918	San Jacinto	6.9	43 (69)

Table 3.10- Historical Earthquakes Near Anaheim			
Date	Location	Maximum Magnitude (M)*	Approximate Epicenter Distance miles (km)
7/2311923	San Bernardino Region	6.0	56 (90)
3/11/1933	Long Beach	6.3	16 (26)
2/9/1971	San Fernando	6.5	51(82)
10/1/1987	Whittier Narrows	5.8	20(32)
1/17/1994	Northridge	6.7	45(72)
* Magnitudes listed are "summary magnitudes." Prior to 1898, these are adjusted intensity magnitudes and after 1898, are surface wave magnitudes (www.pasadena.wr.usgs.gov).			

Causes and Characteristics of Earthquakes in Southern California

Earthquake Faults
A fault is a fracture along between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.

Strike-slip
Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's 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
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 Related Hazards
Ground shaking, surface rupture, 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.

Seismic activity along nearby or more distant fault zones are likely to cause ground shaking within the City limits. Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the United States Geological Survey (1999), the horizontal peak ground acceleration having a 10 percent probability of being exceeded in 50 years ranges from approximately (0.35g to 0.56g within the City limits).

Fault Rupture
The potential for ground rupture due to fault movement is generally considered related to the seismic activity of known fault zones. Recognized active fault zones are generally located outside the City of Anaheim. Faults such as the El Modeno fault or the Peralta hills fault could conceivably cause ground rupture within the City. Compared with the more active recognized fault zones, the potential for ground rupture due to seismic activity in the City is considered low.

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.

Earthquake-Induced Landslide Potential
Earthquake-induced landsliding may potentially occur in the hillside terrain of the Peralta Hills and the Santa Ana Mountains. Generally, these types of failures consist of rock falls, disrupted soil slides, rock slides, soil lateral spreads, soil slumps, soil block slides, and soil avalanches. Areas having the potential for earthquake-induced landsliding generally occur in areas of previous landslide movement, or where local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements.

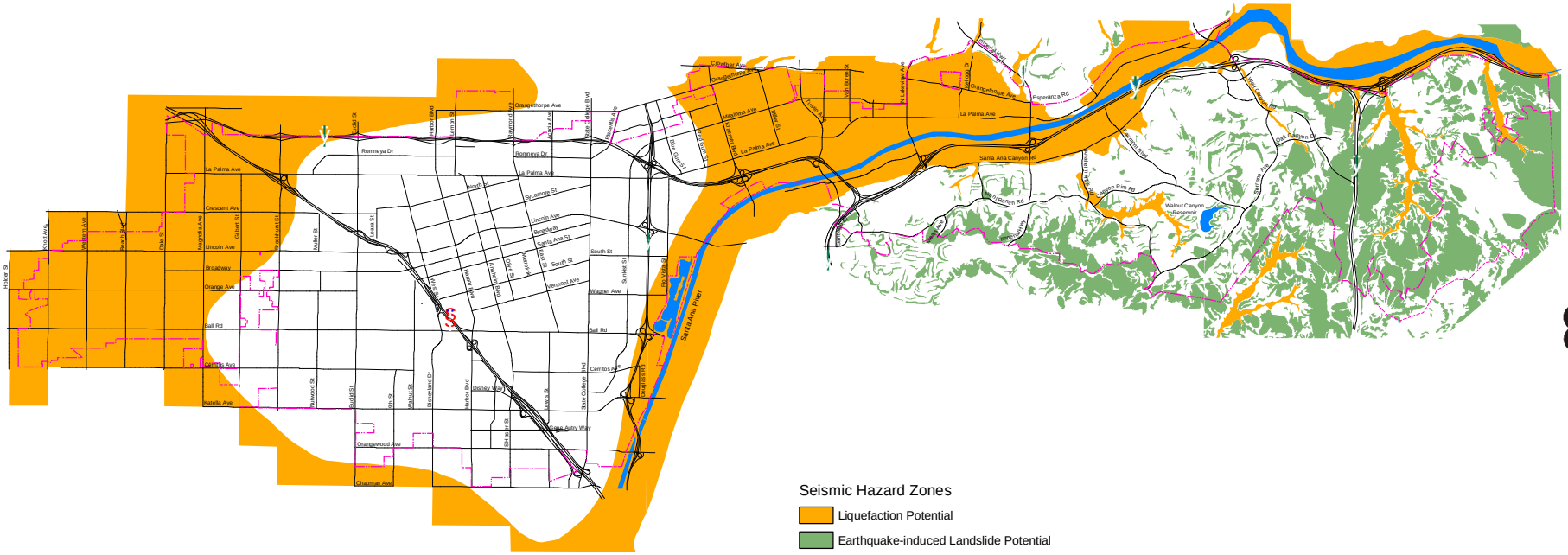
Areas considered to have a potential for earthquake-induced landsliding are generally found in the Hill and Canyon area of the City and its sphere-of-influence and are shown on Figure 3.7. The landslide potential zones were compiled from CDMG digital files for the State Seismic Hazard Maps for the Orange and Black Star Canyon Quadrangles. The CDMG evaluation of landslide potential is based on anticipated earthquake ground shaking, an inventory of existing landslides, geologic structure, geotechnical soil properties, and slope gradients. The data are collected from a variety of sources and the quality of the data varies. Mapped earthquake induced landslide potential zones are intended to prompt more detailed, site specific geotechnical studies as required by the Seismic Hazard Mapping Act. The landslide potential zones were transferred from the CDMG digital files to the base map provided for the City of Anaheim. Due to different datums between the CDMG files and the City base map information, the positioning of the landslide potentia1 zones was manually adjusted based on recognized cultural features.

Therefore, the zone boundaries are appropriate. The State official seismic hazard maps should be referenced for more detailed data.

Earthquake Induced Liquefaction Potential
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. Liquefaction generally occurs during significant earthquake activity, and structures located on soils such as silt or sand may experience significant damage during an earthquake due to the instability of structural foundations and the moving earth. 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. See also the California Geological Survey website at http:\\gmw.consrv.ca.gov/shmp/html/pdf_maps_so.html.

Soil liquefaction is a seismically induced form of ground failure, which has been a major cause of earthquake damage in southern California. During the 1971 San Fernando and 1994 Northridge earthquakes, significant damage to roads, utility pipelines, buildings, and other structures in the Los Angeles area were caused by liquefaction. Research and historical data indicate that loose, granular materials situated at depths of less than 50 feet with fines (silt and clay) contents of less than 30 percent, which are saturated by a relatively shallow groundwater table are most susceptible to liquefaction. These geological and groundwater conditions exist in parts of southern California and Anaheim, typically in valley regions and alluviated floodplains.

Seismic and Geologic Hazards



References:

Liquefaction and Earthquake Induced Landslide Potential Zones prepared from State of California Seismic Hazard Zones digital files compiled by the California Department of Conservation, Division of Mines and Geology (DMG). Seismic Hazard Zones data from the Los Alamitos Quadrangle map (3/25/99), Anaheim Quadrangle map (4/15/98), Orange Quadrangle map and the Black Star Canyon Quadrangle map (1/17/01).

Notes:

1) The information presented on this map is primarily intended for planning purposes and should not be construed as definitive data for a specific site. The information presented is a collection of readily available data at the time of completion. Since much of the information was transferred from maps of differing scales and datums, the accuracy is limited. All boundaries should be considered approximate.

2) Date of compilation August 2001. By Ninyo & Moore.

3) For additional information on seismic hazards in this map area, the rationale used for zoning, and additional references consulted, refer to the State of California Division of Mines and Geology World Wide Web site (www.consrv.ca.gov/dmg/).

The liquefaction potential zones presented on Figure3.5 were compiled from CDMG digital files for the State Seismic Hazard Maps for the Los Alamitos, Anaheim, Orange, and Black Star Canyon Quadrangles. The CDMG evaluation of liquefaction potential is based on anticipated earthquake ground shaking, surface and subsurface lithology, geotechnical soil properties, and groundwater depth data. The data are collected from a variety of sources and the quality of the data varies. Mapped liquefaction potential zones are intended to prompt more detailed, site specific geotechnical studies as required by the Seismic Hazard Mapping Act. The liquefaction potential zones were transferred from the CDMG digital files to the base map provided for the City of Anaheim. Due to different datums between the CDMG files and the City base map information, the positioning of the liquefaction zones was manually adjusted based on recognized cultural features. Therefore, the zone boundaries are approximate. The State official seismic hazard maps should be referenced for more detailed data.

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. Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Earthquake Hazard Assessment

In California, many agencies are focused on seismic safety issues: the State's Seismic Safety Commission, the Applied Technology Council, Governor's Office of Emergency Services, United States Geological Survey, Cal Tech, the California Geological Survey as well as a number of universities and private foundations.

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. Figure 3.3 illustrates the known earthquake faults in Southern California.

Newport-Inglewood Fault
Nearest Communities: Orange County cities potentially affected by the fault are Seal Beach, Huntington Beach, Newport Beach, and Costa Mesa
Most Recent Major Rupture: March 10, 1933, M6.4 (but no surface rupture)
Interval Between Major Ruptures: unknown
Probable Magnitudes: M6.0 - 7.4
Note: This represents a worst-case earthquake that could affect the urban areas of the coast of Orange County. In California, each earthquake is followed by revisions and improvements in the Building Codes.

Regulatory Background

The State regulates development within California to reduce or mitigate potential hazards from earthquakes or other geologic hazards. Development in potentially seismically active areas is also governed by the Alquist-Priolo Earthquake Fault Zoning Act and the Seismic Hazards Mapping Act.

Chapter 16A, Division IV of the California Building Code (CBC), titled "Earthquake Design." states that "The purpose of the earthquake provisions herein is primarily to safeguard against major structural failures or loss of life." The CBC and the Uniform Building Code (UBC) regulate the design and construction of excavations, foundations, building frames, retaining walls, and other building elements to mitigate the effects of seismic shaking and adverse soil conditions. The procedures and limitations for the design of structures are based on site characteristics, occupancy type, configuration, structural system, height, and seismic zonation. Seismic zones are mapped areas (Figure 16A-2 of the CBC and Figure 16-2 of the UBC) that are based on proximity to known active faults and the potential for future earthquakes and intensity of

seismic shaking. Seismic zones range from 0 to 4, with areas mapped as Zone 4 being potentially subject to the highest accelerations due to seismic shaking and the shortest recurrence intervals.

The 1933 Long Beach 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.

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act of 1972 (renamed in 1994) is "to regulate development near active faults so as to mitigate the hazard of surface fault rupture." The State Geologist (chief of the Division of Mines and Geology) is required to delineate Earthquake Fault Zones (formerly known as "Special Studies Zones") along known active faults. As defined by the California Division of Mines and Geology (DMG), an active fault is one which has had surface displacement within Holocene time (roughly the last 11,000 years) and/or has an instrumental record of seismic activity. Potentially active faults are those which show evidence of surface displacement during Quaternary time (roughly the last 2 million years), but for which evidence of Holocene movement has not been established. The DMG evaluates faults on an individual basis to determine if a fault will be classified as an Alquist-Prioto Earthquake Fault Zone. In general, faults must meet certain DMG criteria, including seismic activity, historic rupture, and geologic evidence to be zoned as an Earthquake Fault Zone. Cities and counties affected by the zones must regulate certain development within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. Typically, structures for human occupancy are not allowed within 50 feet of the trace of an active fault.

The Seismic Hazard Mapping Act was adopted in 1990 for the purpose of protecting public safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure caused by earthquakes. The Seismic Hazard Mapping Act requires that the State Geologist delineate the various seismic hazard zones. Cities, counties, or other permitting authorities are required to regulate certain development projects within the zones. They must withhold development permits for a site within a zone until the geologic conditions are investigated and appropriate mitigation measures, if any, are incorporated into the development plans. In addition, sellers (and their agents) of real property within a mapped hazard zone must disclose that the property lies within such a zone at the time of sale.

The City's General Plan identifies the following goals to reduce exposure of people or structures to geological impacts:

- Enforce the requirements of the California Seismic Hazard Mapping and Alquist-Priolo Earthquake Fault Zoning Acts when siting, evaluating, and constructing new projects within the City. *(*Safety Element, Goal 1.1, Policy 3)
- Require removal or rehabilitation of hazardous or substandard structures that may collapse in the event of an earthquake. *(*Safety Element, Goal 1.1, Policy 5)
- Require that lifelines crossing a fault be designed to resist the occurrence of fault rupture. *(*Safety Element, Goal 1.1, Policy 6)
- Require that new construction and significant alterations to structures located within potential landslide areas (Figure 3.5) be evaluated for site stability, including the potential impact to other properties, during project design and review. *(*Safety Element, Goal 1.1, Policy 7)
- Require that engineered slopes be designed to resist earthquake-induced failure. *(*Safety Element, Goal 1.1, Policy 4)

Additionally, the EIR for the General Plan and Zoning Code update, identified the following mitigation measure to be implemented by the City:

> The City shall require geologic and geotechnical investigations in areas of potential seismic or geologic hazards as part of the environmental or development review process. All grading operations will be conducted in conformance with the recommendations contained in the applicable geotechnical investigation.

Vulnerability Assessment
The effects of earthquakes span a large area, and large earthquakes occurring in many parts of the Southern California region would probably be felt throughout the region. However, the degree to which the earthquakes are felt, and the damages associated with them may vary. At risk from earthquake damage are large stocks of old buildings and bridges: many high tech and hazardous materials facilities: extensive sewer, water, and natural gas pipelines; earth dams; petroleum pipelines; and other critical facilities and private property located in the county. The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake.

Risk Analysis
Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. 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. This type of analysis can generate estimates of the damages to the region due to an earthquake event in a specific location.

For greater Southern California there are multiple worst-case scenarios, depending on which fault might rupture, and which communities are in proximity to the fault. But damage will not necessarily 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 for a large earthquake almost anywhere in Southern California are likely to run into the billions of dollars. Although building codes are some of the most stringent in the world, ten's of thousands of older existing buildings were built under much less rigid codes. California has laws affecting unreinforced masonry buildings (URM's) and although many building owners have retrofitted their buildings, hundreds of pre-1933 buildings still have not been brought up to current standards.

Non-structural bracing of equipment and contents is often the most cost-effective type of seismic mitigation. Inexpensive bracing and anchoring may be the most cost effective way to protect expensive equipment. Non-structural bracing of equipment and furnishings will also reduce the chance of injury for the occupants of a building.

Distances from Anaheim to active faults within 100 kilometers of the City are presented in Table 3.11 below. The distances presented represent the closest portion of the listed fault to the closest geographic portion of the City.

Table 3.11 - Principle Active Faults

Fault	Approximate Fault to Site Distance miles (km)	Maximum Moment Magnitude Earthquake
Elsinore-Whittier	0.7 (1.2)	6.8
Elsinore-Glen Ivy	1.3 (2.2)	6.8
Chino-Central Avenue	2.0 (3.4)	6.7
Newport-Inglewood (L.A. Basin)	7.0 (11.5)	6.9
San Jose	13.0 (21.0)	6.5
Newport-Inglewood (offshore)	15.0 (24.0)	6.9
Palos Verdes	15.0 (24.0)	7.1
Cucamonga	19.0 (31.0)	7.0
Sierra Madre (central)	19.0 (31.0)	7.0

Table 3.11 - Principle Active Faults		
Fault	Approximate Fault to Site Distance miles (km)	Maximum Moment Magnitude Earthquake
Raymond	21.0 (34.0)	6.5
Verdugo	22.0 (36.0)	6.7
Clamshell-Sawpit	23.0 (37.0)	6.5
Hollywood	23.5 (38.0)	6.5
San Jacinto-San Bernardino	25.0 (40.0)	6.7
San Jacinto-San Jacinto Valley	27.0 (43.0)	6.9
Santa Monica	28.5 (46.0)	6.6
San Andreas-Southern	31.0 (50.0)	7.4
Elsinore Temecula	33.0 (53.0)	6.8
Malibu Coast	33.0 (53.0)	6.7
San Andreas-1857 Rupture	33.0 (53.0)	7.8
Cleghorn	33.5 (54.0)	6.5
Sierra Madre (San Fernando)	35.0 (56.0)	6.7
San Gabriel	37.0 (60.0)	7.0
North Frontal Fault Zone (West)	38.0 (61.5)	7.0
Coronado Bank	39.0 (63.0)	7.4
Anacapa-Dume	40.5 (65.5)	7.3
San Jacinto-Anza	43.5 (70.0)	7.2
Santa Susana	44.0 (71.0)	6.6
Elsinore-Julian	50.0 (80.0)	7.1
Holister	50.0 (80.0)	6.5
Rose Canyon	53.0 (85.0)	6.9
Oak Ridge (onshore)	55.0 (88.5)	6.9
Simi-Santa Rosa	55.0 (89.0)	6.7
Helendale-South Lockhardt	57.8 (93.0)	7.1
San Cayetano	60.0 (97.0)	6.8

Community Earthquake Issues

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 32 dams in Orange County, with Prado Dam the closest dam to Anaheim. The ownership of these dams ranges from the Federal government to Home Owners Associations. These dams hold billions of gallons of water in reservoirs. The major reservoirs are designed to protect Southern California from floodwaters and to store domestic water. Seismic activity can compromise the dam structures, resulting in catastrophic flooding.

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 County of Orange, 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 County of Orange 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, food, and leisure, and separates businesses from their customers and suppliers,

Bridge 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 - with even minor damages, making some areas inaccessible. Because bridges vary in size, materials, location and design, any given earthquake will affect them differently. Bridges built before the mid-1970' s have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980 when design improvements were made.

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.

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 County of Orange, 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 brick, 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
Existing mitigation activities include current mitigation programs and activities that are being implemented by county, regional, state, or federal agencies or organizations. The Community Emergency Response Team (CERT) is provided by the fire department to the community to help educate the public on how to be better prepared for any type of disaster.

Identify the applicable code sections that apply to earthquake hazard mitigation
Generally, these codes seek to discourage development in areas that could be prone to flooding, landslide, wildfire and/or seismic hazards; and where development is permitted, that the applicable construction standards are met. Developers in hazard-prone areas may be required to retain a qualified professional engineer to evaluate level of risk on the site and recommend appropriate mitigation measures.

Businesses/Private Sector
Natural hazards have a devastating impact on businesses. In fact, of all businesses which close following a disaster, more than forty-three percent never reopen, and an additional twenty-nine percent close for good within the next two years. The Institute of Business and Home Safety has developed “Open for Business,” which is a disaster planning toolkit to help guide businesses in preparing for and dealing with the adverse affects natural hazards. The kit integrates protection from natural disasters into the company's risk reduction measures to safeguard employees, customers, and the investment itself. The guide helps businesses secure human and physical resources during disasters, and helps to develop strategies to maintain business continuity before, during, and after a disaster occurs.

Hospitals
“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.

In approving the Act, the Legislature noted that:

“Hospitals, that house patients who have less than the capacity of normally healthy persons to protect themselves, and that must be reasonably capable of providing services to the public after a disaster, shall be designed and constructed to resist, insofar as practical, the forces generated by earthquakes, gravity and winds.” (Health and Safety Code Section 129680)

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.

SB 1953 directed the Office of Statewide Health Planning and Development ("OSHPD"), in consultation with the Hospital Building Safety Board, to develop emergency regulations including "…earthquake performance categories with sub gradations for risk to life, structural soundness, building contents, and nonstructural systems that are critical to providing basic services to hospital inpatients and the public after a disaster." (Health and Safety Code Section 130005)

The Seismic Safety Commission Evaluation of the State's Hospital Seismic Safety Policies
In 2001, recognizing the continuing need to assess the adequacy of policies, and the application of advances in technical knowledge and understanding, the California Seismic Safety Commission created an Ad Hoc Committee to re-examine the compliance with the Alquist Hospital Seismic Safety Act. The formation of the Committee was also prompted by the recent evaluations of hospital buildings reported to OSHPD that revealed that a large percentage (40%) of California's operating hospitals are in the highest category of collapse risk."

California Earthquake Mitigation Legislation
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 dense, the risk will continue to increase. For decades the Legislature has passed laws to strengthen the built environment and protect the residents.

Table 3.12 provides a sampling of some of the 200 plus laws in the State's codes.

Code Section	**Description**
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 central 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	Established the Earthquake Research Evaluation Conference.

Code Section	Description
Section 8899.10-8899.16	
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	

Earthquake Education

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, Orange County along with other Southern California counties, sponsors the Emergency Survival Program (ESP) of which Anaheim is a member, 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.

Landslides

Landslides as a Threat to the City of Anaheim

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year. The best estimate of direct and indirect costs of landslide damage in the United States range between $1 and $2 billion annually. As a seismically active region, California has had significant number of locations impacted by landslides. Some landslides result in private property damage; other landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life.

Landslides can be broken down into two categories: (1) rapidly moving (generally known as debris flows), and (2) slow moving. Rapidly moving landslides or debris flows present the greatest risk to human life, and people living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

The primary effects of mudslides/landslides can include:

- Abrupt depression and lateral displacement of hillside surfaces over distances of up to several hundreds of feet.
- Disruption of surface drainage.
- Blockage of flood control channels and roadways.
- Displacement or destruction of improvements such as roadways, buildings, and water wells.

Existing Landslide Deposits

Landslide deposits occur in the steep slopes of the Peralta Hills and Santa Ana Mountains which are generally underlain by Tertiary and Cretaceous age sedimentary deposits. Landslide deposits include relatively shallow surficial slumps, mudflows, and debris flows, which develop within the near surface topsoils, colluvium, and weathered formational materials. Larger landslide features include deep-seated landslides within the formational sedimentary rock materials. In general, the landslides occur due to various factors including steep slope conditions, erosion, rainfall, groundwater, adverse geologic structure, and grading impacts. Large, deep-seated landslides commonly develop when weak dipping bedding planes daylight along a slope face. Faulting is also a common factor in the development of planes of weakness which contribute to landslide potential.

The Santiago Landslide includes an area of land deformation encompassing approximately 25 acres in a residential tract of the Anaheim Hills area, which became active in 1993, following the floods of 1992 (Eberhart & Stone, 1996). Several homes located at the crest of the hill began to slide and had to be evacuated. These structures were deemed unsafe for continued habitation. The Santiago Landslide is located south of Walnut Canyon Reservoir along the southern limits of the City. Continuing mitigation efforts to stabilize this area include groundwater withdrawal from numerous wells throughout the area. A Geologic Hazard Abatement District was established by the City for maintaining, monitoring, and managing the dewatering system. Most, but not all, landslides in southern California begin to move when the soils have become saturated during heavy rains.

Historic Southern California Landslides

1928 St. Francis Dam failure, Los Angeles County, California. The dam gave way on March 12, and its waters swept through the Santa Clara Valley toward the Pacific Ocean, about 54 miles away. Sixty-five miles of valley was devastated, and over 500 people were killed. Damages were estimated at $672.1 million (year 2000 dollars).

1956 Portuguese Bend, California Cost, $14.6 million (2000 dollars) California Highway 14, Palos Verde's Hills. Land use on the Palos Verdes Peninsula consists mostly of single-family homes built on large lots, many of which have panoramic ocean views. All of the houses were constructed with individual septic

systems, generally consisting of septic tanks and seepage pits. Landslides have been active here for thousands of years, but recent landslide activity has been attributed in part to human activity. The Portuguese Bend landslide began its modern movement in August 1956, when displacement was noticed at its northeast margin. Movement gradually extended down slope so that the entire eastern edge of the slide mass was moving within 6 weeks. By the summer of 1957, the entire slide mass was sliding towards the sea.

1978 Bluebird Canyon, Orange County Cost, $52.7 million (2000 dollars) 60 houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the 1978 slide area was approximately 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.

1980 Southern California Slides $1.1 billion in damage (2000 dollars) Heavy winter rainfall in 1979-80 caused damage in six southern California counties. In 1980, the rainstorm started on February 8th. A sequence of 5 days of continuous rain and 7 inches of precipitation had occurred by February 14th. Slope failures were beginning to develop by February 15th and then very high-intensity rainfall occurred on February 16. As much as 8 inches of rain fell in a 6-hour period in many locations. Records and personal observations in the field on February 16 and 17 showed that the mountains and slopes literally fell apart on those two days.

1983 San Clemente, California, Orange County Cost, $65 million (2000 dollars), California Highway 1. Litigation at that time involved approximately $43.7 million (2000 dollars).

1978-1979, 1980 San Diego County, California Experienced major damage from storms in 1978, 1979, and 1979-80, as did neighboring areas of Los Angeles and Orange County, California. One hundred and twenty landslides were reported to have occurred in San Diego County during these 2 years. Rainfall for the rainy seasons of 78-79 and 79-80 was 14.82 and 15.61 inches (37.6 and 39.6 cm) respectively, compared to a 125-year average (1850-1975) of 9.71 inches (24.7 cm). Significant landslides occurred in the Friars Formation, a unit that was noted as slide-prone in the Seismic Safety Study for the City of San Diego. Of the nine landslides that caused damage in excess of $1 million, seven occurred in the Friars Formation, and two in the Santiago Formation in the northern part of San Diego County.

1994 Northridge, California earthquake landslides
As a result of the magnitude 6.7 Northridge, California, earthquake, more than 11,000 landslides occurred over an area of 10,000 km2. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. Destroyed dozens of homes, blocked roads, and damaged oil-field infrastructure. Caused deaths from Coccidioidomycosis (valley fever) the spore of which was released from the soil and blown toward the coastal populated areas. The spore was released from the soil by the landslide activity.

March 1995 Los Angeles and Ventura Counties, Southern California: Above normal rainfall triggered damaging debris flows, deep-seated landslides, and flooding. Several deep-seated landslides were triggered by the storms, the most notable was the La Conchita landslide, which in combination with a local debris flow, destroyed or badly damaged 11 to 12 homes in the small town of La Conchita, about 20 km west of Ventura. There also was widespread debris-flow and flood damage to homes, commercial buildings, and roads and highways in areas along the Malibu coast that had been devastated by wildfire 2 years before.

Landslide Characteristics
A landslide is defined as, the movement of a mass of rock, debris or earth down a slope. Landslides are a type of ‘mass wasting, which denotes any down slope movement of soil and rock under the direct influence of gravity. The term ‘landslide’ encompasses events such as rock falls, topples, slides, spreads, and flows. Landslides can be initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of these factors. Landslides can also occur underwater, causing tidal waves and damage to coastal areas. These landslides are called submarine landslides.

The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of

occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.

"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."

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 miles per hour, and can often move much faster. This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Soil Slumps
Loose, partly to completely saturated sand or silt; poorly compacted manmade fill composed of sand, silt, or clay; preexisting soil slump**.** *Source: USGS Website*

Landslide Events and Impacts
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. Many landslides are difficult to mitigate, particularly in areas of large historic movement 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.

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

Earth flows are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Earthquakes often trigger flows. Debris flows normally occur when a landslide moves down-slope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapid moving and also tend to increase in volume as they scour out the channel. Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances.

Landslide Conditions
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.

Wildland fires 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.

Natural Conditions
Natural processes can cause landslides or re-activate historical landslide sites. The removal or undercutting of shoreline-supporting material along bodies of water by currents and waves produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks.

Landslide Risk Areas
Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills
- Steep road-cuts or excavations
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground)
- Steep areas where surface runoff is channeled, such as below culverts, V -shaped valleys, canyon bottoms, and steep stream channels

Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons
Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire

Impacts of Development
Although landslides are a natural occurrence, human impacts can substantially affect the potential for landslide failures in County of Orange. Proper planning and geotechnical engineering can be exercised to reduce the threat of safety of people, property, and infrastructure. Excavation and Grading Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill.

Drainage and Groundwater Alterations
Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area.

Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems. Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.

Changes in Vegetation
Removing vegetation from very steep slopes can increase landslide hazards. Areas that experience wildfire and land clearing for development may have long periods of increased landslide hazard. Also, certain types of ground cover have a much greater need for constant watering to remain green. Changing from native ground cover plants may increase the risk of landslide.

Landslide Hazard Assessment

Vulnerability and Risk
Vulnerability assessment for landslides will assist in predicting how different types of property and population groups will be affected by a hazard. Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

Past landslide events have caused major property damage or significantly impacted city residents, and continuing to map city landslide and debris flow areas will help in preventing future loss.
Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. Following the Santiago landslide of 1993, a landslide study was commissioned and completed in 1996 by Eberhart & Stone. The City has followed the mitigation recommendations presented in this study.

Susceptibility 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.

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.

California Seismic Hazards Mapping Act:
The California Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards including liquefaction and seismically induced landslides. Cities, counties, or other permitting authorities are required to regulate certain development within seismic zones. Agencies must withhold development permits for a site within a zone until the geologic conditions have been investigated and appropriate mitigation measures are incorporated into development plans.

Epidemic

General Situation
Vaccines, antibiotics, and improved living conditions resulted in dramatic declines in communicable diseases in the latter part of the 20th Century. However, infectious diseases have become an increasing threat to all persons in Orange County due to a variety of factors such as: population growth (crowding, aging, migration), methods of food production (large scale, wide distribution, importation), environmental changes (drought, encroachment of humans on wild areas, global warming), microbial adaptation (resistance to antibiotics, re-assortment of genetic material), changes in health care (drugs causing immunosuppression, widespread use of antibiotics), and human behavior (travel, diet, sexual behavior). Orange County has programs within the Health Care Agency/Public Health Services that monitor the occurrence of communicable diseases and work to prevent their occurrence. Under California Law, certain communicable diseases are required to be reported to local health departments. An on call system, utilizing Sheriff Communications, allows reports to be received 24 hours per day, 7 days a week. Staff investigates individual cases and outbreaks of reported communicable diseases, analyze trends in disease occurrence, and make recommendations to prevent spread. More information is available at http://www.ochealthinfo.com/epi/index.htm.

Specific Situation
Current epidemic threats include:
West Nile Virus
Mosquitoes spread this virus. A small proportion of persons infected develop systems, which can range from fever and body aches to encephalitis. West Nile Virus was first detected in the United States in New York City in 1999 and has moved westward in subsequent years, causing epidemics across the country.

- **Antibiotic-resistant microorganisms**
  - Widespread and improper use of antibiotics and insufficient use of control measures has resulted in resistance to antibiotics. Methicillin-resistant Staphylococcus aureus (MRSA) has become resistant to many other antibiotics and a new strain recently began circulating in the community.
- **Pandemic influenza (see Table 3.13 below)**
  - 'Pandemic' refers to a worldwide epidemic. New influenza strains with pandemic potential can appear when animal and human strains have the opportunity to exchange genetic material resulting in a virulent strain that can infect humans. This could happen at any time.
- **Reemergence of SARS (Severe Acute Respiratory Syndrome)**
  - SARS likely emerged from an animal or animals in China to infect humans. Reemergence could occur at any time, since the actual source is unknown and cannot be eradicated.
- **Food borne illness**
  - Contaminated food sources and human error can cause food borne outbreaks. Small food borne outbreaks occur frequently.
- **Bioterrorism**
  - The diseases of greatest concern include anthrax, smallpox, plague, tularemia, botulism, and viral hemorrhagic fevers.

Responding to epidemics
Once an epidemic has been identified by the Orange County Health Care Agency/Public Health Services, a three-pronged response is launched:

1. Investigation of the epidemic to determine its etiology, source, mode of transmission and persons affected and at risk;
2. Determining and instituting control measures to prevent further spread;
3. Public and health professional communication.

Table 3.13 - Estimates of number of affected people by pandemic influenza in Orange County

CDC Estimates of Percent of Population Affected by the Next Pandemic	Number Affected in California (Pop. 32,268,301)	Number Affected in Orange County (Pop. 2,846,289)	Number Projected Based on CDC Estimates in Anaheim (Pop. 348,000)
Up to 35% of pop. will become ill with flu	11,293,906	996,201	121,804
Up to 19% of pop. will require outpatient visits	6,054,763	540,795	66,122
Up to 0.4% of pop. will require hospitalization	127,442	11,385	1,392
Up to 0.1% of pop. will die of flu-related causes	28,409	2,846	348

High Wind (Santa Ana Winds)

General Situation
Information was obtained form the San Diego National Weather Service website at http://nimbo.wrh.noaa.gov/Sandiego/snawind.html.

Santa Ana winds are generally defined as warm, dry winds that blow from the east or northeast (offshore). These winds occur below the passes and canyons of the coastal ranges of Southern California and in the Los Angeles basin. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon (the canyon from which it derives its name). Forecasters at the NWS in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "Santa Ana" for winds greater than 25 knots.

The complex topography of Southern California combined with various atmospheric conditions creates numerous scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Mountains and west of the Rocky Mountains including most of Nevada and Utah). Clockwise circulation around the center of this high-pressure area forces air downslope from the high plateau. The air warms as it descends toward the California coast at the rate of 5 degrees F per 1000 feet due to compressional heating. Thus, compressional heating provides the primary source of warming. The air is dry since it originated in the desert, and it dries out even more as it is heated.

Santa Ana wind conditions can result in two general disaster conditions. The most common is fire fanned by the high winds. This was the situation in 1993 in Laguna Beach when a massive fire destroyed a number of homes in the hills around Laguna Beach. Wind driven flames again caused the destruction of more than 3,000 homes in Southern California in October 2003. Other forms of disaster would be direct building damage, damage to utilities and infrastructure as a result of the high winds. This has occurred in the past few years in many southland communities including Orange County.

Specific Situation
Santa Ana winds commonly occur between October and February with December having the highest frequency of events. Summer events are rare. 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. Santa Ana winds are an important forecast challenge because of the high fire danger associated with them. Also, unusually high surf conditions on the northeast side of the Channel Islands normally accompany a Santa Ana event. Other hazards include: wind damage to property, turbulence and low-level wind shear for aircraft, and high wind dangers for boaters.

Vector Issues (Pests)

General Situation
The information for this assessment was obtained from the Orange County Vector Control District website. The Orange County Vector Control District routinely conducts field surveys to determine the presence of vector-borne disease. The diseases of prime concern are those carried by mosquitoes, fleas, ticks, and rodents. Surveillance and detection programs are designed around each of these vectors. When a vector-borne disease is detected by routine surveillance activities, management evaluates the risk options. If it is determined that a risk to the public exists, then local and state health agencies are informed, including the public.

Specific Situation
The district routinely surveys for several pests carried diseases that have been in the county for some time. These include:

Mosquito-Borne Diseases:
The primary concern with mosquito-borne disease is the transmission of encephalitis virus to humans. Since certain wild birds carry encephalitis viruses, the District samples blood from the birds from key locations throughout the County. The blood samples are tested for antibodies associated with a recent infection (via mosquito bite) of either St. Louis Equine Encephalitis (SLE) or Western Equine Encephalomyelitis (WEE) virus. Human SLE infections normally affect elderly persons, while WEE infections impact infants and adolescents. Furthermore, human SLE cases are more abundant from late summer to early fall and WEE cases usually occur in late spring and early summer. Protocols have been developed for the detection of West Nile Virus using the wild bird serosurveillance system already in place. The District also closely monitors local mosquito population numbers by simultaneously operating carbon dioxide-baited traps that selectively trap female mosquitoes searching for blood meals from a vertebrate host.

Plague
Plague is a natural occurring bacterial disease associated with wild rodents and fleas. In Orange County, plague has demonstrated some sporadic historical occurrence in the uplands along the Santa Ana River adjoining San Bernardino and Riverside Counties. Plague in southern California is typically associated with ground squirrels and pack rats, and very rarely with rodents like the roof rat. The District routinely traps ground squirrels at parks and historic plague sites. A sample of blood is taken along with the fleas brushed from their bodies. The blood sample is tested for plague antibodies and fleas are tested for the presence of infectious plague bacteria.

Hantavirus
Hantavirus is a recently discovered viral pathogen found in rodents that affects humans by attacking the lungs and producing an often (50%) fatal pneumonia. The virus is inhaled as an aerosol originating from contaminated fecal pellets (droppings) and urine. The particular strain of Hantavirus encountered locally is the Sin Nombre Virus (or SNV) associated naturally with deer mice and rarely pack rats (See Figure 24). The District traps and takes blood samples from both deer mice and pack rats throughout the County.

Lyme Disease
Lyme Disease, carried by ticks, is caused by a single-celled bacterial parasite called a spirochete. When a tick carrying Lyme disease spirochetes attaches and begins ingesting blood, transmission of the spirochetes does not occur immediately, but approximately six to eight hours thereafter. The disease can become very debilitating if not treated shortly after infection. Common symptoms occurring after infection include a rash followed by aches and pains, stiffness in joints, muscular abnormalities, and loss of equilibrium/coordination.

Lyme Disease in California is more prevalent along the north coast where the cool and wet climate favors optimal survival of the Pacific Black-legged Tick vector. This tick is relatively common in Orange County, but the factors affecting the Black-legged tick that affect its spirochete infection capacity are unknown.

Because the risk of Lyme spirochete transmission is probably cyclic, the District continues to regularly collect and test Pacific Black-legged Ticks and other tick species.

Tornadoes

General Situation
Tornadoes are one of nature's most violent storms. In an average year, 800 tornadoes are reported across the United States, resulting in 80 deaths and over 1,500 injuries. A tornado is as a violently rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be in excess of one mile wide and 50 miles long.

Tornadoes come in all shapes and sizes and can occur anywhere in the U.S at any time of the year. In the southern states, peak tornado season is March through May, while peak months in the northern states are during the summer.

Specific Situation
Though not common, tornadoes do occur throughout California. Between 1958 and 1998 Orange County was hit by 28 tornadoes. The vast majority of those events had Fujita Scale readings of F0, however 2 events reached F2. No deaths have been attributed to these events and only a small number of injuries. The following table provides information on these events.

Table 3.14 - Historic Tornado Events in Orange County (1958-1998)

Date	Deaths	Injuries	Fujita Scale	Date	Deaths	Injuries	Fujita Scale
01 APR 1958	0	0	F1	28 FEB 1991	0	0	F0
19 FEB 1962	0	0	F0	26 MAR 1991	0	0	F1
08 APR 1965	0	0	F1	07 DEC 1992	0	0	F1
07 NOV 1966	0	0	F1	29 DEC 1992	0	0	F0
07 NOV 1966	0	0	F2	14 JAN 1993	0	0	F1
16 MAR 1977	0	4	F1	17 JAN 1993	0	1	F1
09 FEB 1978	0	6	F2	18 JAN 1993	0	0	F0
31 JAN 1979	0	0	F1	08 FEB 1993	0	0	F0
09 NOV 1982	0	0	F0	03 NOV 1993	0	2	F0
09 NOV 1982	0	0	F1	07 FEB 1994	0	0	F0
13 JAN 1984	0	0	F0	07 NOV 1997	0	0	F1
16 MAR 1986	0	0	F1	21 DEC 1997	0	0	F1
18 JAN 1988	0	0	F0	24 FEB 1998	0	0	F0
JAN 18, 1988	0	0	F0				

(Reference: http://www.tornadoproject.com/alltorns/catorn.htm California Tornadoes 1888 - 2000)

Part One

Chapter Four
Hazard Mitigation Strategy

Hazard Mitigation Prioritization

The Anaheim City Council has set "Public Safety" as one of the city's number one priorities. Commitment of both the City Council and the City's Emergency Management Organization to emergency preparedness and hazard mitigation has been consistent for many years.

Priorities were assigned based on the Natural Hazard Analysis (Table 3.2, Ch. 3) and how that those threats might impact public safety, including life and property. Furthermore, priorities were determined based upon available resources and the proposed project timelines. Those projects with identified resources, either financial or structural, were considered over other projects that would require significant investigation into resources, funding, or other mitigation components.

Multi-Hazard Goals and Action Items

Hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. This section provides information on the process used to develop the mitigation strategy, based on goals and action items that pertain to the hazards addressed in this mitigation plan. It also describes the framework that focuses the plan on developing successful mitigation strategies.

Hazard Mitigation Goals

The plan goals describe the overall direction that the City of Anaheim agencies, organizations, and residents can take to minimize the impacts of natural hazards. The goals serve as stepping stones and help to guide direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Protect Life and Property

- Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to natural hazards.
- Reduce losses and repetitive damage for chronic hazard events, while promoting insurance coverage for catastrophic hazards.
- Improve hazard assessment information to make recommendations for mitigating new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

Public Awareness

- Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.
- Provide information on tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.

Natural Systems

- Balance watershed planning, natural resource management, and land use planning with natural hazard mitigation to protect life, property, and the environment.
- Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.

Partnerships and Implementation

- Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in implementation.
- Encourage leadership within public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities.

Emergency Services

- Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.

- Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
- Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Hazard Mitigation Plan Action Items

The action items are a listing of activities in which the City and residents can be engaged to reduce risk. The mitigation plan identifies short and long-term action items developed through data collection and research, and the public participation process. Mitigation plan activities may be considered for funding through Federal and State grant programs, and when other funds are made available through the City. Action items address multi-hazard (MH) and hazard specific issues. To help ensure activity implementation, each action item includes information on the time line and coordinating organizations. Upon implementation, the coordinating organizations may look to partner organizations for resources and technical assistance. A description of the partner organizations is provided in Appendix E, the resource directory of this plan.

Organization of Action Items

The action items are organized within the following matrix, which lists all of the multi-hazard and hazard-specific action items included in the mitigation plan. Data collection and research and the public participation process resulted in the development of these action items.

Coordinating Organization

The coordinating organization is the public agency with regulatory responsibility to address natural hazards, or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Coordinating organizations may include local, county, or regional agencies capable of or responsible for implementing activities and programs.

Timeline

Action items include both short and long-term activities. Each action item includes an estimate of the time line for implementation. Short-term action items are activities which the City is capable of implementing with existing resources and authorities within one to two years. Long-term action items may require new or additional resources or authorities, and may take between one and five years (or more) to implement.

Ideas for Implementation

Each action item includes ideas for implementation and potential resources, which may include grant programs or human resources. The matrix includes the page number within the mitigation plan where this information can be found.

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. The plan goals are organized into the following five areas:

- Protect Life and Property
- Public Awareness
- Natural Systems
- Partnerships and Implementation
- Emergency Services

Partner Organizations

Partner organizations are agencies or public/private sector organizations that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization. These organizations are not listed with the individual action items or in the plan matrix, and instead are listed in Appendix E of this plan. The partner organizations listed in the Resource Directory of the City of Anaheim Natural Hazards Mitigation Plan are potential partners recommended by the project steering committee, but were not necessarily contacted during the development of the Mitigation Plan. Partner organizations should

be contacted by the coordinating organization to establish commitment of time and resources to action items.

Constraints
Constraints may apply to some of the action items. These constraints may be a lack of City staff, lack of funds, or vested property rights that might expose the City to legal action as a result of adverse impacts on private property.

Cost Benefit Analysis
There will be some limitations on the number and cost of mitigation activities that can be completed within a given period of time. There are likely to be multiple ideas to mitigate the effects of a given hazard. Therefore, it will be necessary for the committee to select the most cost effective mitigation projects and to further prioritize them.

Multi-Hazard Action Items
Multi-hazard action items are those activities that pertain to two or more of the ten hazards in the mitigation plan: flood/storm, wildland/urban fire, earthquake, dam failure, epidemic, high winds/Santa Ana winds, vector issues, mud/landslide, and tornados.

Short Term Activities	
Hazard:	Multi Hazard Short Term Activity #1
Action Item:	Develop inventories of critical facilities and infrastructure and prioritize mitigation projects.
Coordinating Organization:	Anaheim Fire Department
Ideas for Implementation:	- Identify critical facilities and roadways at risk from hazard events. - Develop strategies to mitigate risk to these facilities, or to utilize alternative facilities should hazard events cause damage to the facilities in question. - Incorporate the building inventory developed by the City of Anaheim into the hazard assessment.
Time Line:	1 – 2 years
Plan Goals Addressed:	Protect Life and Property, Partnerships and Implementation.

Long Term Activities	
Hazard:	Multi Hazard Long Term Activity #1
Action Item:	Integrate the goals and action items from the City of Anaheim Natural Hazard Mitigation Plan into existing regulatory documents and programs, where appropriate.
Coordinating Organization:	Planning Department
Ideas for Implementation:	- Ensure that the Safety Element of the General Plan and the Local Hazard Mitigation Plan are periodically reviewed in order to ensure that they remain mutually consistent - Integrate the City's mitigation plan into current capital improvement plans to ensure that development does not encroach on known hazard areas: and
Time Line:	Ongoing
Plan Goals Addressed:	Partnerships and Implementation

Long Term Activities	
Hazard:	Multi Hazard Long Term Activity #2
Action Item:	Identify and pursue funding opportunities to develop and implement mitigation activities.
Coordinating Organization:	Anaheim Fire Department
Ideas for Implementation:	- Develop incentives for residents, and businesses to pursue hazard mitigation projects. - Allocate City resources and assistance to mitigation projects when possible. - Partner with other organizations and agencies in the City of Anaheim to identify grant programs and foundations that may support mitigation activities
Time Line:	Ongoing
Plan Goals Addressed:	Partnerships and Implementation

Long Term Activities	
Hazard:	Multi Hazard Long Term Activity #3
Action Item:	Strengthen emergency services preparedness and response by linking emergency services with hazard mitigation programs, and enhancing access to hazard information.
Coordinating Organization:	Anaheim Fire Department
Ideas for Implementation:	- Encourage individual and family preparedness through public education projects such as safety fairs. - Identify opportunities for partnering with residents, private contractors, and other jurisdictions to increase availability of equipment and manpower for efficiency of response efforts. - Work with Community Based Organizations (CBO's) and other neighborhood groups to establish community response teams (CERT). - Identify all organizations within the City of Anaheim that have programs or interests in hazard mitigation. - Involve private businesses throughout the City in mitigation planning.
Time Line:	Ongoing
Plan Goals Addressed:	Emergency Services

Long Term Activities	
Hazard:	Multi Hazard Long Term Activity #4
Action Item:	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to residents, public agencies, private property owners, businesses, and schools.
Coordinating Organization:	Anaheim Fire Department Community Relations
Ideas for Implementation:	- Make the City of Anaheim Natural Hazards Mitigation Plan available to the public by publishing the plan electronically on the City websites. - Continue outreach programs regarding flood hazard preparedness to business organizations that must prepare for flooding events. - Use cable stations as a conduit for advertising public forums. - Conduct workshops for public and private sector organizations to raise awareness of mitigation activities and programs. - Develop outreach materials for mitigation, preparedness, response and recovery.
Time Line:	Ongoing
Plan Goals Addressed:	Public Awareness, Protect Life and Property

Long Term Activities	
Hazard:	Multi Hazard Long Term Activity #5
Action Item:	Establish a formal role for the City of Anaheim Hazard Mitigation Task Force to develop a sustainable process for implementing, monitoring, and evaluating citywide mitigation issues.
Coordinating Organization:	Hazard Mitigation Planning Task Force
Ideas for Implementation:	- Establish clear roles for participants, meeting regularly to pursue and evaluate implementation of mitigation plan. - Oversee implementation of the mitigation plan. - Establish measurable standards to evaluate mitigation policies and programs and provide a mechanism to update and revise the mitigation plan. - Monitor hazard mitigation implementation by the City departments and divisions and participating organizations through surveys and other reporting methods. - Develop updates for the Hazard Mitigation Plan based on new information. - Conduct a full review of the Hazard Mitigation Plan every 5 years by evaluating mitigation successes, failures, and areas that are not addressed. - Provide training for Task Force and Working Group members to remain current on developing issues in the hazard loss reduction field.
Time Line:	Ongoing
Plan Goals Addressed:	Partnerships and Implementations

Specific Hazard Activities:

The following mitigation actions provide direction for specific hazards with specific activities that organizations and residents in the City of Anaheim can undertake to reduce risk and prevent loss from these events. Each action item is followed by ideas for implementation, which can be used by the Hazard Mitigation Plan Task Force and local decision makers in pursuing strategies for implementation.

Flooding/Storms

Short Term Activities	
Hazard:	Flood Short Term Activity #1
Action Item:	Recommend revisions to requirements for development within the flood plain where appropriate.
Coordinating Organization:	Planning Department
Ideas for Implementation:	- Explore raising the base elevation requirement for new residential construction to two or three feet above base flood elevation, or greater. An increased elevation standard is one activity the City can engage in to receive credit from the NFIP Community Rating System Program.
Time Line:	2 years
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Flood Long Term Activity #1
Action Item:	Continue development and management strategies to preserve open space for flood mitigation, and water quality in the floodplain.
Coordinating Organization:	Planning & Community Services Departments
Ideas for Implementation:	- Explore funding for property acquisition from federal (e.g. FEMA Hazard Mitigation Grant Program), state, regional governments, as well as private and non-profit organizations, trails programs, as well as options for special appropriations; - Identify sites where environmental restoration work can benefit flood mitigation, and water quality; - Continue to promote the installation on private and public property, of detention basins and pervious surfaces, in order to reduce the peak and overall runoff from rainfall.
Time Line:	5 years (as funding permits)
Plan Goals Addressed:	Natural Systems, Protect Life and Property

Long Term Activities	
Hazard:	Flood Long Term Activity #2
Action Item:	Identify surface water drainage obstructions for all parts of the City.
Coordinating Organization:	Public Works and Utilities Departments
Ideas for Implementation:	- Research and establish ownership of all storm drain systems in Anaheim - Map culverts and other potential bottlenecks or obstructions in the storm drain system. - Prepare an inventory of culverts that historically create flooding problems and target them for retrofitting; - Prepare an inventory of major urban drainage problems, and identify causes and potential mitigation actions for urban problem areas.
Time Line:	5 years
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Flood Long Term Activity #3
Action Item:	Study the need for Public Utilities facilities near flood channels to be less susceptible to damage from floods.
Coordinating Organization:	Public Utilities Department
Ideas for Implementation:	- Complete a study of susceptible buildings and mitigation actions.
Time Line:	5 years (As funding permits)
Plan Goals Addressed:	Protect Life and Property, Partnerships and Implementation

Wildland/Urban Fires

Short Term Activities	
Hazard:	Fire Short Term Activity #1
Action Item:	Enhance emergency services to increase the efficiency of wildfire/urban response and recovery activities.
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Install more fire reporting stations for better access and coverage; - Develop a City call list that includes all at-risk wildland/urban interface residents within City in order to contact them during evacuations.
Time Line:	2 years
Plan Goals Addressed:	Emergency Services

Short Term Activities	
Hazard:	Fire Short Term Activity #2
Action Item:	Educate agency personnel on federal cost-share and grant programs, Fire Protection Agreements and other related federal programs so the full array of assistance available to local agencies is understood.
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Investigate potential funding opportunities for individual mitigation projects; and - Develop, approve and promote Fire Protection Agreements and partnerships to clarify roles and responsibilities and to provide for fire mitigation activities and suppression preparedness.
Time Line:	1 – 2 years
Plan Goals Addressed:	Protect Life and Property, Public Awareness

Short Term Activities	
Hazard:	Fire Short Term Activity #3
Action Item:	Inventory alternative firefighting water sources and encourage the development of additional sources.
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Advocate for water storage facilities with fire resistant electrical pump systems in developments outside the fire protection districts that are not connected to a community water or hydrant system; and
Time Line:	1 year
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Fire Long Term Activity #1
Action Item:	Encourage development and dissemination of maps relating to the fire hazard to help educate and assist builders and home owners in being engaged in wildland/urban fire mitigation activities and to help guide emergency services during response.
Coordinating Organization:	City of Anaheim Fire Department GIS
Ideas for Implementation:	- Update wildland/urban interface maps; - Conduct risk analysis incorporating data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities; and
Time Line:	1 – 3 years
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Fire Long Term Activity #2
Action Item:	Increase communication, coordination and collaboration between wildland/urban interface property owners, City planners and fire prevention crews and officials to address risks, existing mitigation measures and federal assistance programs.
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Encourage single-family residences to have fire plans and practice evacuation routes; - Encourage fire inspections in residential homes by fire departments to increase awareness among home owners and potential fire responders; - Require fire department notification of new business applications to ensure that appropriate fire plans have been developed;
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Public Awareness, Emergency Services, Partnerships and Implementation

Long Term Activities	
Hazard:	Fire Long Term Activity #3
Action Item:	Enhance outreach and education programs aimed at mitigating wildland/urban hazards and reducing and preventing the exposure of residents, public agencies, private property owners and business to these hazards
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Encourage the hiring of fire prevention and education personnel to oversee education programs; - Visit urban interface neighborhoods and rural areas to conduct education and outreach activities; - Conduct specific community-based demonstration projects of fire prevention and mitigation in the urban interface; - Establish neighborhood “drive-through” activities that pinpoint site-specific mitigation activities. Fire crews can give property owners personal suggestions and assistance; and - Perform public outreach and information activities at fire stations by creating “Wildfire Awareness Week” activities, Fire stations can hold open houses and allow the public to visit, see the equipment and discuss wildfire mitigation with the station crews.
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Public Awareness

Long Term Activities	
Hazard:	Fire Long Term Activity #4
Action Item:	Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.
Coordinating Organization:	City of Anaheim Fire Department
Ideas for Implementation:	- Employ mechanical thinning and consider prescribed burns to abate the risk of catastrophic fire and restore the more natural regime of high frequency, low-intensity burns. Prescribed burning may provide benefit to ecosystems by thinning hazardous vegetation and restoring ecological diversity to areas homogenized by invasive plants; and - Clear trimmings, trees, brush and other debris completely from sites when performing routine maintenance and landscaping to reduce fire risk.
Time Line:	Ongoing
Plan Goals Addressed:	Natural Systems

Earthquake

Short Term Activities	
Hazard:	Earthquake Short Term Activity #1
Action Item:	Incorporate the Earthquake Transportation Evacuation Routes developed by the Emergency Managers Group into appropriate planning documents.
Coordinating Organization:	Anaheim Police Department PW Traffic Management
Ideas for Implementation:	- Update the transportation routes map in the City of Anaheim Hazard Mitigation Plan with the evacuation routes data; and - Integrate the evacuation routes data into the City of Anaheim Emergency Operations Plan. - Need to identify key travel corridors with priority for those to focus on maintaining should roadway be affected.
Time Line:	2 years
Plan Goals Addressed:	Emergency Services

Long Term Activities	
Hazard:	Earthquake Long Term Activity #1
Action Item:	Identify funding sources for structural and nonstructural retrofitting for facilities identified as seismically vulnerable.
Coordinating Organization:	Community Development Department Building
Ideas for Implementation:	- Provide information for property owners, small businesses, and organizations about sources of funds (low cost loans, grants, etc.); and - Explore options for including seismic retrofitting in existing programs such as low-income housing, insurance reimbursements, and pre and post disaster repairs.
Time Line:	Ongoing
Plan Goals Addressed:	Partnerships and Implementation, Public Awareness

Long Term Activities	
Hazard:	Earthquake Long Term Activity #2
Action Item:	Replace overhead power lines with underground lines to reduce outages caused by earthquakes.
Coordinating Organization:	Anaheim Public Utilities Department
Ideas for Implementation:	- Replace overhead power lines with underground lines in arterial streets.
Time Line:	5 years (as funding permits)
Plan Goals Addressed:	Protect Live and Property, Emergency Services

Epidemic

Long Term Activities	
Hazard:	Epidemic Long Term Activity #1
Action Item:	Educate the public about Epidemics
Coordinating Organization:	Orange County Health Care Agency Anaheim Fire Department Community Relations
Ideas for Implementation:	- Coordinate with local hospitals, clinics and medical groups to disseminate information about the effects and transmission of diseases causing epidemics
Time Line:	Ongoing
Plan Goals Addressed:	Public Awareness, Protect Life and Property

Vector Issues

Short Term Activities	
Hazard:	Vector Issues Short Term Activity #1
Action Item:	
Coordinating Organization:	Anaheim Fire Department Community Relations
Ideas for Implementation:	- Monitor efforts of county & assist in disseminating information to the Anaheim Community
Time Line:	Ongoing
Plan Goals Addressed:	Public Awareness

Landslide

Short Term Activities	
Hazard:	Landslide Short Term Activity #1
Action Item:	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.
Coordinating Organization:	Public Works Department
Ideas for Implementation:	- Continue to implement and monitor the suggestions of the Eberhart and Stone Santiago Landslide Study (1996). - Develop public information to emphasize economic risk when building on potential or historical landslide areas.
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property

Short Term Activities	
Hazard:	Landslide Short Term Activity #2
Action Item:	Encourage construction and subdivision design that can be applied to steep slopes to reduce the potential adverse impacts from development.
Coordinating Organization:	Public Works Department
Ideas for Implementation:	- Increase communication and coordination between City Departments involved in the planning and construction of developments.
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Landslide Long Term Activity #1
Action Item:	Review local ordinance regarding building and development in landslide prone areas.
Coordinating Organization:	Public Works Department
Ideas for Implementation:	- Staff to investigate and make recommendations regarding building and development in landslide prone areas.
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property

Long Term Activities	
Hazard:	Landslide Long Term Activity #2
Action Item:	Mitigate activities in identified potential and historical landslide areas through regulation and public outreach.
Coordinating Organization:	Public Works Department
Ideas for Implementation:	- Analyze existing regulations regarding development in landslide prone areas; - Identify existing mechanisms for public outreach.
Time Line:	Ongoing
Plan Goals Addressed:	Protect Life and Property, Public Awareness

Winds (Santa Ana Winds)

Long Term Activities	
Hazard:	High Winds Long Term Activity #1
Action Item:	Replace overhead power lines with underground lines to reduce outages caused by earthquakes.
Coordinating Organization:	Anaheim Public Utilities Department
Ideas for Implementation:	- Replace overhead power lines with underground lines in arterial streets.
Time Line:	5 years (as funding permits)
Plan Goals Addressed:	Protect Live and Property, Emergency Services

Part One

Chapter Five
Plan Maintenance

Plan Maintenance

The Plan Maintenance Chapter of this document details the formal process that will ensure the City's Hazard Mitigation Plan remains an active and relevant document. The plan maintenance process is based upon annual review and a plan revision will be produced every five years. This chapter describes how the City will integrate public participation throughout the plan maintenance process. Finally, this chapter includes an explanation of how the City's government intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City's General Plan, Capital Improvement Plans, and Anaheim Building Codes.

Coordinating Body

The City of Anaheim Hazard Mitigation Planning Task Force will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The City Council, City Manager and Department Heads will assign representatives from City agencies, including, but not limited to, the current Hazard Mitigation Planning Task Force members.

The following City staff will serve as representatives of the Hazard Mitigation Planning Task Force:

Department	Personnel
Building	Building Official
City Attorney's Office	Senior Assistant City Attorney - Civil
City Manager's Office	Management Intern
Community Development	Redevelopment Manager
Community Services	Community Services Superintendent
Convention Center	Tenant Service Manager
Fire	Division Chief – Admin /Disaster Preparedness Manager
GIS	GIS Manager
Human Resources	Human Resources Director
Planning	General Plan and Regional Coordination Team
Police	Special Operations Division Commander Police Lieutenant Homeland Security
Public Utilities	Environmental Services Manager
Public Works	Civil Engineer
Risk Management	Risk Manager

Convener

The Fire Department will serve as the convener to facilitate the Hazard Mitigation Planning Task Force meetings, and will assign tasks such as updating and presenting the Plan to the members of the committee. Plan implementation and evaluation will be a shared responsibility among all of the Hazard Planning Task Force Members. The Fire Department will conduct annual reviews of the Hazard Mitigation Plan, as well as facilitate plan updates every five years, at a minimum.

Monitoring, Evaluating, and Updating the Hazard Mitigation Plan

The City of Anaheim Hazard Mitigation Plan will be monitored and evaluated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The evaluation process includes a firm schedule and time line, and identifies the local agencies and organizations participating in plan evaluation. The Fire Department will be responsible for contacting the Hazard Mitigation Planning Task Force members and organizing the annual meeting, scheduling, incorporating public input and providing revised drafts to the public.

A thorough review of the plan will take place within the third year of the review process to coincide with the review of the Emergency Response Plan. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan. The committee will review the goals and action items to determine their relevance to changing situations in the City, as well as changes in County, 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. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised.

The Fire Department will assign the duty of updating the plan to one or more of the committee members. The designated committee members will have three months to make appropriate changes to the Plan before submitting it to the Hazard Committee members, and presenting it to the 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.

Plan Adoption

The City Council is responsible for adopting the City of Anaheim Hazard Mitigation Plan. The City Council has the authority to promote sound public policy regarding natural hazards. Once the plan has been adopted, the Fire Department will be responsible for submitting it to the State Hazard Mitigation Officer at the Governor's Office of Emergency Services. The Governor's Office of Emergency Services will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the City of Anaheim will gain eligibility for Hazard Mitigation Grant Program funds.

The City Council will periodically need to re-adopt the plan as it is revised to meet changes in the hazard risks and exposures in the community. The approved Hazard Mitigation Plan will be a significant tool in managing the future growth and development of the community.

Incorporating Mitigation into Existing Planning Mechanisms

The City of Anaheim addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans and City Building and Safety Codes. The Natural Hazard Mitigation Plan provides a series of recommendations - many of which are closely related to the goals and objectives of existing planning programs. The City of Anaheim will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

The City's Building and Code Enforcement Divisions of the Planning Department are responsible for administering the Building and Safety Codes. In addition, the Hazard Planning Task Force will work with other agencies at the state level to review, develop and ensure Building and Safety Codes that are adequate to mitigate or present damage by natural hazards. This is to ensure that life-safety criteria are met for new construction.

The goals and action items in the mitigation plan may be achieved through activities recommended in the City's Capital Improvement Program (CIP). Various City departments develop plans, and review them on

an annual basis. Upon annual review of the Capital Improvement Program, the Hazard Mitigation Planning Task Force will work with the City departments to identify areas that the hazard mitigation plan action items are consistent with CIP planning goals and integrate them where appropriate.

Within six months of formal adoption of the mitigation plan, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the City level. The meetings of the Hazard Mitigation Planning Task Force will provide an opportunity for committee members to report back on the progress made on the integration of hazard mitigation plan elements into City planning documents and procedures.

Economic Analysis of Mitigation Projects

FEMA's approach to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: cost/benefit analysis and cost-effectiveness analysis. Conducting cost/benefit analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later.

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Given federal funding, the Hazard Mitigation Planning Task Force will use a FEMA-approved cost/benefit analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Hazard Mitigation Planning Task Force will use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, please see Appendix C of the Plan.

Continued Public Involvement

The City is dedicated to involving the public directly in the review and updates of the Hazard Mitigation Plan. The Hazard Mitigation Planning Task Force members are responsible for the annual review and update of the plan.

The public will also have the opportunity to provide feedback about the Plan. Copies of the Plan will be catalogued and kept at the City of Anaheim, City Clerk’s office, Central Library and Canyon Hills Library. The plan also includes the address and the phone number of the, Fire Department Personnel responsible for keeping track of public comments on the Plan. In addition, copies of the Plan and any proposed changes will be posted on the City of Anaheim website at www.anaheim.net. This site will also contain an email address and phone number to which people can direct their comments and concerns. A public meeting will also be held after each annual evaluation or when deemed necessary by the Hazard Mitigation Planning Task Force. The meetings will provide the public a forum in which they can express their concerns, opinions, or ideas about the Plan. The Fire Department will be responsible for using City resources to publicize the annual public meetings and maintain public involvement through the public access channel, web page, and newspapers.

Part One

Chapter Six
Local Capabilities Assessment

Agency Name (Mission/Function)	Programs, Plans, Policies, Regulations, Funding, or Practices	Point of Contact Name, Address, Phone, Email	Effect on Loss Reduction Support Facilitate Hinder	Comments
The County of Orange	Codified Ordinances	County of Orange Clerk of the Board, Darlene Bloom 10 Civic Center Plaza, Rm 465, Santa Ana, CA 92702 www.oc.ca.gov	S	Ordinances dedicated to Public Facilities; Public Morals, Safety and Welfare; Property Maintenance; Health and Sanitation and Animal Regulations; Business and Special Licenses, Regulations; Highways, Bridges, Rights-ofWay, Vehicles; Land Use and Building Regulations; Fees; Water Quality – Orange County Flood Control; Stormwater Management and Urban Runoff.
County of Orange Agencies & Departments	Standard Operating Procedures	See website, www.oc.ca.gov for Department Contacts	S	Dependent upon mission and goals of the agency/department.
Orange County Fire Authority (OCFA) Mission: To serve the changing needs of the community by providing the highest quality regional emergency, safety and support services, including protecting lives, property, and the environment with compassion, vigilance and dedication to excellence	Orange County Hazardous Materials Area Plan (Nov. 1999)	Daniel A. Drake, Battalion Chief Emergency Planning & Coordination Section, OCFA (714) 573-6000	S	Addresses the storage, use and emergency planning for hazardous materials
	California Fire Code		S	The purpose of the Code is to prescribe regulations governing conditions hazardous to life and property from fire or explosion.
	Califonria Public Resources Code, Division 4. Forests, Forestry and Range and Forage Lands		S	The purpose is to prescribe regulations governing forests, forestry and fire issues.
Orange County Health Care Agency To protect and promote the health of the community.	Disease Control & Epidemiology	Hildy Meyers, MD, MPH 1719 West 17th Street, Santa Ana, CA 92706 hmeyers@ochca.com	S	Monitor and work to prevent the occurrence of communicable diseases. Includes investigation of individual cases and outbreaks, education, and in some cases, preventative treatment.
	HCA Disaster Plan	Darlene Isbell, EMS Program 405 West 5th Street, Santa Ana, CA 92701 (714) 834-2791 disbell@ochca.com	S	To provide for the coordinated response and recovery from health and environmental emergencies.
	Epidemiology & Assessment Program Disaster Plan	Hildy Meyers, MD, MPH 1719 West 17th Street, Santa Ana, CA 92706 hmeyers@ochca.com	S	OCHCA monitors disease trends, and often provides current and other information to doctors, hospital, the public and news media. OCHCA may also provide education or preventative treatment in some circumstances.
	Smallpox and Pandemic Influenza Preparedness and Response Plan	Deborah Morton, RN 405 West 5th Street, Santa Ana, CA 92701 (714) 834-6235 dmorton@ochca.com	S	Response plan for mass vaccinations

Agency Name (Mission/Function)	Programs, Plans, Policies, Regulations, Funding, or Practices	Point of Contact Name, Address, Phone, Email	Effect on Loss Reduction Support Facilitate Hinder	Comments
Orange County Health Care Agency To protect and promote the health of the community.	Strategic National Stockpile Plan	Michelle Zink, Bioterrorism Program Coordinator 405 West 5th Street, Santa Ana, CA 92701	S	Response plan for the management and use of resources associated with the Strategic National Stockpile.
Orange County Resources and Development Management Department Planning and Development Services Function (RDMD, PDSF) Mission: To serve the planning and development entitlements requirements of private and public project applicants within unincorporated areas.	Flood Season Erosion Control Policies and Procedures	Brian Speegle, Director, RDMD 300 North Flower Street, Santa Ana, CA 92702 (714) 834-4643	S	Coordinate overall "Flood Season" erosion control efforts to minimize erosion and deposition of sediment on private and public properties.
	7-Year Flood Control Capital Improvement Program	Nadeem Majaj, RDMD 300 N. Flower St., Santa Ana, CA 92702 (714) 834-3719	S	Coordinates the 7-year Capital Improvement Program with regard to flood control.
	RDMD Plans and Manuals		S	Orange County Hydrology Manual; Orange County Flood Control District Design Manual; Orange County Drainage Design Criteria and Aids; Orange County Standard Plans for Public Works Construction; Americans with Disabilities Act 2 and 3.
	Orange County Nuisance Code	Richard Sherrry, RDMD, PDSF 300 N. Flower St., Santa Ana, CA 92703	S	To provide remedies for public nuisances. This division is not exclusive and is supplementary to other state and ordinance sanctions for maintenance of nuisances and provisions for abatement of nuisances.
	Orange County Zoning Code		S	To provide a guide for the growth and development of the County in accordance with the Government Code.
	Orange County Grading Code		S	This Code sets forth rules and regulations to control excavation, grading and earthwork construction, including fills and embankments, and establishes administrative requirements for issuance of grading permits and approval of plans and inspection of grading construction in accordance with the requirements for grading and excavation as contained in the Uniform Building Code then in effect as adopted and modified by county ordinance as well as water quality requirements relevant to activities subject to this article.
	California Building Code 1997		S	The purpose is to prescribe regulations for the erection, construction, enlargement, alteration, repair, improving, removal,, conversion, demolition, occupancy, equipment, use, height, area and maintenance of all buildings and structure.

Agency Name (Mission/Function)	Programs, Plans, Policies, Regulations, Funding, or Practices	Point of Contact Name, Address, Phone, Email	Effect on Loss Reduction Support Facilitate Hinder	Comments
Orange County Sheriff's Department (OCSD) Mission: To provide professional, responsive, and caring law enforcement services to the residents, visitors and businesses of Orange County. We believe a safe community can only exist through a partnership with our employees, residents, businesses and other public entities	County of Orange Emergency Operations Plan	Terre Duensing, OCSD Emergency Management 2644 Santiago Canyon Rd., Silverado, CA 92676 (714) 628-7054	S	To provide for the coordinated response and recovery from major emergencies and disasters.
	County of Orange Hazard Mitigation Plan	Donna Boston, OCSD, Emergency management 2644 Santiago Canyon Rd., Silverado, CA 92676 (714) 628-7054	S	Describes mitigation strategy, plans and projects within the County of Orange.
City of Anaheim Anaheim Fire Department Mission Statement: To Provide Excellent Fire, Rescue and Emergency Medical Services to All Those Who Live, Work and Play in the City of Anaheim, So that the Amount of Fires, Deaths, Injuries and Property Damage is Minimized.	Fire Administration/Office of Disaster Preparedness	Ellen McNeill Lopez (714) 765-6950	S	Responsible for developing, administering and coordinating the emergency planning preparedness program in conformity with local, State and Federal requirements. The mission is also to provide training to City staff in emergency planning and preparedness in order to maintain a high level of preparedness, provide businesses and residents with emergency planning and preparedness material to help reduce the loss of life and property resulting from a disaster. This section works with, and coordinates the efforts of volunteer organizations.
City of Anaheim Planning Department	General Plan	Jonathan Borrego (714) 765-5139	S	Work on General Plan Amendments, Environmental Impact Reports, Flood Plain Designations, Seismic Hazard Zone Designations, and Demographics. Provide zoning information, Special Event Permits, Home Occupation Permits, Large-Family Day Care Permits, and zoning clearance for business licenses. Process public hearing items before the Planning Commission/Zoning Administrator such as conditional use permits, variances, reclassifications, and tract/parcel maps
	Code Enforcement	William Sell (714) 765-5194	S	Enforce the Anaheim Municipal Code and other related State codes. Conduct business license inspections. Enforce City parking regulations. Investigate and conduct housing, nuisance and zoning code inspections in residential, industrial and commercial areas. Oversee the City's graffiti removal and prevention programs. Conduct anti-scavenging enforcement. Street vendor enforcement. Taxicab enforcement. Promote and distribute free "Dusk to Dawn" security lights to all City of Anaheim property owners

Agency Name (Mission/Function)	Programs, Plans, Policies, Regulations, Funding, or Practices	Point of Contact Name, Address, Phone, Email	Effect on Loss Reduction Support Facilitate Hinder	Comments
City of Anaheim Planning Department	Building	Julie Seay (714) 765-5153	S	Conducts inspections to ensure new buildings, alterations and electrical, plumbing and mechanical systems are constructed and installed in compliance with all adopted codes and City ordinances.
	Zoning	Greg Hastings (714) 765-5139	S	To promote the growth of the City in an orderly manner and to promote and protect the public health, safety, peace, comfort and general welfare in conformance with the General Plan.
City of Anaheim Public Works	Operations: Streets & Sanitation	Louie Vecchione (714) 765-6860	S	This division is responsible for citywide asphalt and concrete maintenance of local street, storm drain and sewer maintenance, street sweeping, street sweeping, parking control and right-of-way landscape maintenance.
	Operations: Fleet & Facility Maintenance, Resort District Maintenance	Doris Roush (714) 765- 6800	S	The division is responsible for maintaining the City's motorized equipment, City facilities, Anaheim Resort District and Traffic Signal maintenance.
	Traffic & Engineering	John Lower (714) 765-5183	S	Provides for mobility and safety of people and goods. Services range from increasing arterial street capacity by operating Intelligent Transportation Systems infrastructure, to reducing vehicle demand with commuter programs to place more people in fewer vehicles.
	Design Services	Russell H. Maguire (714) 765-5176	S	Responsible for pavement management of the arterial highway system and the master planning/design of all arterial street, storm drain and sewer improvements involving Public Works construction.
	Development Services	Natalie Meeks (714) 765-5176	S	Subdivisions, Records, Real Property, and Contract Administration, and provides development-related services for private sector developments and the acquisition/disposal of public property. Development Services staff issue permits for grading, construction in the public right-of-way, oversize loads, abandonments and encroachments. The division provides project construction contract administration, which includes advertising, bid tabulations, awards, payments, etc., through the filing of the Notice of Completion. Public improvement construction administration for all other City departments, such as Parks, Community Development, and Public Utilities is also provided.

Appendix A

Hazard Mitigation Task Force Team Members

Appendix A

Hazard Mitigation Task Force Team Members

Department	Personnel	Assigned
Building	Building Official	Julie Seay
City Attorney's Office	Senior Assistant City Attorney - Civil	Lawrence Newberry
City Manager's Office	Management Intern	Mary Jo Flynn
Community Development	Redevelopment Manager	David Gottlieb Bob Gorson
Community Services	Community Services Superintendent	Steve Swaim
Convention Center	Tenant Service Manager	Tim Gillilan
Fire	Division Chief – Admin /Disaster Preparedness Manager	Ellen McNeil Lopez Bob Logue Scott Berg
GIS	GIS Manager	Mark Lopez
Human Resources	Human Resources Director	Dave Hill
Planning	General Plan and Regional Coordination Team	Jonathan Borrega Tracy Sato
Police	Special Operations Division Commander Police Lieutenant Homeland Security	Joe Reiss Randy West
Public Utilities	Environmental Services Manager	Dick Wilson
Public Works	Civil Engineer	Natalie Meeks Louie Vecchione
Risk Management	Risk Manager	Tom Vance

Appendix B

Public Participation

Appendix C

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Appendix C

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Appendix D

Fire Defense Analysis

FIRE DEFENSE ANALYSIS

Task 1: Draft review of existing and proposed future development in Anaheim Hills.

INTRODUCTION

Anaheim Hills is an upscale, mountainous community within the City of Anaheim. The average population per household in Anaheim is 3.34 persons. For comparison, the average is 4.55 in Santa Ana. The current, built upon area is bordered by the 55 freeway on the west, the 91 freeway on the north and the 241 freeway on the east. The currently developed portions of Anaheim Hills are classified as a "Special Protection Area" by the Fire Department. In addition, there is a significant amount of vacant land east of the 241 to the Riverside County line. This land is proposed to be developed by the Irvine Company and will be in the City. This undeveloped area is classified as a "Very High Fire Hazard Severity Zone" by the Fire Department.

The predominant current use is that of upscale, single-family detached dwellings of a low to medium density. The structures appear to have been constructed, beginning at the west end along the 55 freeway, in the 1960's. Most structures in Anaheim Hills appear to have been constructed since 1980. The type of construction is predominately wood frame. Most exteriors are stucco. Many older structures have wood roofs. Most new structures have tile roofs.

In addition to the single-family residences, there is a large multi-family apartment complex, "The Cascades" on the east end, off Santa Ana Canyon Road. This structure appears to be wood frame. It has a stucco exterior. It does not appear to have fire sprinkler systems. There is a major shopping center, "the Festival" on Santa Ana Canyon west of Weir. In addition, there are some smaller centers that appear to be Type 111, "tilt-up" masonry construction. The Fire Department reports that all shopping centers have fire sprinkler systems. Anaheim Hills contains some commercial/professional buildings that also appear to be type 111, tilt-up construction. In addition, there are parks, schools and residential uses. There are no trailer parks or high-rise buildings. There are no rail yards, lumberyards, or large storage occupancies.

The majority of Anaheim Hills, west of the 241, is built upon. The area east of the 241 is planned for low to medium density housing, schools, and some general commercial along the freeways. This undeveloped area is classified as a "Very High Fire Hazard Severity Zone" by the Fire Department.

FIELD OBSERVATIONS

The consultant made an extensive tour and inspection of Anaheim Hills. The following observations have been made:

- Very upscale and clean neighborhoods were observed. There are no deteriorated, low-income neighborhoods, or densely constructed neighborhoods.
- Heavy traffic was observed on the main arteries. This can cause delays in emergency response. The busiest intersections appear to be Santa Ana Canyon, Weir Canyon and Imperial Highway.
- Steep, windy roads were observed. Such roads will slow down response of Fire Engines.
- Narrow on-site roads were observed in condominium and apartment projects.
- Many wood roofs were seen on structures. This presents a significant fire hazard, and potential for ignition of a structural conflagration.
- Newer homes have tile roofs which will resist a certain amount of fire.
- While there are several areas in the Anaheim Hills with extensive amounts of flammable, ornamental shrubbery, most of these areas are maintained under our Special Protection Area requirements for clearance to structures and roadways.[1]
- Fire Hydrant spacing in new tracts appears acceptable. Hydrants are required at 300' intervals. Spacing in some older tracts is lacking.
- Hydrant spacing at the Festival shopping center complies with all current AFD requirements.[2]
- Main arterial routes through Anaheim Hills are limited to several main roads. Beyond those roads, emergency response must be through residential developments. The main access roads are limited to Santa Ana Canyon, Weir Canyon, Serrano Road, Anaheim Hills Road, Imperial Highway, and Nohl Ranch Road. This can result in delayed response. In the event of a major wildland fire, the lack of main arterial highways and feeders results in the need for emergency vehicles to respond through relatively narrow, winding streets in subdivisions. Such streets can become clogged with people trying to escape as fire crews try to enter the area.
- There are high voltage power lines running through Anaheim Hills east of Imperial Highway.
- Numerous communities are gated. Gated communities can delay emergency response by at least two minutes. Two minutes can be critical during a medical emergency or structural fire.

[1] Per the Anaheim Fire Department; Memo dated August 22, 2003
[2] Per the Anaheim Fire Department; Memo dated August 22, 2003

- There is a very high fire hazard presented by the chaparrals on the hillsides, and other vegetation within common areas. Fire spread models were conducted for this vegetation, including the vegetation types east of the 241. The modeling was done on a computerized fire spread modeling program called BEHAVE, which is used by many fire agencies for fire behavior prediction. The model is based upon actual fire history and observations. The modeling assumed a BEHAVE Fuel Model 4, which represents chaparral of the density observed at Anaheim Hills, and a Fuel Model 3 which represents grass which is 3' high. The results of the modeling are as follows

Fuel Model 4: Chaparral

This model utilized input criteria which represent the type of weather and winds, commonly referred to as Santa Ana or Santana (devil) winds, which occur during fire season (typically June to the first significant rain in November). Such "fire weather" is typically characterized by several days of hot dry weather and high winds resulting in low fuel moisture in vegetation. The model focused on the Fuel Model 4 vegetation on the hills east of Freeway 241, and other hills in east Anaheim Hills. The wind was assumed to be 50 MPH at a 20' height (30 MPH at ground level). The fire will most likely burn towards Anaheim Hills from out of county areas to the east/northeast and be a wind-driven fire.

The results indicate that a worst-case fire could spread at the rate of 2,029' per minute. This would equal a speed of 23 mph. Flame lengths would reach 96.4'. The heat released on the fire line would be 116,724 BTU/ft/second, which is extremely hot. The fire would result in ignition of fires 4.2 miles ahead of the main fire due to airborne burning debris. This means that a major fire burning in the east end of Anaheim Hills could start other fires on wood roofs or in ornamental vegetation, in the middle of Anaheim Hills. In one hour, a worst-case fire could spread to 31,558 acres if there is no intervention. A structural conflagration would probably result and could destroy hundreds of homes. The structural loss could be similar to that which occurred in Laguna Beach, Santa Barbara, Glendale, Malibu, and San Diego County in recent years.

Fuel Model 3: Grass 3' High

This model predicts the type of fire which could occur in grassy areas where grass is 3' high. This model uses inputs which reflect "fire weather" in fire season. A wind speed of 50 mph at a 20' elevation is used. The flame lengths would be 42.4'; the amount of heat released on the fire line would be 19,541 BTU/ft/sec. The rate of spread would be 1,196' per minute (13.5 mph). This fire could spread to 15,612 acres in one hour if no intervention occurs. Fires can be ignited 2.2 miles ahead of the main fire due to burning debris which is airborne, and which lands on wood roofs or in ornamental vegetation.

These models are meant as a guide to predicting potential worst-case fire spread. Actual fire spread and flame lengths may vary. However, it is obvious that there is a very high potential for a major wildland fire to occur and to result in major vegetation and property loss, and perhaps

injury and death, in Anaheim Hills. The risk of such a fire can be quantified as a moderate probability/high consequence event. As the unmodified vegetation continues to age and as the population increases in the area, the fire risk will increase.

Steps should be taken by the City, without delay, to mitigate this risk by intensifying requirements for all new development in Anaheim Hills. This should include:

- Intensified fire resistive building construction features
- Fire sprinklers in all new or significantly remodeled structures
- Enforcement of defensible space requirements
- Encouraging the homeowners of homes with wood roofs to replace them with a fire resistive roof
- Requirements for Fire Protection Plans for all new development.
- Creation and implementation of a community-wide Vegetation Management Plan, which results in requirements for proper vegetation modification on an ongoing basis on all private lots, common areas and open space.

The last major wildland fire in Anaheim hills was the "Stagecoach Fire" in 1995. This fire burned 700 acres. Prior to that fire, the Gypsum Canyon fire occurred in 1982 and burned 16,800 acres (a major fire). In 1967, the Paseo Grande Fire, which began in Corona, burned through portions of this area, and also burned into Irvine, Orange Park and Villa Park. Many homes were lost in that fire. 48,639 acres were burned. This was a major conflagration. In 1948, the Green River fire burned 47,000 acres. This fire history indicates a major fire occurs about every 15.6 years in or near to Anaheim Hills. The average acreage burned is 28,534. At this rate, the next major wildland fire in Anaheim Hills could occur within the next 10 years and could destroy 28,534 acres or more.

- Various new developments have Vegetation Management Zones around the perimeter. However, extensive amounts of ornamental shrubbery present a hazard on and around individual lots, and along streets. There are some common area open spaces which are not being maintained and therefore present a fire hazard to abutting structures. Examples can be found on Weir Canyon road and on Serrano.
- There is an over abundance of street trees, such as eucalyptus, which can serve to spread fire to structures and to impede response or evacuation.
- There is an older area along Santa Ana Canyon west of Imperial to Nohl Ranch, and along the 55 freeway, which has a significant amount of wood roofs, Eucalyptus and grass. This area is very vulnerable to fire.
- There are structures, with wood roofs, which are near Weir Canyon Wilderness Park and are thus exposed to a potential wildland fire from that park.

- The current water supply is from the City water system which is a combination of three pump stations, and reservoirs located in various pressure zones. The water department states that they have emergency power provisions on all pumps. The needed fire flow, as required by Fire Code and the Fire Department ranges from 1,500 GPM for 2 hours, at 20 PSI for residential occupancies under 3,600 square feet to 4,000 GPM at 20 PSI for 4 hours at the Festival shopping center. Needed fire flows for the other shopping centers, and commercial buildings are generally 3,000 GPM for three hours assuming protection by Fire Sprinklers for any occupancy over 5,000 square feet. Per the AFD, fire flow availability at the Festival shopping center complies with all current AFD requirements.[3]

- There are numerous single and multi-family residential occupancies that have fire sprinklers installed in the Anaheim Hills area.[4]

- Fire station locations and staffing will be discussed in task 3.

CURRENT NEW DEVELOPMENT REQUIREMENTS

The current Fire Department development requirements are as follows:

1. Appendix 11-A of the Fire Code:

   Appendix 11-A primarily addresses vegetation, spark arrestors, and other outdoor fire hazards. It requires "firebreaks" (vegetation modification) for a distance of 30' to 100' from structures, and 10' from roadsides.

2. Fire Sprinklers when required by the Fire Code or Building Code.

   The Code requirements are minimal and not adequate for Anaheim Hills. The City had a sprinkler ordinance requiring sprinklers in any occupancy over 500 square feet, but it was rescinded in 1995. Due to the high fire hazard risk, long responses, and fire weather conditions, all new structures and all significantly remodeled structures should have fire sprinkler systems.

3. Fire hydrant requirements are as per the Fire Code Appendix 111-B. The Fire Department requires fire hydrants to be at 300' intervals (600' is allowed if all structures have internal sprinkler systems).

4. Fire flow requirements are as per the Fire Code Appendix 111–A. The Fire Department requirements are 1,500 GPM at 20 PSI for 2 hours for residences up to 3,600 square feet. Above that size, required flows increase based upon square footage. For example, a 10,000 square foot house would require 2,750 GPM (1,375 GPM if equipped with internal fire sprinklers. Major commercial occupancies such as

[3] Memo dated August 22, 2003

[4] Per the Anaheim Fire Department; Memo dated August 22, 2003

the festival shopping center require as much as 8,000 GPM for 4 hours (4,000 GPM if equipped with fire sprinklers).

5. Roads are as required by the Fire Code: The requirement is 20' unobstructed width and 13'6" clear height. Roads should be at least 24' wide unobstructed by parking.
6. Roofs in Anaheim Hills are required to be Class A rated.
7. Plainly visible addressing is required on all structures.
8. LPG tanks are regulated as to labeling, vegetation clearances and crash posts.
9. The Fire Department has a Fuel Modification Plan and maintenance requirements for new development in Anaheim Hills, which is referred to as a "Special Protection Area". The plan requires a 170' fuel modification zone around the perimeter of developments and in common areas. Such perimeter zones can be observed around new developments. However, the maintenance is questionable in some locations. In addition, as stated previously, there were some common areas observed, where no modification is being maintained.

   The Fire Department has not adopted any intensified construction requirements for Anaheim Hills even though it is designated as a "Special Protection Area". This should be done based upon the risks presented.

The Building Department requires Class A rated roofs. Class A roofs offer the highest fire resistance of currently available roofing materials. There are no specific, intensified, building requirements based upon the high fire hazard area.

The Anaheim Fire Department protects Anaheim Hills with two fire stations in Anaheim Hills: Station 9 at Nohl Ranch and Canyon View, and Station 10 at Sycamore park, on Monte Vista off Weir Canyon. In addition, Fire Station 8 is close by but north of the 91 freeway. In addition, fire companies from adjoining agencies can be summoned to respond to significant fires. Orange City Station 8 is close to Anaheim Hills. It is located on the extension of Imperial Highway. Automatic aid response is also available from nine other fire stations in the general area. However, they are further away from Anaheim Hills. These include three stations in Yorba Linda and Station 3 in Orange. If a major fire occurs, fire companies from throughout Orange County and the state can be requested. However, response times are lengthy. The fire suppression capability will be discussed in Section 3.

TARGET RESPONSE AREAS

The Fire Department has identified nine target response areas in Anaheim Hills. These target areas represent the concerns by the Fire Department for the occurrence of a significant fire in these areas. The areas are shown on the following page:

Target Area/Thomas Guide grid#	First due Fire Engine	Estimated number of needed fire units	Number of structures
1. Mohler Loop: 770/J1	Station 10; Weir Canyon	30 engines, 2 helicopters, 4 handcrews	262. 110 on perimeter
2.Pelanconi Park; 770/E3[5]	Anaheim Hills Station 9	30 engines, 2 helicopters, 2 hand crews	329. 119 on perimeter.
3.Pathfinder/Stagecoach 770/E4, F4, G4	Anaheim Hills Station 9	30 engines, 2 helicopters, 2 handcrews	349. 94 on perimeter
4. Quintana. 770/G2	Anaheim Hills Station 9	26 engines, 2 helicopters, 3 hand crews.	26. 12 on perimeter
5. Old bridge. 770/H1	Weir Canyon Station 10	15 engines, 1 helicopter, 1 hand crew	70 on perimeter
6. Eucalyptus. 770/J1	Weir Canyon Station 10	15 engines, 2 helicopters, 2 hand crews	15. 12 on perimeter
7. Hummingbird.770/J2	Weir Canyon Station 10	25 engines, 2 helicopters, 2 handcrews	54. 47 on perimeter
8. Hidden Canyon. 771/A4	Anaheim Hills Station 9	12 engines, 2 helicopters, 2 hand crews	87. 24 on perimeter
9. Walnut Canyon reservoir.770/A4	Anaheim Hills Station 9	7 engines, 1 helicopter, 1 hand crew	173. 40 on perimeter

[5] Worst-case target area per Fire Department: Pelanconi Park (based upon the number of perimeter structures and resources needed)

RECOMMENDATIONS

Based upon the risks identified in this section, the following recommendations are made:

Structural Safeguards For All New And Remodeled Structures:

The City should consider adopting an ordinance or amending the Fire Code, or taking whatever other legal action is deemed appropriate to require the following type of construction features in all new or significantly remodeled structures.

1. One-hour fire rated wall system for the exterior walls (if vegetation management inadequate).
2. Tempered glazing in windows and doors.
3. Internal fire sprinkler system designed to proper standards and approved by the Fire Department.
4. Exclusion of eaves, or boxing in of eaves with 1-hour construction.
5. Approved spark arrestor in chimney (visible from grade)
6. Class A, non-wood roof system.
7. Tile roof filled at ends to eliminate entrance of sparks, etc.
8. No vents facing wildland vegetation, when vegetation management is inadequate.
9. Approved steel screen on vents.
10. Noncombustible rain gutters and spouts.
11. No flammable wood, foam, plastic, etc. on exterior walls.
12. No non-fire rated vinyl or plastic window or door assemblies.
13. Non-wood garage doors.
14. Heavy steel window and door screens.
15. One-hour rated or heavy timber for any patio or deck.
16. Enclosed ends on decks and wooden patios.
17. No decks overhanging slopes.
18. No skylights.
19. Wooden exterior doors to be solid core (1 3/4" minimum.). Glazing to be tempered.
20. Install water faucets and hose on all sides of house.
21. Install fire truck connection on swimming pool drain line.
22. No canvas awnings.

Vegetation Management:

1. Continue to implement the three vegetation management programs (weed abatement, hazardous reduction for existing homes, and fuel modification for new development) as established for the wildland section. Sprinklers should be required on all new or significantly remodeled structures in the wildland areas of Anaheim Hills. Also implement special construction requirements to help prevent the spread of fire when homes are near a wildland area, including, but not limited to: double-paned windows, enclosed decks, and boxed eaves.[6]
2. Actively enforce current Fire Code requirements for vegetation management and elimination of ornamental shrubbery on all properties.

Public Education:

Intensify public education efforts to encourage all owners of existing structures with wood roofs, and flammable siding to replace roofs with Class A non-wood roof systems, and eliminate any flammable siding materials.

Fire Protection Plans:

All new development and all new or significantly remodeled structures in Anaheim Hills should be required to submit a Fire Protection Plan, as required by Article 86 of the 2000 edition of the Uniform Fire Code, to the Anaheim Fire and Planning Departments. Such plan should set forth in detail the proposed construction, infrastructure, fire protection systems, and fire stations, if necessary, to mitigate the local fire risk in the area where the development or construction is occurring. Such plans should be to the approval of the Anaheim Fire Department and Planning Departments.

[6] Per the Anaheim Fire Department; Memo dated August 29, 2001

Appendix E

List of Acronyms

Acronym	Definition
A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
AASHTO	American Association of State Highway and Transportation Officials
AB	Assembly Bill (State of California)
ACOE	US Army Corps of Engineers
ALERT	Automated Local Evaluation in Real Time
ARC	American Red Cross
ARES	Amateur Radio Emergency Services
ARP	Accidental Risk Prevention
ATC	Applied Technology Council
ATC20	Applied Technology Council Form 20
ATC21	Applied Technology Council Form 21
ATWC	Alaska Tsunami Warning Center
B/CA	Benefit/Cost Analysis
BCP	Budge Change Proposal
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BMP	Best Management Practices
BNSF	Burlington Northern Santa Fe Railway
BOS	Board of Supervisors
BSA	California Bureau of State Audits
BSSC	Building Seismic Safety Council
CAER	Community Awareness & Emergency Response
CAL TECH	California Institute of Technology
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
CBA	Cost Benefit Analysis
CBO	Community Based Organization
CBSP	Commuter Bikeways Strategic Plan
CD	Civil Defense
CDBG	Community Development Block Grant
CDEC	California Data Exchange Center (DWR)
CDF	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEO	Chief Executive Officer
CEPEC	California Earthquake Prediction Evaluation Council
CERT	Community Emergency Response Team
CESRS	California Emergency Services Radio System
CFR	Code of Federal Regulations
CFS	Cubic Feet Per Second
CHIP	California Hazardous Materials Identification Program
CHMIRS	California Hazardous Materials Incident Reporting System
CHP	California Highway Patrol
CIP	Capital Improvement Projects
CIWMB	California Integrated West Management Board
CLETS	California Law Enforcement Telecommunications System
CRS	Community Rating 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 Services)
DAE	Disaster Assistance Employee
DAC	Disaster Application Center
DAMP	Drainage Area Management Plan
DCO	Defense Coordinating Officer
DFO	Disaster Field Office
DGS	California Department of General Services
DHS	Department of Homeland Security (US Government)
DHSRHB	California Department of Health Services, Radiological Health Branch
DMA	Disaster Mitigation Act
DMG	California Division of Mines and Geology
DO	Duty Officer
DOC	Department Operations Center
DOE	Department of Energy (US)
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
EAP	Emergency Action Plan
EAS	Emergency Alerting System
EDA	Economic Development Administration
EDC	Economic Development Commission (Orange County)
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EICC	Emergency Information Coordination

	Center (FEMA)
EM	Emergency Management
EMA	Emergency Management Assistance
EMB	Emergency Management Bureau (OCSD)
EMC	Emergency Management Council (Orange County)
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 (US)
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ER	Emergency Relief
ERT	Emergency Response Team
ESC	Emergency Services Coordinator
ESRI	Environmental Systems Research Institute
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FAST	Field Assessment Team
FCO	Federal Coordinating Officer (FEMA)
FAY	Federal Award Year
FDAA	Federal Disaster Assistance Administration
FEAT	Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FHWA	Federal Highway Administration
FIR	Final Inspection Reports
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Studies
FMA	Flood Mitigation Assistance (FEMA Program)
FP	Flood Plan
FRP	Federal Response Plan
FSR	Feasibility Study Report
FTE	Full Time Equivalent
FY	Fiscal Year
GIS	Geographic Information System
GMA	Growth Management Act
GNS	Institute of Geological and Nuclear Science (International)
GSA	General Services Administration
HAD	Housing and Community Development (alternate - see HCD)
HAZMAT	Hazardous Materials
HAZMIT	Hazardous Mitigation
HAZUS	Hazards US
HCA	Health Care Agency
HCD	Housing and Community Development (alternate - see HAD)
HEICS	Hospital Emergency Incident Command System
HEPG	Hospital Emergency Planning Guidance
HIA	Hazard Identification and Analysis Unit
HMEP	Hazardous Mitigation Emergency Preparedness
HMG	Hazard Mitigation Grant
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HMPG	Hazard Mitigation Program Grant
HMPT	Hazard Mitigation Plan Task Force (Orange County)
HMPWG	Hazard Mitigation Plan Working Group (Orange County)
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (US)
IA	Individual Assistance
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IDE	Initial Damage Estimate
IFG	Individual & Family Grant (program)
IHMT	Interagency Hazard Mitigation Team
IPA	Information and Public Affairs (State Office of Emergency Services)
IRG	Incident Response Geographic Information System
IWMD	Integrated Waste Management Department (Orange County)
LAMS	Los Angeles Metropolitan Statistical Area
LAN	Local Area Network
LEA	Local Enforcement Agency
LEMMA	Law Enforcement Master Mutual Aid
LEPC	Local Emergency Planning Committee
LIP	Local Implementation Plan
LUPIN	California Land Use Planning Information Network
M	Magnitude
MARAC	Mutual Aid Regional Advisory Council
MEP	Maximum Extent Practicable
MH	Multi-Hazard
MHID	Multi-Hazard Identification
MOU	Memorandum of Understanding
MSL	Meters above Sea Level
NAWS	National Warning System
NBC	Nuclear, Biological, Chemical
NCDC	National Climate Data Center
NDAA	National Disaster Assistance Act
NEMA	National Emergency Management Association
NEMIS	National Emergency Management Information System
NEXRAD	Next Generation of Radar
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	National Hazard Mitigation Plan (AKA 409 Plan)
NIBS	National Institute of Building

	Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Services
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPP	Nuclear Power Plant
NPS	National Park Service
NRCS	National Resources Conservation Service
NSF	National Science Foundation
NTS	Natural Treatment System
NWS	National Weather Service
OA	Operational Area
OAEX	Operational Area Executive Board
OASIS	Operational Area Satellite Information System
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OCEMO	Orange County Emergency Management Organization
OCFA	Orange County Fire Authority
OCHCA	Orange County Health Care Agency
OCTA	Orange County Transit Authority
OEP	Office of Emergency Planning
OES	Office of Emergency Services (State of California)
OSD	Operations Support Division (Sheriff's Department)
OSFM	Office of State Fire Marshal
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PCH	Pacific Coast Highway
PDA	Preliminary Damage Assessment
PDMGP	Post Disaster Mitigation Grant Program
P-DMGP	Pre-Disaster Mitigation Grant Program
PDSD	Planning & Development Services Division
PEW	Project Evaluation Worksheet
PIO	Public Information Office
POST	Police Officer Standards and Training
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
PSTRG	Private Sector Terrorism Response Group
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
RDMD	Resources Development and Management Department
RDMHC	Regional Disaster Medical Health Coordinator
RDO	Radiological Defense Officer
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information
RES	Regional Emergency Staff
RIMS	Response Information Management System
RMP	Risk Management Plant
RPU	Radiological Preparedness Unit (OES)
RRT	Regional Response Team
SAM	State Administration Manual
SARA	Superfund Amendments & Reauthorization Act
SARS	Severe Acute Respiratory Syndrome
SAVP	Safety Assessment Volunteer Program
SB	Senate Bill (State of California)
SBA	Small Business Administration
SCEC	Southern California Earthquake Center
SCO	California State Controller's Office
SEAO	Structural Engineers Association of Oregon
SEPIC	State Emergency Public Information Committee
SFHA	San Francisco Housing Authority
SHMO	State Hazard Mitigation Officer
SLA	State and Local Assistance
SLE	St. Louis Equine Encephalitis
SNV	Sin Nombre Virus
SOC	Storm Operations Center
SONGS	San Onofre Nuclear Generating Station
SOP	Standard Operation Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TOR	Transfer of Development Rights
TRU	Transuranic
TTT	Train the Trainer
UCI	University of California Irvine
UCLA	University of California Los Angeles
UCSB	University of California Santa Barbara
UGB	Urban Growth Boundary
UPA	Unified Program Account
UPRR	Union Pacific Rail Road
UPS	Uninterrupted Power Source
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USAR	Urban Search and Rescue
USBR	United States Bureau of Reclamation

USC	University of Southern California
USDA	Untied States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WAN	Wide Area Network
WC	California State Warning Center
WEE	Western Equine Encephalomyelitis
WEROC	Water Emergency Response of Orange County
WGA	Western Governors' Association
WIPP	Waste Isolation Pilot Project
WNV	West Nile Virus
WSSPC	Western State Seismic Policy Council

Appendix F

List of Tables

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Part Two

Resources

Review and incorporation of other plans and studies

Several plans and studies were incorporated in the Local Hazard Mitigation Plan, the most important of which include the City of Anaheim General Plan, Environmental Impact Report and Emergency Response Plan. The development and background of these plans incorporate technical studies as well as referenced materials, which are utilized in the formation of the Hazard Mitigation Plan.

A key resource that was utilized in preparation of the Local Hazard Mitigation Plan was the City's recently adopted General Plan. The General Plan, which was adopted in May 2004, includes a Safety Element that contains a thorough analysis of various potential local hazards related to wildland fires, flooding and seismic shaking. Through the preparation of the General Plan and its associated Environmental Impact Report, various technical studies were completed (e.g., fire defense analysis, geotechnical study, etc.) and data from these studies were incorporated in the Local Hazard Mitigation Plan.

The Anaheim Emergency Response Plan (ERP) identifies the City's emergency planning, organization, and response policies and procedures. This plan is based on the functions and principles of the Standardized Emergency Management System (SEMS), which is based on the FIRESCOPE Incident Command System (ICS), and identifies how the City fits in the overall SEMS structure. The ERP addresses how the City will respond to extraordinary events or disasters, from preparation through recovery. This information was integrated into the Hazard Mitigation Plan in order to develop sections pertaining to known areas in need of mitigation and the types of hazards that can occur within the City of Anaheim.

The ERP is a living document, subject to revision based on agency reorganization, new laws, experience with exercises, and actual disasters. The planning process is designed to ensure a commitment to the tenets contained in the plan; consider the needs of the community; incorporate the various supporting agencies capabilities and limitations; and maximize resources. As the ERP is changed to reflect the ongoing examination of events and circumstances in relation to the plan, the Hazard Mitigation Plan will also be modified, when necessary, in order to maintain synchronization between the two documents.

Plan Resource Directory

The following resource directory lists the resources and programs that can assist the City. The resource directory will provide contact information for county, regional, state and federal programs that deal with natural hazards.

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
X				Orange County Resources & Development Management Department	300 N. Flower St., Santa Ana, CA 92703 www.ocrdmd.com	714.834.2300	714.834.2395	Protects property and promotes public safety	Multi
X				RDMD – Watershed & Costal Resources	300 N. Flower St., Santa Ana, CA 92703 www.oc.ca.gov/pfrd/flood/StormCenter.html	714.834.5173	714.834.5106	Provides near real time rainfall accumulations for Orange County	Multi
X				RDMD – Storm Operations		714.567.6300	714.567.6340	Activated when heavy to extreme rainfall is predicted or occurs and/or when storm run-off conditions are such that there is a probability of flood damage	Multi
X				Orange County Sheriffs Department Operations Support Division Emergency Management Bureau	2644 Santiago Canyon Rd., Silverado, CA 92676 www.ocsd.org/operations/emergencyManagement.asp	714.628.7055	714.628.7154	Provides emergency management and preparedness services to Orange County	Multi
		X		California Department of Conservation, Southern California Regional Office	655 S. Hope St. #700, Los Angeles, CA 90017	213.239.0878	213.239.0984	Provides services and information to promote environmental health, economic vitality, informed land-use decisions and sound management of the state's natural resources	Multi
		X		California Resources Agency	1416 Ninth St., Suite 1311, Sacramento, CA 95814	916.653.5656		Restores, protects and managers the state's natural, historical and cultural resources	Multi
		X		California Department of Transportation (CalTrans)	Headquarters: 1120 N. Street P.O. Box 942873, Sacramento, CA 94273-0001 www.dot.ca.gov/ District 12: (Orange County) 3347 Michelson dr., Suite 380, Irvine, CA 92612 www.dot.ca.gov/dist12	916.654.5266 949.724.2000		Responsible for design, construction, maintenance and operation of the highway system.	Multi

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
		X		California Department of Water Resources (DWR)	1416 Ninth Street PO Box 942836, Sacramento, CA 94236	916.653.5791	916.653.5028	Operates and maintains the State Water Project, provides dam safety and flood control and inspection services, assists local water districts in water management and water conservation planning, and plans for future statewide water needs.	Multi
		X		California Division of Forestry & Fire Protection (CDF)	1416 Ninth Street PO Box 944246, Sacramento, CA 94244 www.fire.ca.gov/php/index.php	916.653.5123		Responsible for all aspects of wildland fire protection	Multi
		X		California Division of Mines and Geology (DMG)	801 K Street, Sacramento, CA 95814	916.445.1825	916.445.5718	Develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources.	Multi
		X		California Geological Survey Headquarters, Office of the State Geologist	801 K Street, Sacramento, CA 95814	916.845.8162	916.323.7778	Provides information on the geology, natural resources and geologic hazards of California	Multi
		X		California Land Use Planning Information Network (LUPIN)	http://ceres.ca.gov/planning/			Publishes basic information on local planning agencies	Multi
		X		DWR – California Data Exchange Center (CDEC)	http://cdec.water.ca.gov/	916.574.1777		Provides real-time decision support system to DWR Flood Management and other flood emergency response organizations, providing operational and historical hydrologic and meteorological data, forecasts and reports.	Multi
		X		Governor's Office of Emergency Services (OES)	PO Box 419047 Rancho Cordova, CA 95741-9047 www.oes.ca.gov	916.845.8911	916.845.8910	Coordinates overall state agency response to major disasters in support of local government	Multi
		X		OES – Southern Region (Los Alamitos)	4671 Liberty Ave., Los Alamitos, CA 90720	562.795.2900	562.795.2877		Multi
			X	Federal Emergency Management Agency (FEMA) Region IX	1111 Broadway, Suite 1200, Oakland, CA 94607 www.fema.gov	510.627.7100	510.627.7112	Tasked with responding to, planning for, recovering from and mitigating against disasters	Multi

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
			X	Federal Emergency Management Agency (FEMA) Mitigation Division	500 C Street, S.W., Washington, D.C. 20472	202.566.1600		Managers the NFIP and oversees FEMA's mitigation programs.	Multi
			X	Institute for Business & Home Safety	4775 E. Gowler Ave., Tampa Fl 33617 www.ibhs.org	813.286.3400	813.286.9960	Works to reduce death, injury, property damage, economic losses and human suffering.	Multi
			X	United States Geological Survey	345 Middlefield Rd., Menlo Park, CA 94025 www.usgu.gov/	650.853.8300		Provides Reliable scientific information to describe and understand the Earth, minimize loss of life and property	Multi
			X	American Public Works Association	2345 Grand Blvd., Suite 500, Kansas City, MO 64108-2641	816.472.6100	816.472.1610	Provides a forum in which public works professionals can exchange ideas, improve professional competency, increase the performance of their agencies and companies and bring important public works related topics to public attention in local, state and federal arenas	Flood
			X	The Association of State Floodplain managers, Inc.	2809 Fish Hatchery Rd., Madison, WI 52713 www.floods.org/home/	608.274.0123	608.274.0696	Organization of professionals involved in flood plain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery	Flood
			X	Bureau of Reclamation Mid Pacific Region Federal Office Building	2800 Cottage Way, Sacramento, CA 95825-1989 www.usbr.gov/mp/	916.978.5000	916.978.5599	Leadership and technical expertise in water resources development	Flood
			X	Bureau of Reclamation Southern California Area Office	27710 Jefferson Ave., Suite 201, Temecula, CA 92590 www.usbr.gov/lc/	909.695.5310	909.695.5319	Responsible for water conservation, reclamation and reuse projects throughout southern California	Flood

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
			X	Floodplain management Association (California)	PO Box 712080, Santee, CA 92702 www.floodplain.org	619.204.4380		Promotes the reduction of flood losses and encourages the protection and enhancement of natural floodplain values through the use of effective wetland management strategies and engineering technologies	Flood
			X	National Flood Insurance Program (NFIP)	500 C Street, S.W., Washington, D.C. 20472 www.fema.gov/nfip/	202.566.1600		Flood Insurance Rate Maps, General Floodplain information	Flood
			X	National Oceanic & Atmospheric Administration (NOAA)	14th Street & Constitution Ave., N.W., Rm. 6217, Washington, DC 20230 www.noaa.gov/	202.482.6090	202.482.3154	Primary source of weather data, forecasts and warnings for the United States and the sole US official voice for issuing warnings during life-threatening weather situations	Flood
			X	National Weather Service (NWS)	1325 East West Highway, Silver Spring, MD 20910 www.nws.noaa.gov/				Flood
			X	National Weather Service Los Angeles/Oxnard Weather Forecast Office	520 North Elevar St., Oxnard, CA 93030 www.nwsla.noaa.gov/	805.988.6615		Provides weather information for Los Angeles, Ventura, Santa Barbara, and San Luis Obispo counties, as well as adjacent costal waters out 60 nautical miles.	Flood
			X	Santa Ana Mountains Radar	www.wrh.noaa.gov/radar/loop/DS.p38cr/si.ksox.shtml			NEXRAD (Next Generation Radar) obtains weather information (precipitation and wind) based upon returned energy.	Flood
			X	NWS Office of Hydrologic Development	1325 E. West Highway, SSMC2, Silver Spring, MD 20910 www.nws.noaa.gov/oh/index.html	301.713.1658	301.713.0963	Information of flooding, water, supply outlooks, current hydrologic conditions	Flood
			X	National resources Conservation Service (NRCS) US Department of Agriculture	14th and Independence Ave., SW, Room 5105-A, Washington, DC 20250 www.nrcs.usda.gov	202.720.7246	202.720.7690	Wetlands Reserve Program, Flood Risk Management Program, Emergency watershed Protection Program	Flood

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
			X	US Army Corps of Engineers Operations Center (USACE OC)	441 G. Street, NW, Room 3J50, Washington, DC 20314-1000 www.hq.usace.army.mil/uoc/default.htm	202.761.1001		Responsible for protection and development of water resources.	Flood
			X	USGS Water Resources	6000 J. Street, Placer Hall, Sacramento, CA 95819-6129 http://water.usgs.gov/index.html	916.278.3000	916.278.3070	Current US water news, current and historical water data, and water survey programs	Flood
			X	Flood Hazard Mitigation Planning: A Community Guide	Massachusetts Flood Hazard Management Program www.magnetstate.ma.us/dem/programs/mitigate			Plan for successful flood hazard mitigation	Flood
			X	Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP	www.fema.gov/nfip	800.480.2520		Discussion for floodplain processes and terminology	Flood
			X	NFIP Community Rating System Coordinator's Manual Indianapolis, IN	www.fema.gov/nfip/crs	800.480.2520		Detail the CRS point system and rating for community	Flood
			X	Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February, 1987) FEMA-116	www.fema.gov	800.480.2520		Opportunities for flood hazard mitigation, mapping assistance for floodplains.	Flood
X				Orange County Fire Authority	One Authority Rd., Irvine, CA www.ocfa.org	714.881.2411		Principal agency responding to wildland/urban fires	Fire
		X		Office of the State Fire Marshall	1131 S Street PO Box 944246, Sacramento, CA 94244-2640	916.445.8200	916.445.8509	Protects life and property through the development and application of fire prevention, engineering, education and enforcement	Fire
			X	Federal Wildland Fire Policy, Wildland/Urban Interface Protection	http://fs.fed.us/land/wdfire7c.htm			Report describing federal policy and interface fire	Fire
			X	National Fire Protection Association (NFPA) Public Fire Protection Division Firewise Program	1 Battery March Park PO Box 9101, Quincy, MA 02269-9101	617.770.3000		Principal Federal agency involved in the national Wildland/Urban Interface Fire Protection Initiative	Fire

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
			X	National Interagency Fire Center (NIFC)	16825 S. Seton Ave., Emmitsburg, MD 21727 www.fema.gov/hazards/fires/wildfires.shtm	301.447.1000		To reduce life and economic losses due to fire and related emergencies	Fire
			X	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 Publications, Washington, DC www.nfpa.org	800.344.3555		Provides criteria for fire agencies, land use planners, architects, developers and local governments	Fire
	X			Southern California Earthquake Center	3651 Trousdale Parkway, Suite 169, Los Angeles, CA 90089	213.740.5843	213.740.0011	Gathers new information on EQ and communicates to public	Earthquake
		X		Western States Seismic Policy Council (WSSPC)	125 California Avenue, Suite D201, Palo Alto, CA 94306 www.swwpc.org/home.html	650.330.1101	650.326.1769	Website is a great resource, with information clearly categorized from policy to engineering to education	Earthquake
		X		"Elementary Seismology"	CF Richter, pp 135-149; 650-653 Published by: WS Freeman and Company, San Francisco, CA				Earthquake
		X		"Faults of Southern California"	www.scecdc.scec.org/faultmap.html				Earthquake
		X		"Land Use Planning for earthquake hazard Mitigation: Handbook for Planners"	Myer R. Wolf, et. Al., (1986) University of Colorado, Institute of Behavioral Science, Nations Science Foundation www.coorado.edu/UCB/Research/ibs/hazardsq	303.492.6818	303.492.2151	Provides techniques that planners and others can utilize to help mitigate for seismic hazards	Earthquake
		X		Joaquin Hills, Southern Los Angeles Basin, California	L.B. Grant, KJ Mueller EM Gath, H. Chang, RL Edwards, R Munro and GL Kennedy				Earthquake
		X		"Seismic Hazards in Southern California: Probable Earthquakes, 1994 to 2024"	www.scecdc.scec.org/phasell.htm				Earthquake
			X	Planning for Hillside Development (1996)	Robert B. Olshansky, American Planning Association			Describes history, purpose and functions of hillside development	Landslide

County	Regional	State	Federal	Agency	Address	Phone	Fax	Summary	Hazard Type
			X	Public Assistance Debris Management Guide (July 2000)	Federal Emergency Management Agency			Developed to assist local officials in planning, mobilizing, organizing and controlling large-scale debris clearance, removal and disposal operation	Landslide
			X	Unstable ground: Landslide Policy in the United States (1987)	Robert B. Olshansky & J. David Rogers, Ecology Law Quarterly			History and policy of landslide mitigation in the US	Landslide
			X	USGS Landslide Program Brochure	National Landslide Information (NLIC), United States Geologic Survey			General information on the importance of landslide studies, types and causes of landslides, rock falls and earth flows.	Landslide