Executive Summary: Hazard Mitigation Action Plan Matrix

The City of Whittier Natural Hazards 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 City of Whittier in reducing risk and preventing loss from future natural hazard events. The action items address multi-hazard issues, as well as activities for earthquakes, flooding, and wildfires.

How is the Plan Organized?

The Mitigation Plan contains a Mitigation Actions Matrix, background on the purpose and methodology used to develop the mitigation plan, a profile of City of Whittier, sections on three natural hazards that occur within the City, and a number of appendices. All of the sections are described in detail below.

Who Participated in Developing the Plan?

The City of Whittier Natural Hazards Mitigation Plan is the result of a collaborative planning effort between City of Whittier, City of Santa Fe Springs, Whittier City School District, Whittier Union High School District, East Whittier City School District, Little Lake City School District, citizens, public agencies, non-profit organizations, the private sector, and regional and state organizations. Public participation played a key role in development of goals and action items. A Multi-Jurisdictional Planning Team guided the process of developing the plan.

The Multi-Jurisdictional Planning Team was comprised of the following individuals:

City of Whittier - Ann-Marie Hayashi, Emergency Services Assistant
City of Whittier – David Mochizuki, Director of Public Works
City of Whittier – Don Dooley, Planning Services Manager
City of Whittier – Nancy Mendez, Assistant City Manager
City of Santa Fe Springs – Fernando Tarin, Director of Police Services
City of Santa Fe Springs – Neal Welland, Fire Chief
City of Santa Fe Springs – Bryan Collins, Administrative Public Safety Officer
City of Santa Fe Springs – Cuong Ngyuen, Assistant Planner
City of Santa Fe Springs – Tony Olmos, Principal Civil Engineer
East Whittier City School District – Steve Ritter, Assistant Superintendent
East Whittier City School District – Lee Bean, Director of Facilities, Maintenance and Operations

Whittier City School District – Bob Mazzeo, Director of Business Projects
Little Lake City School District – Maureen Evans, Assistant Superintendent – Business Services
Whittier Union High School District – Paul Muschetto, Associate Superintendent
Emergency Planning Consultants – Carolyn J. Harshman, President

In addition, the City of Whittier established a Working Group that assisted with the development of the Plan and shared local expertise to ensure its comprehensiveness.

The Whittier Working Group was comprised of the following individuals:

City of Whittier - Ann-Marie Hayashi, Emergency Services Assistant
City of Whittier – David Mochizuki, Director of Public Works
City of Whittier – Don Dooley, Planning Services Manager
City of Whittier – Nancy Mendez, Assistant City Manager
City of Whittier – Bob Chavez, Park Director
City of Whittier – Rod Hill, City Controller
City of Whittier – Joe Dyer, Assistant Public Works Director/City Traffic Engineer
City of Whittier – Leon Yehuda, Assistant Public Works Director/City Engineer
City of Whittier – Carl Reese, Building Services Manager
City of Whittier – Howard Miller, Senior Engineering Tech
City of Whittier - Sgt. Aviv Bar, Police Department
County of Los Angeles - Battalion Chief Ron Lawrence

What is the Plan Mission?

The mission of the City of Whittier Natural Hazards Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment 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 becoming a Disaster Resistant Community.

What are the Plan Goals?

The plan goals describe the overall direction that City of Whittier agencies, organizations, and citizens can take to work toward mitigating risk from natural hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the Mitigation Actions Matrix (Attachment 1).

Protect Life and Property

Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to losses from natural hazards.

Reduce losses and repetitive damages for chronic hazard events while promoting insurance coverage for catastrophic hazards.

Improve hazard assessment information to make recommendations for discouraging new development in high hazard areas 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 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, citizens, 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 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.

How are the Action Items Organized?

The action items are a listing of activities in which City agencies and citizens can be engaged to reduce risk. Each action item includes the assigned coordinating organization and an estimate of the timeline for implementation (see Attachment 1: Mitigation Actions Matrix).

The action items are organized within the following Mitigation Actions Matrix, which lists all of the multi-hazard and hazard-specific action items. The action items are prioritized by category: the highest priority items are categorized as multi-hazard, next priority are the earthquake items, then the flooding items, and lastly, the wildfire items. Data collection, research, and the public participation process resulted in the development of these action items (see Appendix B: Public Participation). The Matrix includes the following information for each action item:

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 that are capable of or responsible for implementing activities and programs.

Timeline. Each action item includes an estimate of the timeline for implementation.

Plan Goals Addressed. The plan goals addressed by each action item are included as a way to monitor and evaluate how well the mitigation plan is achieving its goals once implementation begins. The plan goals are organized into the following five areas:

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

How Will the Plan be Implemented, Monitored, and Evaluated?

The Plan Maintenance Section of the Plan details the formal process that will ensure that the City of Whittier Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan

maintenance process. Finally, this section includes an explanation of how City of Whittier 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 Building & Safety Codes.

Plan Adoption

Adoption of the Natural Hazards Mitigation Plan by the local jurisdiction's governing body is one of the prime requirements for approval of the plan. Once the plan is completed, the City Council will be responsible for adopting the City of Whittier Natural Hazards Mitigation Plan. The local agency governing body has the responsibility and authority to promote sound public policy regarding natural hazards. The City Council will be requested to grant authority to the City Manager to amend and update the Plan as it is revised to meet changes in the natural hazard risks and exposures in the community. The approved Natural Hazards Mitigation Plan will be significant in the future growth and development of the community.

Coordinating Body

The City of Whittier Hazard Mitigation Advisory Committee will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The City Manager will assign representatives from City agencies, including, but not limited to, the current Hazard Mitigation Planning Team members representing the City of Whittier.

Convener

The City Council will adopt the City of Whittier Natural Hazards Mitigation Plan, and the Hazard Mitigation Advisory Committee will take responsibility for plan implementation. The Assistant City Manager will serve as a convener to facilitate the Hazard Mitigation Advisory Committee 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 Mitigation Advisory Committee Members.

Implementation through Existing Programs

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

Economic Analysis of Mitigation Projects

The Federal Emergency Management Agency's approaches to identify costs and benefits associated with natural hazard mitigation strategies or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost 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.

Formal Review Process

The City of Whittier Natural Hazards Mitigation Plan will be 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 convener will be responsible for contacting the Hazard Mitigation Advisory Committee members and organizing the annual meeting. Group members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan.

Continued Public Involvement

City of Whittier is dedicated to involving the public directly in the continual review and updates of the Natural Hazards Mitigation Plan. Copies of the plan will be catalogued and made available at City Hall and at both City operated public libraries. The existence and location of these copies will be publicized in various community newsletters. The plan also includes the address and the phone number of the City Planning Division, 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 website. This site will also contain an email address and phone number to which people can direct their comments and concerns.

City of Whittier
Mitigation Actions Matrix

Sect. 1 (p. 1-1 to 1-7):	**Multi-Hazard Action Items**
Sect. 2 (p. 1-7 to 1-9)	**Earthquake Action Items**
Sect. 3 (p. 1-9 to 1-10)	**Flood Action Items**
Sect. 4 (p. 1-10 to 1-11)	**Wildfire Action Items**

(Note: It is the City of Whittier's goal to implement these Mitigation Actions Items subject to availability of City budget and staffing resources.)

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
Multi-Hazard Action Items								
MH #1-1	Integrate the City of Whittier Natural Hazard Mitigation Plan into future General Plan Safety Element updates.	Hazard Mitigation Advisory Committee	4 years	X	X		X	X
MH #1-2	Establish a formal role for the City of Whittier Hazard Mitigation Advisory Committee to develop a sustainable process for implementing, monitoring, and evaluating citywide mitigation activities.	Hazard Mitigation Advisory Committee	Ongoing		X		X	
MH #1-3	Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration in the City of Whittier.	Hazard Mitigation Advisory Committee	Ongoing		X		X	
MH #1-4	Develop, enhance, and implement education programs aimed at mitigating natural hazards, and	Hazard Mitigation Advisory Committee	Ongoing		X			

City of Whittier
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Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
	reducing the risk to citizens, public agencies and private property owners.							
MH #1-5	Work with Los Angeles County Fire Department and Puente Hills Landfill Native Habitat Preservation Authority to coordinate mitigation activities for fire prevention.	Hazard Mitigation Advisory Committee	Ongoing	X	X	X	X	
MH #1-6	Educate the public about emergency sheltering and evacuation procedures.	Hazard Mitigation Advisory Committee	4 years		X			
MH #1-7	Post the community's Hazard Mitigation Plan on the City's website.	Emergency Preparedness Program	Ongoing		X			
MH #1-8	Provide a response/reply section on the website where residents can comment on the effectiveness of the current Plan and where they can make suggestions for the future revisions of the plan.	Emergency Preparedness Program	Ongoing		X			

City of Whittier
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Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
MH #1-9	Develop an Emergency Preparedness for Pets brochure including information on emergency supply kits for pets and information on sheltering pets in a disaster.	Emergency Preparedness Program	1 year		X			
MH #1-10	Create a series of government access public safety announcements on mitigation steps and strategies and disaster preparedness tips to be shown on the local cable access channel.	Emergency Preparedness Program	Ongoing		X			
MH #1-11	Send news releases to local newspapers about pre-disaster information.	Emergency Preparedness Program	Ongoing		X			
MH #1-12	Develop a Business Continuity Planning Display. The display will be designed to raise the awareness level of why it is important to have a Business Continuity Plan and how to	Hazard Mitigation Advisory Committee	4 years		X			

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(Note: It is the City of Whittier's goal to implement these Mitigation Actions Items subject to availability of City budget and staffing resources.)

Natural Hazard	Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
				Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
	develop a plan. This display will be appropriate for use at local Chamber of Commerce meetings and activities, civic group gatherings and other business-related gatherings.							
MH #1-13	The American Red Cross will hold a variety of courses, including: CPR, Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, babysitting, Healthcare Provider, pet first-aid and others at the Red Cross Office and at other locations throughout the City.	Emergency Preparedness Program	Ongoing		X			

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MH #1-14	Update the City website to provide additional hazard related information that is easily accessible.	Emergency Preparedness Program	Ongoing		X			
MH #1-15	Distribute FEMA's Emergency Management Guide for Businesses and Industry and Preparing Your Business for the Unthinkable brochure to the local Chamber of Commerce.	Emergency Preparedness Program	1 year		X			
MH #1-16	Train in-house shelter staff to work as a shelter team with courses including the American Red Cross's Introduction to Disasters, Shelter Operations, Mass Care and Donations Management.	Hazard Mitigation Advisory Committee	Ongoing		X			X
MH #1-17	Identify and prioritize needs for additional shelter supplies to include but not limited to additional cots, blankets and shelter kits.	Emergency Preparedness Program	Ongoing					X
MH #1-18	Conduct full-scale exercises that include evaluation tools that will identify critical performance expectations for each discipline on a regular basis.	Hazard Mitigation Advisory Committee	Ongoing				X	
MH #1-19	Publicize the Emergency Management Institute's Independent Study Courses available to the public to include but not limited to Emergency Preparedness USA,	Emergency Preparedness Program	1 year		X			

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	Hazardous Materials: Citizen Orientation, Animals in Disaster, Disaster Mitigation for Homeowners, etc. on the City's website.							
MH #1-20	Maintain database in future hazard GIS system of all repetitive loss properties in the City to be used in future mitigation activities.	Hazard Mitigation Advisory Committee	5 years (as City resources are available)	X	X			
MH #1-21	Encourage and facilitate the adoption of building codes, as adopted by the State of California, that provide protection for new construction and substantial renovations from the effects of identified hazards.	Community Development Department	Ongoing	X				
MH #1-22	Review existing regulations to reduce the effect of natural hazards on future development.	Community Development Department	Ongoing	X				
MH #1-23	Assess availability of backup power resources (generators) of police, City emergency operations center; upgrade resources as necessary.	Hazard Mitigation Advisory Committee	2 years					X
MH #1-24	Maintain mutual aid agreement with LA County.	Hazard Mitigation Advisory Committee	Ongoing					X

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MH #1-25	Partner with other organizations and agencies in the community to identify grant programs and foundations that may support mitigation activities.	Hazard Mitigation Advisory Committee	Ongoing				X	
MH #1-26	Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.	Hazard Mitigation Advisory Committee	Ongoing				X	
MH #1-27	Conduct a full review of the Natural Hazards Mitigation Action Plan every 5 years by evaluating mitigation successes, failures, and areas that were not addressed.	Hazard Mitigation Advisory Committee	5 years	X				
MH #1-28	Work with Historic Neighborhood Assn., Whittier Conservancy, and the Historical Society to develop and distribute public education materials aimed at mitigating natural hazards and reducing risk to residents and private property owners.	Hazard Mitigation Advisory Committee	3 years	X	X		X	
Earthquake Action Items								
EQ #2-1	Integrate new earthquake hazard mapping data into future City GIS.	Public Works Department	5 years, as City resources are available	X			X	
EQ #2-2	Incorporate earthquake transportation evacuation routes	Community Development Department	4 years					X

City of Whittier
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	into the Safety Element of the General Plan.							
EQ #2-3	Review seismic strength of remodeled structures in the city as deemed appropriate by the building official.	Community Development Department	Ongoing	X	X			
EQ #2-4	Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.	Hazard Mitigation Advisory Committee	Ongoing	X	X			
EQ #2-5	When possible, partner with other organizations and agencies with similar goals to promote building codes that are more disaster resistant at the local level.	Hazard Mitigation Advisory Committee	Ongoing	X			X	
EQ #2-6	Adoption of uniform Building Code by municipality.	Community Development Department	Ongoing	X				
EQ #2-7	Support and facilitate additional building policies and requirements adopted by the State of California into local government building code for post-disaster situations.	Community Development Department	Ongoing	X				
EQ #2-8	Ensure compliance to rebuilding in conformance with applicable codes, specifications, and standards.	Community Development Department	Ongoing	X				
EQ #2-9	Ensure repairs or construction funded by Federal disaster assistance conform to applicable codes and standards.	Community Development Department	Ongoing	X				

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EQ #2-10	Encourage seismic strength evaluation of critical facilities in the City to identify vulnerabilities for mitigation of schools, public infrastructure, and critical facilities to meet current seismic standards.	Community Development Department	Ongoing	X				
Flood Action Items								
FLD #3-1	Analyze each repetitive flood property within the City of Whittier and identify feasible mitigation options.	Hazard Mitigation Advisory Committee	3 years	X				
FLD #3-2	Recommend revisions to requirements for individual development within the floodplain, where appropriate.	Hazard Mitigation Advisory Committee	4 years	X		X		
FLD #3-3	Enhance data and mapping for floodplain information within the city.	Hazard Mitigation Advisory Committee	5 years, as City resources are available		X	X		
FLD #3-4	Prepare an inventory of major urban drainage problems, and identify causes and potential mitigation actions for urban drainage problem areas.	Public Works Department	Ongoing	X				
FLD #3-5	Establish a framework to compile and coordinate surface water management plans and data throughout the city.	Public Works Department	Ongoing			X		

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FLD #3-6	Recommend revisions to plans for development within the floodplain, where appropriate.	Community Development Department	Ongoing	X				
FLD #3-7	Enhance data and mapping for Floodplain information within the City, and identify and map flood-prone areas outside of designated floodplains.	Public Works Department	Ongoing	X				
Wildfire Action Items								
WF #4-1	Enhance emergency services to increase the efficiency of wildfire evacuation.	Police Department	Ongoing	X				X
WF #4-2	Inventory flow at hydrants and prioritize facility improvements to increase water pressure.	Public Works Department	Ongoing	X				X
WF #4-3	Encourage dissemination of maps relating to the fire hazard to help educate and assist builders and homeowners.	Community Development Department	Ongoing	X				
WF #4-4	Continue to promote communication, coordination and collaboration between wildland/urban interface property owners, local planners, the Puente Hills Landfill Native Habitat Preservation Authority, and the Los Angeles County Fire Department to address risks and mitigation	Hazard Mitigation Advisory Committee	Ongoing	X	X		X	X

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	measures.							
WF #4-5	Puente Hills Landfill Native Habitat Preservation Authority will work with the L.A. County Fire Department on public education regarding wildfire mitigation efforts.	Hazard Mitigation Advisory Committee	2 years	X	X		X	

Section 1

Introduction

Throughout history, the residents of City of Whittier have dealt with the various natural hazards affecting the area. Photos, journal entries, and newspapers from the 1800's show that the residents of the area dealt with earthquakes, flooding, and wildfires.

The Hazard Mitigation Planning Team considered a range of natural hazards facing the region including: Earthquakes, Tsunamis, Flooding, Drought, Windstorms, Earth Movement, Liquefaction, Dam Failure, and Wildfire. The "Ranking Your Hazards" handout (Attachment 1, page 1-12) guided the Team in prioritizing the natural hazards with the highest probability of significantly impacting the City of Whittier.

At its meeting on April 5, 2004, the Planning Team agreed that any hazards receiving a Team average score of "3" or higher would be included in the Hazard Mitigation Plan. Utilizing that ranking technique, the Team identified Earthquakes, Flooding, and Wildfire as the most prominent hazards facing the community.

Although there were fewer people in the area, the natural hazards adversely affected the lives of those who depended on the land and climate conditions for food and welfare. As the population of the City continues to increase, the exposure to natural hazards creates an even higher risk than previously experienced.

The City of Whittier is the 22nd most populous City in Los Angeles County, and offers the benefits of living in a Mediterranean type of climate. The City is characterized by the unique and attractive landscape that makes the area so popular. However, the potential impacts of natural hazards associated with the terrain make the environment and population vulnerable to natural disasters.

The City is subject to earthquakes, flooding to a limited extent, and wildfires. It is impossible to predict exactly when these disasters will occur, or the extent to which they will affect the City. 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.

In 1987, the Whittier Narrows Earthquake caused 8 fatalities and approximately $358 million in property damage. The initial earthquake on Oct. 1, 1987 had a magnitude that was first reported to be 6.1, but was later downgraded to 5.9. A major aftershock causing much damage occurred 3 days later on Oct. 4th, with a magnitude of 5.5. Los Angeles County reports estimate that both earthquakes damaged over 9100 residential and business structures throughout the county. The older "Uptown" section of Whittier, with many unreinforced masonry buildings, was by far the area hardest hit.

The City of Whittier most recently experienced destruction due to flooding in 1995, impacting various areas city-wide. Storms caused flooding in various parts of the city and in addition to storm damage; there were large volumes of debris. The City sought and received a Presidential Disaster Declaration to obtain federal assistance for its recovery effort. This flooding event caused $15,000 worth of damage to public facilities.

In Whittier, a wildland interface area runs across the northwest and central north borders of the City, and includes populated residential properties. Areas against the foothills are considered at significant risk during the summer months or long periods without rain.

Historically, several wildland fires have threatened the City of Whittier and destroyed structures in nearby areas, but not in the City of Whittier. In the 1990's, the City acquired approximately 1500 acres of underdeveloped land to the north of the City. Concerns associated with this area include the potential for brushfires, fire threats originating from human influence in the urban interface area (for example, bottle rockets from children, and residences that do not adhere to annual fuel modification clearing requirements), potential lack of water supply for fire protection, and periods of high Santa Ana winds. Another serious concern related to wildfires is post-fire hazards such as erosion, debris flows, and floods.

Why Develop a Mitigation Plan?

As the costs of damage from natural disasters continue to increase, the community realizes the importance of identifying effective ways to reduce vulnerability to disasters. Natural 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, and implementation of preventative activities such as land use programs that restrict and control development in areas subject to damage from natural hazards.

The resources and information within the Mitigation Plan:

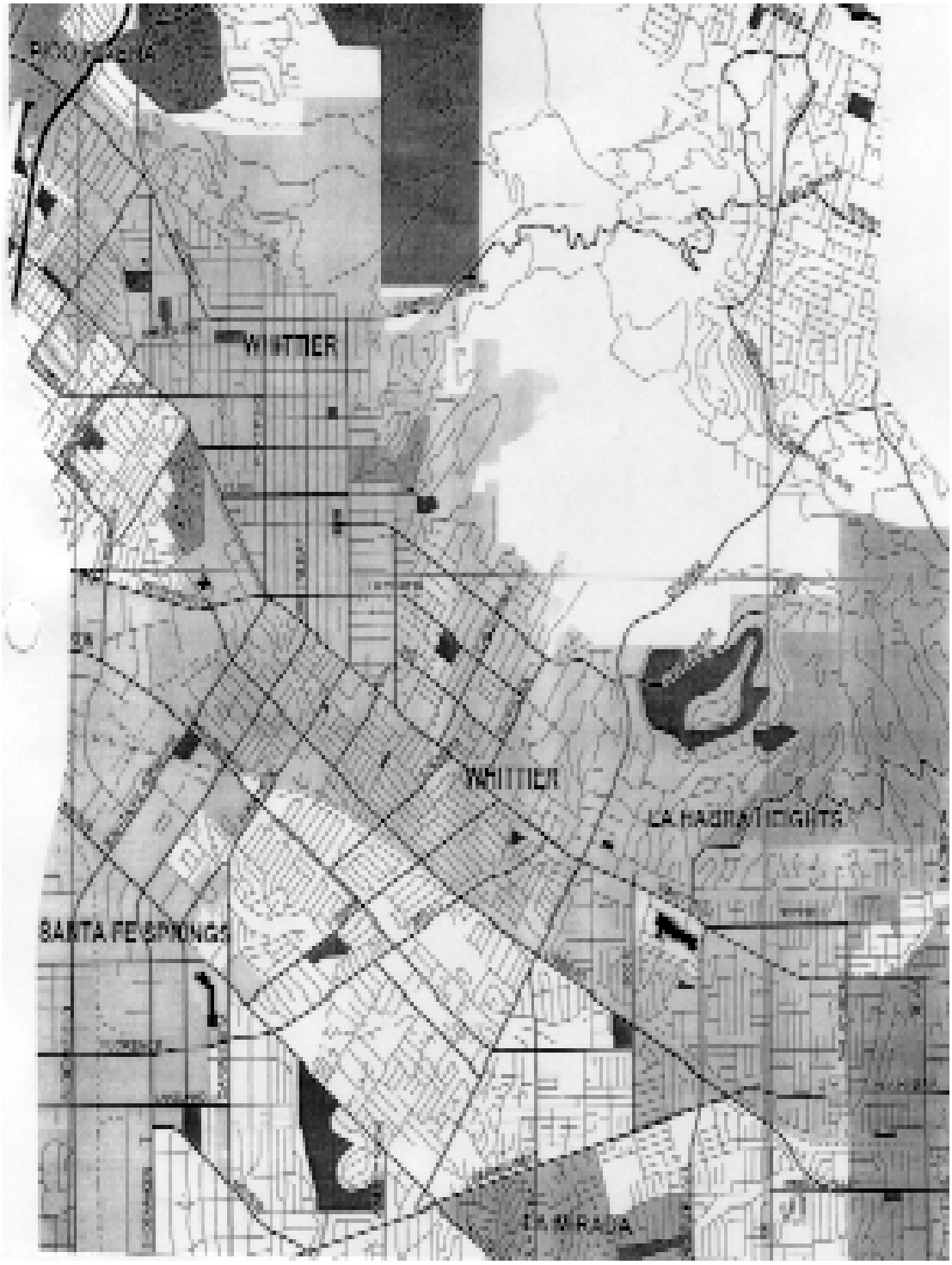
(1) Establish a basis for coordination and collaboration among agencies and the public in City of Whittier;
(2) Identify and prioritize future mitigation projects; and
(3) Assist in meeting the requirements of federal assistance programs.

The mitigation plan works in conjunction with other City plans, including the City's General Plan and Multi-Hazard Functional Plan.

Whom Does the Mitigation Plan Affect?

The City of Whittier Natural Hazards Mitigation Plan affects the entire city. Map 1 shows major roads in the City of Whittier. This plan provides a framework for planning for natural hazards. The resources and background information in the plan is applicable City-wide, and the goals and recommendations can lay groundwork for other local mitigation plans and partnerships.

Map 1-1: Base Map of City of Whittier (Source: City of Whittier General Plan)



Note: larger map is available in City's General Plan

Natural Hazard Land Use Policy in California

Planning for natural hazards should be an integral element of any city's land use planning program. All California cities and counties have General Plans and the implementing ordinances that are required 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.

This is particularly true in the case of planning for natural hazards where communities must balance development pressures with detailed information on the nature and extent of hazards.

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 Natural Hazard Mitigation

All mitigation is local, and the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. Local jurisdictions, however, are not alone. Partners and resources exist at the regional, state and federal levels. Numerous California state agencies have a role in natural hazards and natural hazard mitigation. Some of the key agencies include:

- 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, reduce economic losses, and save lives.

- The California Division of Forestry (CDF) is responsible for all aspects of wildland fire protection on private, state, and administers forest practices regulations, including landslide mitigation, on non-federal lands.

- 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 (based on science-based refinement of tsunami inundation zone delineation) to state mandated tsunami zone restrictions; and

- 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, serves local water needs by providing technical assistance

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. Staff from the City of Whittier conducted data research and analysis, facilitated Planning Team meetings and public outreach activities, and developed the final mitigation plan. The research methods and various contributions to the plan include:

Input from the Planning Team:

The Multi-Jurisdictional Planning Team convened four times to guide development of the Mitigation Plan. The Team played an integral role in developing the mission, goals, and action items for the Mitigation Plan. The Team consisted of representatives of six local government entities, including:

City of Whittier
City of Santa Fe Springs
Whittier City School District
Whittier Union High School District
East Whittier City School District
Little Lake City School District

Stakeholder Interviews:

City staff distributed copies of the Plan draft or notices inviting comments on the Plan draft to 36 agencies and/or specialists from organizations interested in natural hazards planning. The data and support gained from the review process was very valuable to the overall planning effort. A complete listing of all stakeholders (reviewers) is located in Appendix B: Public Participation.

State and federal guidelines and requirements for mitigation plans:

Following are the Federal requirements for approval of a Natural Hazards Mitigation Plan:

- 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 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 Building Codes, and other pertinent documents.

The following components must be part of the planning process:

- 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 monitoring, evaluating and updating the plan and integration of the Natural Hazards Mitigation Plan into other planning mechanisms.
- Formal adoption by the City Council.
- Plan Review by both State OES and FEMA

These requirements are spelled out in greater detail in the following plan sections and supporting documentation.

Public participation opportunities were created through use of local media, the City's website, distribution of a natural hazards questionnaire, and the public comments portion of the Planning Commission and the City Council public meetings. In addition, the makeup of a multi-jurisdictional planning team insured a constant exchange of data and input from outside organizations.

Through its consultant, Emergency Planning Consultants, the City had access to numerous existing mitigation plans from around the country, as well as current FEMA hazard mitigation planning standards (386 series) and the State of California Natural Hazards Mitigation Plan Guidance.

Other reference materials consisted of county and city mitigation plans, including:

Clackamas County (Oregon) Natural Hazards Mitigation Plan
Six County (Utah) Association of Governments
Upper Arkansas Area Risk Assessment and Hazard Mitigation Plan
Urbandale-Polk County, Iowa Plan
Hamilton County, Ohio Plan
Natural Hazard Planning Guidebook from Butler County, Ohio

Hazard specific research: City of Whittier staff collected data and compiled research on three hazards: earthquakes, flooding, and wildfires. Research materials came from the City General Plan and the City's Threat Assessment contained in the Multi-Hazard Functional Plan. The City of Whittier staff conducted research by referencing historical local newspapers, interviewing long time residents, long time City of Whittier employees and locating City of Whittier information in historical documents.

The City of Whittier staff identified current mitigation activities, resources and programs, and potential action items from research materials and stakeholder interviews.

Public Input

The City of Whittier encouraged public participation and input in the Natural Hazards Mitigation Plan by posting its activities in the media, in community newsletters and on the internet. In addition, the City distributed 250 natural hazards questionnaires at the following locations: City Hall, Community Center, Senior Center, Branch Library, and Central Library. Citizens were encouraged to review the Plan Draft and participate in the Planning Commission meeting which was held on August 2, 2004 and the City Council public meeting which was held on September 14, 2004. In addition, the Working Draft of the Plan was presented to the Whittier Historic Resources Commission on August 11, 2004.

Following is a summary of the public comments gathered from the questionnaires as well as during the meetings:

> *At the Planning Commission meeting, there was great support expressed for including the Whittier Police Department and the L.A. County Fire Department in the Hazard Mitigation Plan Whittier Working Group. Also, staff was asked to make sure the maps are clear and easy to understand.*
>
> *An equal number of survey responders live and own businesses in the City of Whittier. Depending on where they lived, the highest level of concern was expressed about earthquakes and wildfires; however, respondees living far from the wildland interface area were only mildly concerned about wildfires. Of the three identified local natural hazards, the lowest concern was expressed for flooding.*
>
> *At the Historic Resources Commission (HRC) meeting, commissioners expressed a desire for the Natural Hazards Mitigation Plan to include language about the historic fabric of Whittier. The HRC also requested that a representative of the local historic preservation community be included on post-disaster inspection teams of historic structures and in the review process of any post-disaster demolition permit for an historic structure.*

The Whittier City Council unanimously adopted the Whittier Natural Hazards Mitigation Plan at its September 14, 2004 public meeting by adopting Resolution No. 7712. The resources and information cited in the adopted mitigation plan provide a strong local perspective and help identify strategies and activities to make City of Whittier a Disaster Resistant Community. When the City's General Plan is next updated, the Natural Hazards Mitigation Plan will be integrated into the General Plan Safety Element.

How Is the Plan Used?

Each section of the mitigation plan provides information and resources to assist people in understanding the City and the hazard-related issues facing citizens, 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. It also allows City government to review and update sections when new data becomes 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. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to City of Whittier.

The mitigation plan is organized into three volumes. Part I contains an executive summary, Mitigation Actions Matrix, introduction, and plan maintenance section. Part II contains a city profile, risk assessment, and hazard-specific sections. Part III includes the appendices. Each section of the plan is described below.

Part I: Mitigation Actions

Executive Summary: Hazard Mitigation Action Plan

The Action Plan provides an overview of the mitigation plan mission, goals, and action items.

> **Attachment 1: Mitigation Actions Matrix**
> This Matrix identifies the priorities, action description, responsible organization, and timeline for each mitigation action item.

Section 1: Introduction

> The Introduction describes the background and purpose of developing the mitigation plan for City of Whittier.

Section 2: Plan Maintenance

> This section provides information on plan implementation, monitoring and evaluation.

Part II: Hazard Analysis

Section 3: Community Profile

> This section presents the history, geography, demographics, and socioeconomics of the City of Whittier. It serves as a tool to provide an historical perspective of natural hazards in the City.

Section 4: Risk Assessment

This section provides information on hazard identification, vulnerability and risk associated with natural hazards in City of Whittier.

Sections 5-7: Hazard-Specific Information

Hazard-specific information on the three chronic hazards is addressed in this plan. Chronic hazards occur with some regularity and may be predicted through historic evidence and scientific methods. The chronic hazards addressed in the plan include:

Section 5: Earthquake
Section 6: Flooding
Section 7: Wildfire

Each of the hazard-specific sections includes information on the history, hazard causes and characteristics, hazard assessment, and local, state, and national resources.

Part III: Resources

The plan appendices are designed to provide users of the City of Whittier Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the mitigation plan, and potential resources to assist them with implementation.

Appendix A: Plan Resource Directory

The resource directory includes City, regional, state, and national resources and programs that may be of technical and/or financial assistance to City of Whittier during plan implementation.

Appendix B: Public Participation

This appendix includes specific information on the various public processes used during development of the plan.

Appendix C: Benefit Cost Analysis

This section describes FEMA's requirements for benefit cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

Appendix D: List of Acronyms

This section provides a list of acronyms for City, regional, state, and federal agencies and organizations that may be referred to within the City of Whittier

Natural Hazards Mitigation Plan.

Appendix E: Glossary

This section provides a glossary of terms used throughout the plan.

Section 2:

Plan Maintenance

The Plan Maintenance Section of this document details the formal process that will ensure that the Natural Hazards Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan maintenance process. Finally, this Section includes an explanation of how the City of Whittier 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 Building and Safety Codes.

Monitoring and Implementing the Plan

Plan Adoption

The City Council adopted the Natural Hazards Mitigation Plan on Sept. 14, 2004. A copy of Resolution No. 7712 is included in Appendix B. As the City's governing body, the City Council has the authority to promote sound public policy regarding natural hazards. The adopted plan has been submitted to the State Hazard Mitigation Officer at The Governor's Office of Emergency Services. The Governor's Office of Emergency Services then submitted 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, City of Whittier will gain eligibility for Hazard Mitigation Grant Program funds.

The City's Natural Hazards Mitigation Plan will be integrated into the General Plan Safety Element the next time the General Plan is updated.

Coordinating Body

The City's Hazard Mitigation Advisory Committee will be responsible for coordinating implementation of plan action items and undertaking the formal review process. The City Council (or other authority) will assign representatives from City agencies, including, but not limited to, the current Hazard Mitigation Planning Team members. The City has formed a Hazard Mitigation Advisory Committee that consists of the members of the Whittier Working Group noted in the Executive Summary.

In order to make this Committee as broad and useful as possible, the City Manager will engage other relevant organizations and agencies in hazard mitigation. Other potential additions to the Hazard Mitigation Advisory Committee could include:

An elected official
A representative from the Chamber of Commerce
An insurance company representative

Community Planning Organization representatives
Representation from professional organizations such as the Home Builders Association

The Hazard Mitigation Advisory Committee will meet no less than semi-annually. Meeting dates will be scheduled once the final Hazard Mitigation Advisory Committee has been established. These meetings will provide an opportunity to discuss the progress of the action items and maintain the partnerships that are essential for the sustainability of the mitigation plan.

Convener

The City Council will adopt the Natural Hazard Mitigation Plan, and the Hazard Mitigation Advisory Committee will take responsibility for plan implementation. The City Manager (or designee) will serve as a convener to facilitate the Hazard Mitigation Advisory Committee 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 Natural Hazard Advisory Committee Members.

Implementation through Existing Programs

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

The City's Building & Safety Department is responsible for administering the Building & Safety Codes. In addition, the Hazard Mitigation Advisory Committee will work with other agencies at the state level to review, develop and ensure Building & 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 Plans (CIP). Various City departments develop CIP plans, and review them on an annual basis. Upon annual review of the CIPs, the Hazard Mitigation Advisory Committee will work with the City departments to identify action items in the Natural Hazards Mitigation Plan 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 Advisory Committee will provide an opportunity for Committee members to report back on the progress made on the

integration of mitigation planning elements into the City's planning documents and procedures.

Economic Analysis of Mitigation Projects

FEMA's approaches to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost 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.

The City of Whittier utilized a practical and reasonable economic perspective when formulating the City's mitigation actions. A more thorough cost-benefit analysis would be done at the time of any federal grant application. The Hazard Mitigation Advisory Committee would use a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Hazard Mitigation Advisory Committee 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: Benefit/Cost Analysis.

Evaluating and Updating the Plan

Formal Review Process

The Natural Hazards Mitigation Plan will be 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 timeline, and identifies the local agencies and organizations participating in plan evaluation. The convener or designee will be responsible for contacting the Hazard Mitigation Advisory Committee members and organizing the annual meeting.

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 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 convener 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 Committee members, and presenting it to the City Manager (or other authority). The Hazard Mitigation Advisory Committee will also notify all holders of the final version of the City's Plan when changes have been made. Every five years the updated Plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review.

Continued Public Involvement

The City is dedicated to involving the public directly in review and updates of the Natural Hazards Mitigation Plan. The Hazard Mitigation Advisory Committee 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 all of the appropriate agencies in the City, as well as on the City's website. The existence and location of these copies will be publicized in the quarterly Community Services Bulletin which reaches every household in the City, and will also be published in the local newspaper. The plan also includes the address and the phone number of the City Planning Division, 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's Website. 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 as deemed necessary by the Hazard Mitigation Advisory Committee. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the Plan. The Committee will be responsible for using City resources to publicize the annual public meetings and maintain public involvement through the public access cable channel, Website, and local newspapers.

Section 3:

Community Profile

Why Plan for Natural Hazards in City of Whittier?

Natural hazards impact citizens, property, the environment, and the economy of City of Whittier. Earthquakes, flooding, and wildfires, the hazards prioritized by the Planning Team as being the natural hazards with the highest probability of significantly impacting the City of Whittier, have exposed or could potentially expose 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 continues to increase when low-density housing is replaced with medium and high-density development projects.

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 citizens and communities. Local residents and businesses can work together with the City to create a natural hazards mitigation plan that addresses the potential impacts of hazard events.

Geography and the Environment

City of Whittier has an area of 15.2 square miles and is located in southeastern Los Angeles County. The City of Whittier borders Hacienda Heights on the north, Santa Fe Springs to the south, Pico Rivera to the west, and La Habra and La Habra Heights to the east. The average elevation of the City of Whittier is 365 feet. The Puente Hills are substantial rolling hills with a considerable amount of housing development in the northeast areas adjacent to the City. In the 1990's, the City acquired approximately 1500 acres in the Puente Hills in which no development is permitted. This development prohibition will definitely mitigate any structural loss in the event of a wildland fire.

Community Profile

The City of Whittier is one of the oldest cities in Los Angeles County and is rich in history. The area comprising the City of Whittier was first settled in 1887 as a Quaker colony and the city itself was incorporated in 1898.

The City is served by Whittier Boulevard (State Highway 72) running northwest to southeast through the City.

The Santa Fe and Southern Pacific railroad serves the city with tracks in the southern area of the City.

Major Rivers

The nearest major river is the San Gabriel River. This River and water reservoirs on the hillsides have a potential minimal impact on the City of Whittier due to elevation of the City. Flooding of the San Gabriel River and severe damage to the flood control levee could inundate the City's wellfield and pumping plant, which supply water to half the City.

Although not a major river, Turnbull Canyon Creek channel presents the City's most likely scenario for flooding. There are Flood Zone A's directly below the Turnbull Canyon Creek debris basin. Worsham Creek also flows though the City of Whittier on a seasonal basis.

The San Gabriel River channel and Turnbull Canyon Creek debris basin are part of the County Flood Control District.

Climate

Temperatures in the City of Whittier average approximately 60 degrees in the winter months and 80 degrees in the summer months. However the temperatures can vary over a wide range, particularly when the Santa Ana winds blow, bringing higher temperatures and very low humidity.

Rainfall in the city averages 14.6 inches of rain per year. However the term "average rainfall" is misleading because over the recorded history of rain fall in the City of Whittier rainfall amounts have ranged dramatically from dry to wet years.

Furthermore, actual rainfall in Southern California tends to fall in large amounts during sporadic and often heavy storms rather than consistently over storms at somewhat regular intervals. In short, rainfall in Southern California might be characterized as feast or famine within a single year. Because the metropolitan basin is largely built out, water originating in higher elevation communities can have a sudden impact on adjoining communities that have a lower elevation.

Minerals and Soils

The characteristics of the minerals and soils present in City of Whittier indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether or not an area will be prone to geologic hazards such as earthquakes, liquefaction and landslides.

The surface material includes unconsolidated, fine-grained deposits of silt, sand, gravel, and recent flood plain deposits. Torrential flood events can introduce large deposits of

sand and gravel. Sandy silt and silt containing clay are moderately dense and firm, and are primarily considered to be prone to liquefaction, an earthquake related hazard. Basaltic lava consists mainly of weathered and non-weathered, dense, fine-grained basalt. Though the characteristics of this lava may offer solid foundation support, landslides are common in many of these areas where weathered residual soil overlies the basalt. Understanding the geologic characteristics of City of Whittier is an important step in hazard mitigation and avoiding at-risk development.

Other Significant Geologic Features

The City of Whittier, like most of the Los Angeles Basin, lies over the area of one or more known earthquake faults, and potentially many more unknown faults, particularly so-called lateral or blind thrust faults.

The major faults that have the potential to affect the greater Los Angeles Basin, and therefore the City of Whittier are the:

Whittier
Elsinore/Chino
Elysian Park Fold
Thrust Belt
Newport-Inglewood
Sierra Madre
Palos Verdes
San Jacinto
San Andreas
Norwalk

The Los Angeles Basin has a history of powerful and relatively frequent earthquakes, dating back to the powerful 8.0+ San Andreas earthquake of 1857, which did substantial damage to the relatively few buildings that existed at the time. Paleoseismological research indicates that large (8.0+) earthquakes occur on the San Andreas Fault at intervals between 45 and 332 years with an average interval of 140 years[1]. Other lesser faults have also caused very damaging earthquakes since 1857. Notable earthquakes include the Long Beach earthquake of 1933, the San Fernando Earthquake of 1971, the 1987 Whittier Narrows Earthquake and the 1994 Northridge Earthquake.

In addition, many areas in the Los Angeles Basin have sandy soils that are subject to liquefaction. The City of Whittier has liquefaction zones in the northeastern and southeastern portions of the City as shown on USGS Seismic Hazard Maps.

The City of Whittier also has areas with land movement potential. Currently the city has active landslide activity in the northeast portion of the City. The hillside areas could potentially pose landslide and erosion hazards.

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[1] Peacock, Simon M., http://aamc.geo.lsa.umich.edu/eduQuakes/EQpredLab/EQprediction.peacock.html

Population and Demographics

City of Whittier has a population of about 83,680 in an area of 15.2 square miles. The population of the City of Whittier has steadily increased from the mid 1800's through 2000, and increased 12.9% from 1990 to 2000 according to the 2000 Census
The increase of people living in City of Whittier creates more community exposure, and changes how agencies prepare for and respond to natural hazards. For example, more people living on the urban fringe can increase risk of fire. Wildfire has an increased chance of starting due to human activities in the urban/rural interface, and has the potential to injure more people and cause more property damage. An urban/wildland fire is not the only exposure to the City of Whittier. In the 1987 publication, Fire Following Earthquake issued by the All Industry Research Advisory Council, Charles Scawthorn explains how a post-earthquake urban conflagration would develop. The conflagration would be started by fires resulting from earthquake damage, but made much worse by the loss of pressure in the fire mains, caused by either lack of electricity to power water pumps, and /or loss of water pressure resulting from broken fire mains.

Furthermore, increased density can affect risk. For example, narrower streets are more difficult for emergency service vehicles to navigate, the higher ratio of residents to emergency responders affects response times, and homes located closer together increase the chances of fires spreading.

The City of Whittier is experiencing a great deal of in-fill building, which is increasing the population density and creating greater service loads on the built infrastructure, including roads, water supply, sewer services and storm drains.

Natural hazards do not discriminate, but the impacts in terms of vulnerability and the ability to recover vary greatly among the population. According to Peggy Stahl of the Federal Emergency Management Agency (FEMA) Preparedness, Training, and Exercise Directorate, 80% of the disaster burden falls on the public, and within that number, a disproportionate burden is placed upon special needs groups: women, children, minorities, and the poor.[2]

According the 2000 census figures, the demographic make up of the city is as follows:

Caucasian	37.6%
Hispanic	55.9%
African American	1.2%
Asian	3.3%
Native American	1.3%
Other	25.8%

[2] www.fema.gov

The ethnic and cultural diversity suggests a need to address multi-cultural needs and services.

Although the percentage of poverty in City of Whittier (10.5%) is about 70% that of the state's (13.7%), 13.7% of the people living in poverty in City of Whittier are under 18 years old, and 8% are over 65. Vulnerable populations, including seniors, disabled citizens, women, and children, as well as those people living in poverty, may be disproportionately impacted by natural hazards.

Examining the reach of hazard mitigation policies to special needs populations may assist in increasing access to services and programs. FEMA's Office of Equal Rights addresses this need by suggesting that agencies and organizations planning for natural disasters identify special needs populations, make recovery centers more accessible, and review practices and procedures to remedy any discrimination in relief application or assistance.

The cost of natural hazards recovery can place an unequal financial responsibility on the general population when only a small proportion may benefit from governmental funds used to rebuild private structures. Discussions about natural hazards that include local citizen groups, insurance companies, and other public and private sector organizations can help ensure that all members of the population are a part of the decision-making processes.

Historic Resources

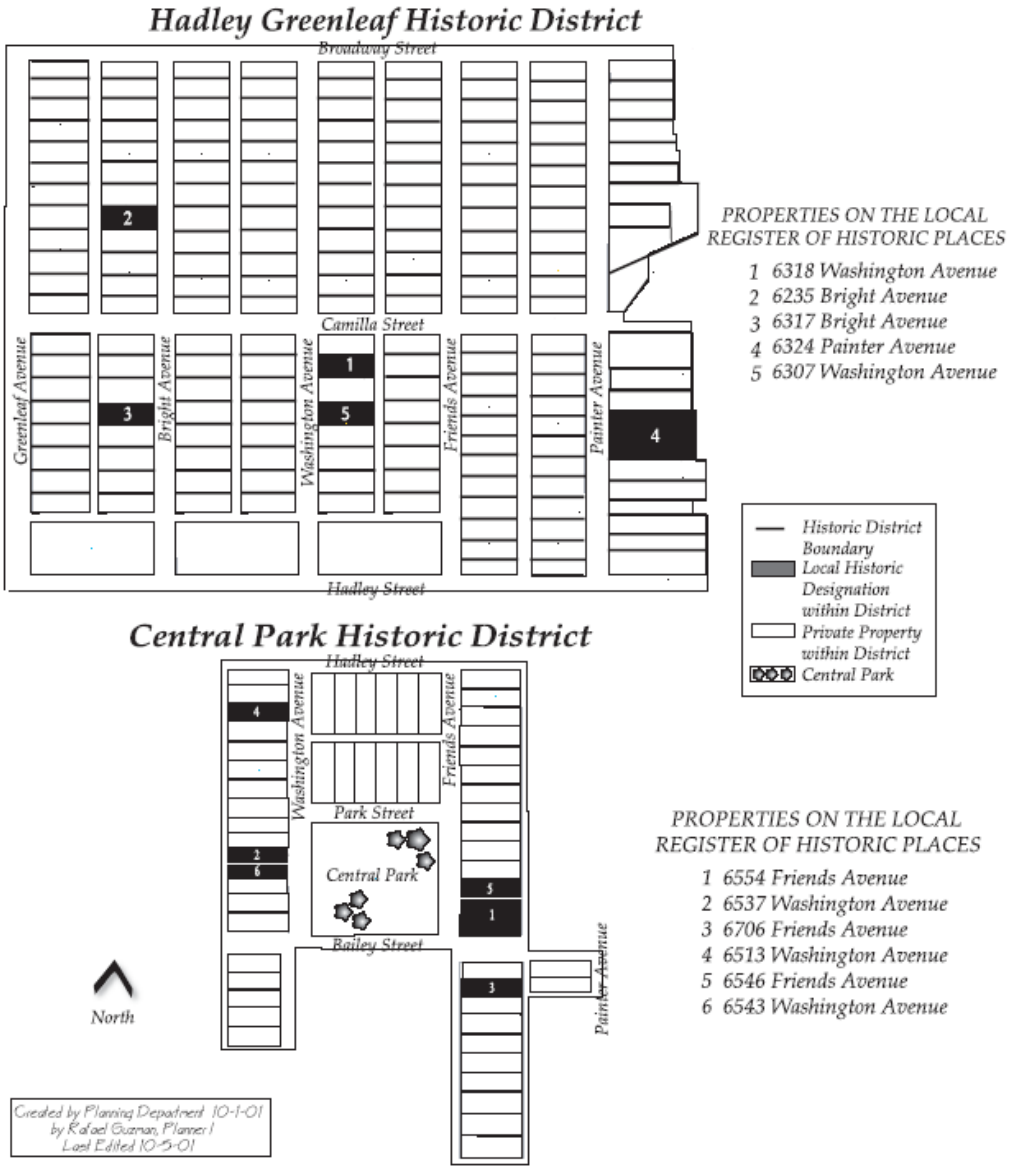
Whittier has a wide variety of cultural resources, which include the homes, and businesses of early residents and founders, along with other notable sites. The City has three Historic Districts, two of which include properties on the Local Register of Historic Places.

The first historic district in the City was the Hadley/Greenleaf Historic District, which is a residential neighborhood. Originally, the area was a single-family residential neighborhood, and many of the original single-family homes remain. Even though some have been converted to multifamily use, and some older homes have been replaced with new multifamily structures, the land use in the area is still predominantly residential. The predominant style is the craftsman bungalow. The District also contains a variety of other architectural styles, including Victorian cottages, Spanish or Mediterranean revival, and modern structures.

The Central Park Historic District was the second historic district. This district is primarily a residential neighborhood on the periphery of the Uptown commercial center. Originally, the residential neighborhood contained single-family uses, and some of the original single-family homes remain. Other properties have been converted to multifamily use, with some minor replacement development of apartment structures. Also located within the District is the former Women's Club building, now housing the Rio Hondo Chapter of the Red Cross. This structure, as well as the post office, serves as

a transition into the Uptown Whittier commercial core. Central Park itself is located within the middle of the district, serving as an Uptown Whittier focal point and special event locale. As with the Hadley/Greenleaf District, the predominant style is the craftsman bungalow. The Central Park District also contains Victorian, Spanish or Mediterranean revival, and other Craftsman structures. Map 3-1 shows the Hadley/Greenleaf and the Central Park Historic Districts.

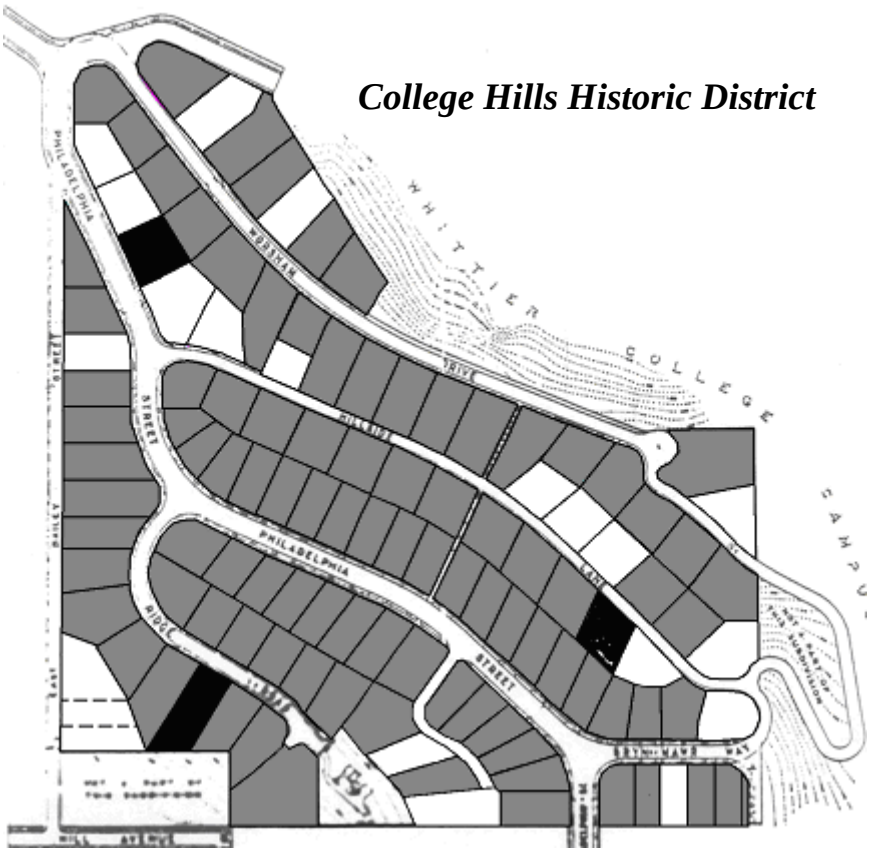
Map 3-1: City of Whittier Hadley/Greenleaf and Central Park Historic Districts



The third Historic District, College Hills, is the first planned hillside development in the City of Whittier. Mastering the steep slopes, grade changes, and curving hills throughout College Hills represents the earliest large-scale example of hillside development. Some design solutions are unique and found only in the College Hills community. College Hills serves as an intact example of architectural evolution from the 1920's to the recent past.

College Hills was connected with several renowned, important, and local personalities. Important members of the regional, national and international economy who called College Hills home include Shelley Martin Stoody of the Stoody Steel Company who was the original homeowner at 6799 Worsham Drive. Frank and Hannah Nixon, parents of Richard M. Nixon, also lived at 6799 Worsham Drive and operated a prominent gas station, drive-in, and market in the City. Map 3-2 shows the College Hills Historic District.

Map 3-2: City of Whittier College Hills Historic District



In addition to the City's Historic Districts, Whittier has a List of Historic Resources, which is available in the Community Development Department at City Hall. Following a disaster, previously documented historical structures in the City will be reviewed and a summary of damage forwarded to the Historical Resources Commission secretary for discussion as to how to manage those resources. For inspection teams assigned to inspect

critical or historic structures, the City will try to include structural engineers, as available. For historic structures, the City will also seek to include a representative of the local historic preservation community, as available. Review of any demolition permit for an historic structure considered to be a threat to health, safety or welfare will be expedited to the greatest extent possible. The City Building Official, the Historic Resources Commission secretary, and a representative of the local historic preservation community, as available, will review these demolition permit applications.

Land and Development

Development in Southern California from the earliest days was a cycle of boom and bust. The Second World War however dramatically changed that cycle. Military personnel and defense workers came to Southern California to fill the logistical needs created by the war effort. The available housing was rapidly exhausted and existing commercial centers proved inadequate for the influx of people. Immediately after the war, construction began on the freeway system, and the face of Southern California was forever changed. Home developments and shopping centers sprung up everywhere and within a few decades the central basin of Los Angeles County was virtually built out. This pushed new development further and further away from the urban center.

The City of Whittier General Plan addresses the use and development of private land, including residential and commercial areas. This plan is one of the City's most important tools in addressing environmental challenges including transportation and air quality; growth management; conservation of natural resources; clean water and open spaces

The environment of most Los Angeles County cities is nearly identical with that of their immediate neighbors and the transition from one incorporated municipality to another is seamless to most people. Seamless too are the exposures to the natural hazards that affect all of Southern California.

Housing and Community Development

In the City of Whittier the demand for housing outstrips the available supply, and the recent low interest rates have further fueled a pent up demand. Currently there are 29,040 housing units in the City of Whittier. There are 19,092 single-family homes (65.7% of available housing units) currently available. As for multiple unit homes, they account for 33.6 % of the total existing housing units at 9,733, units. There are 15,521 owner occupied units in the City of Whittier and 11,953 renter occupied units. Approximately 43.5% of the units are being rented in Whittier and 56.5% of the units are owned. The average change in home prices increased from $209,300 in 1990 to $211,700 in 2000. Demand for low to medium priced homes continues to be strong.

Employment and Industry

According to the 2000 Census, Management (33.7%), sales and office occupations (31.5%), as well as production, transportation, and material moving (14.7%) are City of

Whittier's principal employment activities. Educational, health and social services (21.1%), manufacturing (15.4%), and retail trade (11.2%) make up the major industries in the City of Whittier. The City of Whittier has a labor force of 38,824 persons, about 1.1% of the countywide workforce.

Mitigation activities are needed at the business level to ensure the safety and welfare of workers 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

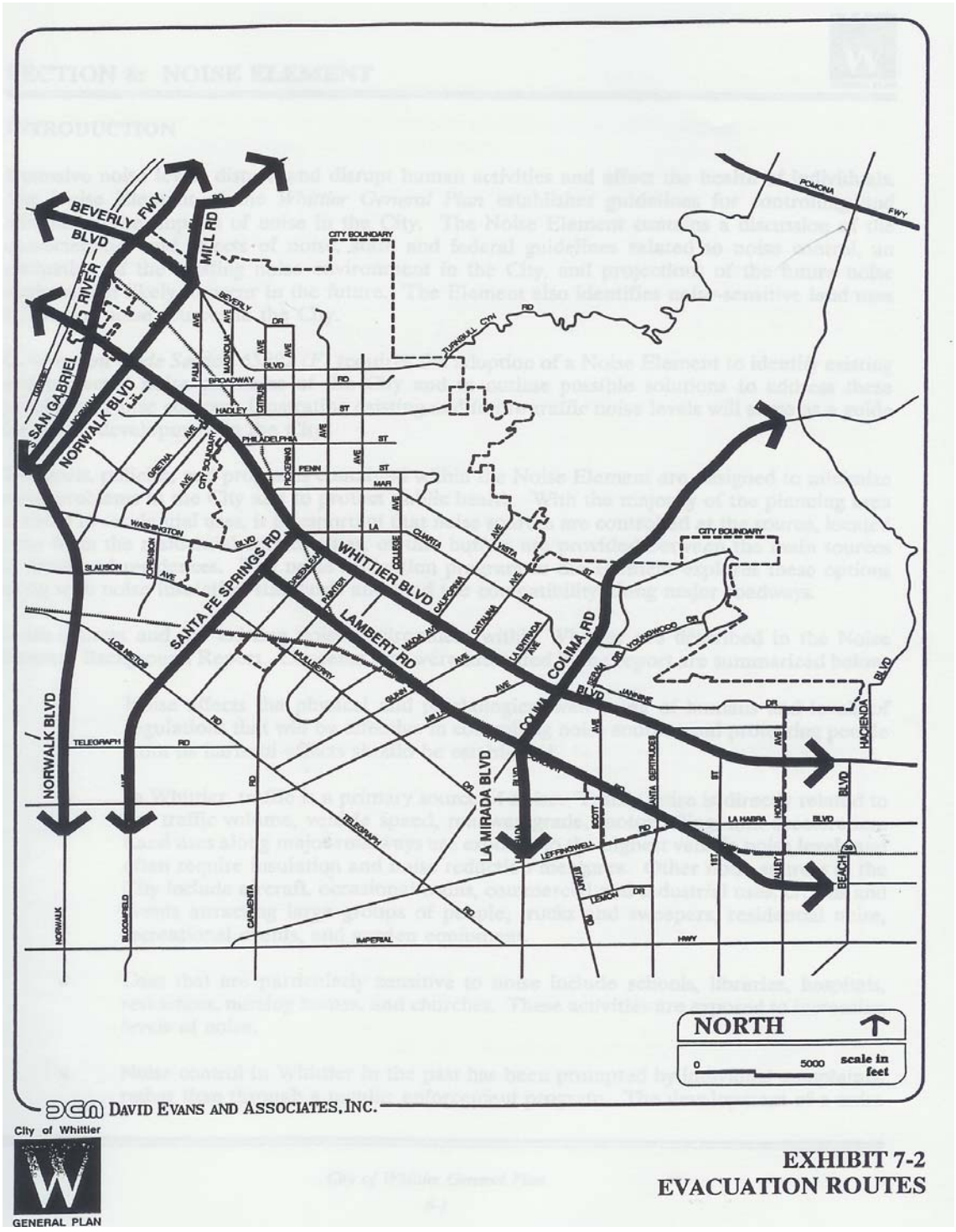
Private automobiles are the dominant means of transportation in Southern California and in the City of Whittier. According to the City's General Plan, the City of Whittier meets its public transportation needs through dial-a-ride, Whittier Transit fixed route system, links to light rail transit, and MTA buses. MTA provides bus service to the City of Whittier and to the Los Angeles County metropolitan area. Montebello Transit and Norwalk Transit provide Whittier residents with transportation to nearby Metrolink stations in Montebello and Norwalk. In addition to these services, the City promotes alternative transportation activities including carpools and park-and-ride.

According to the 2000 Census, the City has a population of 83,680 and a daytime population estimated at around 86,000. The mean travel time to work for the residents of the City of Whittier is 30.1 minutes. There are 592,000 vehicle trips per day in the entire City of Whittier. Approximately 56% of this is residential use and 44% generated primarily by non-residential uses.

According to the General Plan the City of Whittier is served by Whittier Boulevard (State Highway 72) and 605, connecting the city to adjoining parts of Los Angeles County. The City's 198-mile road system includes 41 miles of arterial highways and 157 miles of local roads, and 15 "bridges," as defined by Los Angeles County. As daily transit rises, there is an increased risk that a natural hazard event will disrupt the travel plans of residents across the region, as well as local, regional and national commercial traffic.

Localized flooding can render roads unusable. A severe winter storm has the potential to disrupt the daily driving routine of hundreds of thousands of people. Natural hazards can disrupt automobile traffic and shut down local and regional transit systems.

Map 3-3: City of Whittier Evacuation Routes (Source: City of Whittier General Plan) ***Routes have been designated due to size and flow of streets.***



Section 4:
Risk Assessment

What is a Risk Assessment?

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 three levels of a risk assessment are as follows:

1) Hazard Identification

This is the description of the geographic extent, potential intensity and the probability of occurrence of a given hazard. Maps are frequently used to display hazard identification data. The City of Whittier identified three major hazards that affect this geographic area. These hazards - earthquakes, flooding, and wildfires - were identified through an extensive process that utilized input from the Hazard Mitigation Planning Team. The geographic extent of each of the identified hazards has been identified by the City of Whittier utilizing the maps contained in the City General Plan and the MHFP Threat Assessment, and are illustrated by the tables, maps, and photos listed on page iii.

2) Profiling Hazard Events

The maps help to describe the causes and characteristics of each hazard and what part of the City's population, infrastructure, and environment may be 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-specific sections.

3) Vulnerability Assessment/Inventorying Assets

This is a combination of hazard identification with an inventory of the existing (or planned) property development(s) and population(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 and are illustrated in Table 4-2 at the end of this section. A description of the critical facilities in the City is also provided in this section. In addition, this plan includes a community issues summary in each hazard section to identify the most vulnerable and problematic areas in the City, including critical facilities and essential facilities.

4) 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 community and the state with a common framework in which to measure the effects of hazards on assets.

5) Assessing Vulnerability/ 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. This plan provides comprehensive description of the character of City of Whittier in the Community Profile. This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of City of Whittier can help in identifying potential problem areas and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from City, County or State agency sources.

Regardless of the data available for hazard assessments, there are numerous strategies the City can take to reduce risk. These strategies are described in the action items detailed in the Mitigation Actions Matrix (see Attachment 1). Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items throughout the hazard sections provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment. This 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. There are three hazards profiled in the mitigation plan, including earthquakes, flooding, and wildfires. The Federal criteria for risk assessment and information on how the City of Whittier Natural Hazards Mitigation Plan meets those criteria is outlined in Table 4-1 below.

Table 4-1: 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 data are available, the existing maps identifying the location of the hazard were utilized. The Executive Summary and the Risk Assessment sections of the plan includes a list of the hazard maps.
Profiling Hazard Events	Each hazard section includes documentation of the history, and 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 information on vulnerable areas in the City in the Community Issues section. 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 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 City of Whittier Profile Section of this plan provides a description of the development trends in the City, including the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Critical and Essential Facilities

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, shelters, and shelters. Also, facilities that, if damaged, could cause serious secondary impacts may also be considered "critical." A hazardous materials facility is one example of this type of critical facility.

Essential facilities are those facilities that are vital to the continued delivery of key government services or that may significantly impact the public's ability to recover from

the emergency. These facilities may include: buildings such as the jail, law enforcement center, public services building, community corrections center, the courthouse, and juvenile services building and other public facilities such as schools. The following table illustrates the critical and essential facilities within the City of Whittier. Specific vulnerability determinations were not made because the data are not available.

Table 4-2: Whittier Critical and Essential Facilities Vulnerable to Hazards (* None of Whittier's critical or essential facilities are located in a Flood Zone "A".)

EQ	Flood*	Wildfire	Facility	Address	Type
X			Fire Station 17	12006 Hadley Street	CF
X			Fire Station 28	7733 S. Greenleaf Avenue	CF
X			Fire Station 59	10021 Scott Avenue	CF
X		X	Police Department	7315 Painter Avenue	CF
X			Public Works Yard	12016 Hadley Street	CF
X		X	City Hall	13230 Penn Street	CF
X		X	Whittier Community Center	7630 Washington Avenue	CF
X		X	Whittier Senior Center	13225 Walnut Street	CF
X			Presbyterian Intercommunity Hospital	12401 Washington Boulevard	M
X			Whittier Hospital Medical Center	15151 E. Janine Drive	M
X		X	Bright Medical Associates, Inc.	15725 E. Whittier Boulevard	M
X			Doctor's Surgery Center of Whittier	8135 S. Painter Avenue	M
X			Whittier Hills	10426 S. Bogardus Avenue	N
X			Berryman Health West Whittier	12385 E. Washington Boulevard	N
X			Casa Whittier	10615 S. Jordan Road	N
X			Doctor's Convalescent Hospital	7926 S. Painter Avenue	N
X			Family Practice Center	12291 E. Washington Boulevard	M
X		X	Garden Homes Residential Care for the Elderly	12803 E. Orange Drive	N
X			Guirado Park	5760 Pioneer Boulevard	P
X		X	Merrill Gardens	13250 E. Philadelphia Street	N
X			Palm Park Activity Center	5703 Palm Avenue	P
X			Parnell Park	10711 Scott Avenue	P

EQ	Flood*	Wildfire	Facility	Address	Type
X			Posada Whittier Retirement Hotel	8120 S. Painter Avenue	N
X			Shea Convalescent Hospital	7716 S. Pickering Avenue	N
X		X	College Hills Booster Station	7027 Bryn Mawr	U
X		X	Greenleaf Booster Station	5700 Greenleaf Avenue	U
X		X	Rideout Booster Station	Citrus Grove Place, north end of cul-de-sac	U
X		X	Summit Booster Station	13980 Summit Drive	U
X			Washington Booster Station	8002 Washington Avenue	U
X			Pumping Plant #2	4128 San Gabriel River Parkway; Pico Rivera	U
X			Pumping Plant #3	6003 Pioneer Boulevard	U
X		X	College Hills Reservoirs (Nos. 3 & 8)	13919 Penn Street	U
X		X	Greenleaf I and II Reservoirs	5700 Greenleaf Avenue	U
X		X	Hazzard Reservoir	5800 Friends Avenue	U
X		X	Hoover Reservoir	Citrus Grove Place, north end	U
X		X	Murphy Reservoir (Nos. 10 & 11)	7900 Ocean View Avenue	U
X		X	Ocean View Reservoir	7700 Ocean View Avenue	U
X		X	Painter Reservoir	5800 Friends Avenue	U
X		X	Rideout Heights Reservoir (#5)	11735 East Grande Vista Drive	U
X		X	Starlite Reservoir (#12)	12641 Carinthia Drive	U
X		X	Broadoaks Children's School	13447 Philadelphia Road	S
X			Dexter Middle School	11532 E. Floral Drive	S
X			East Whittier Middle School	14421 E. Whittier Blvd.	S
X			Evergreen Elementary School	12915 E. Helmer Drive	S
X			Hadley School	11703 E. Hadley	S
X		X	Hoover School	6302 S. Alta Avenue	S
X			Jackson School	7015 S. Painter Avenue	S

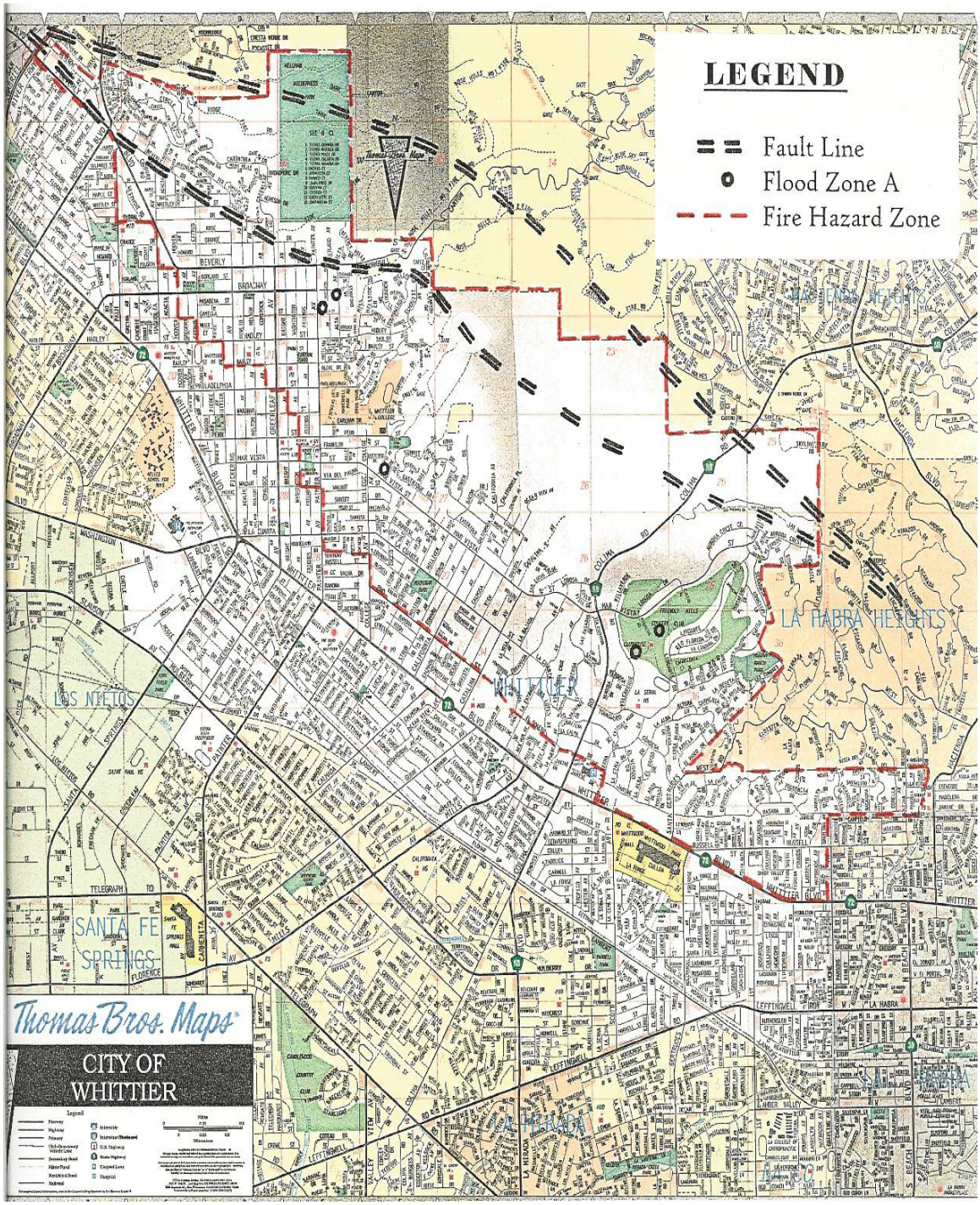
EQ	Flood*	Wildfire	Facility	Address	Type
X			Jordan School	10654 Jordan Road	S
X		X	La Serna High School	15301 Youngwood Drive	S
X		X	Lad 'N Lassie Preschool and Kindergarten	8036 Ocean View Avenue	S
X			Laurel Elementary School	13550 E. Lambert Road	S
X			Leffingwell Elementary School	10625 Santa Gertudres Avenue	S
X		X	Lincoln School	12620 E. Broadway	S
X			Longfellow School	6005 S. Magnolia Avenue	S
X			Mulberry Tree Preschool	13841 E. Christine Drive	S
X		X	Murphy Ranch Elementary School	16021 E. Janine Drive	S
X		X	Ocean View Elementary School	14359 E. 2nd	S
X			Olivas Independent Study	5311 Ben Alder Avenue	S
X			Oralingua School	7056 S. Washington Avenue	S
X			Orange Grove School	10626 E. Orange Grove Avenue	S
X			Painter Avenue Christian School	13885 Philadelphia Street	S
X			Plymouth Christian Elementary School	12058 Beverly Boulevard	S
X			St. Bruno Elementary School	15700 Citrustree Road	S
X			St. Mary of the Assumption Elementary School	7218 South Pickering Avenue	S
X			Trinity Lutheran Elementary School	11716 Floral Drive	S
X			Whittier Adventist Elementary School	8841 Calmada Avenue	S
X			Whittier Christian Elementary School	6548 S. Newlin Avenue	S
X			Whitter Christian Junior High School	6548 S. Newlin Avenue	S
X		X	Whittier College	13406 E. Philadelphia Street	S
X		X	Whittier Friends School	6726 Washington Avenue	S

EQ	Flood*	Wildfire	Facility	Address	Type
X			Whittier High School	12417 E. Philadelphia Street	S
X			Whittwood Mall	15603 E. Whittwood Lane	C
X			Whittier Hilton	7320 Greenleaf Avenue	C
X			Dewitt #3	10808 E. Beverly Boulevard	C
X			Beverly 76 Unocal	10201 E. Beverly Boulevard	C
X			Bob's Unocal	8803 S. Painter Avenue	C
X			Circle K No. 5642	13709 E. Whittier Boulevard	C
X			Friendly Hills 76	14940 E. Whittier Boulevard	C
X			Moten AM-PM Mini Market	13010 E. Lambert Road	C
X			Pas Oil Company	15306 E. Whittier Boulevard	C
X			S & I Service Center Mobil	10737 E. Beverly Boulevard	C
X			U-Haul Company	15707 E. Leffingwell Road	C
X			Zeinna's Mobil #2	15735 E. Leffingwell Road	C

Type of Facility

C = Commercial
CF = Critical Facility
M = Medical Facility
N = Nursing/Boarding Facility
P = Public Facility
U = Utility Facility
S = School

Map 4-1 City of Whittier Local Hazards Map
(Note: larger map is available at City Hall)



Summary

Natural hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Natural hazard mitigation for industries and employers may include developing relationships with emergency management services and their employees before disaster strikes, and establishing mitigation strategies together. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

Section 5: Earthquake Hazards in the City of Whittier

Table of Contents

Why Are Earthquakes a Threat to the City of Whittier?

Attachment 2 is a listing of Earthquake Probable Events gathered from the Southern California Earthquake Data Center. The list includes various faults and projected magnitude earthquakes likely to impact the region. The Southern California Earthquake Data Center predicts that somewhere in southern California (not everywhere, therefore many residents would not be affected) should experience a magnitude 7.0 or greater earthquake about seven times each century. Approximately half of these will be on the San Andreas "system" (the San Andreas, San Jacinto, Imperial, and Elsinore Faults) and half will be on other faults. The equivalent probability in the next 30 years is 85%.

The most significant earthquake event affecting Whittier was the October 1, 1987 Whittier Narrows Earthquake (Magnitude 6.1, which was later downgraded to 5.9), and the October 4, 1987 aftershock (Magnitude 5.5). The earthquake caused 8 deaths (not in Whittier) and extensive property damage, especially to older residential and commercial buildings. The damaged Uptown section of Whittier, with many unreinforced masonry buildings, was by far the area hardest hit.

However, the earthquakes both occurred either early in the morning or on a Sunday. This considerably reduced the potential effects. Many damaged buildings and streets were unoccupied, and most businesses were not yet open.

The earthquakes caused an estimated $358 million in property damage. Los Angeles County reports estimate that both earthquakes damaged over 9,100 residential and business structures throughout the county. Houses in Whittier were partially shaken from their foundations and countless chimneys were damaged. In Uptown Whittier, falling walls and bricks damaged many parked automobiles. Severe structural cracks within the foundation of the nearby interchange of Interstate Highways 5 and 605 caused CalTrans officials to close the interchange for the day for temporary repairs. Small landslides could be observed in Turnbull Canyon in northern Whittier. Fortunately, the terrain was much too dry for the ground shaking to have activated deep-seated landslides. Dust clouds rose over the southern flank of the San Gabriel Mountains caused by rock falls and surface land sliding from road cuts.

These were the first damaging earthquakes to occur in the Los Angeles area since the 1971 San Fernando Earthquake (Magnitude 6.4). The next most recent significant earthquake affecting southern California was the January 1, 1994 Northridge Earthquake (Magnitude 6.7). Fifty-seven people were killed and more than 1,500 people were seriously injured. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. Several collapsed bridges and overpasses created commuter havoc on the freeway system. The Northridge Earthquake resulted in record economic losses.

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."[1]

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

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

Table 5-1: Earthquake Events in the Southern California

Southern California Region Earthquakes with a Magnitude 5.0 or Greater			
1769	Los Angeles Basin	1916	Tejon Pass Region
1800	San Diego Region	1918	San Jacinto
1812	Wrightwood	1923	San Bernardino Region
1812	Santa Barbara Channel	1925	Santa Barbara
1827	Los Angeles Region	1933	Long Beach
1855	Los Angeles Region	1941	Carpenteria
1857	Great Fort Tejon Earthquake	1952	Kern County
1858	San Bernardino Region	1954	W. of Wheeler Ridge
1862	San Diego Region	1971	San Fernando

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

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

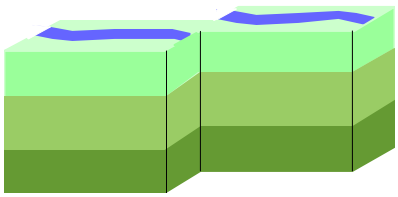
To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on those faults that are the sources of the earthquakes occurring in the Southern California region. Historical earthquake records can generally be divided into records of the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

History of Earthquake Events in Southern California

Since seismologists started recording and measuring earthquakes, there have been tens of thousands of recorded earthquakes in Southern California, most with a magnitude below three. No community in Southern California is beyond the reach of a damaging earthquake. Figure 5-1 describes the historical earthquake events that have affected Southern California.

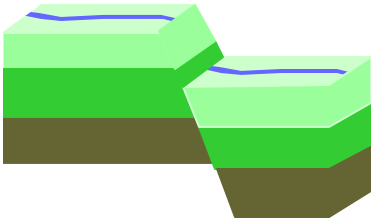
Figure 5-1 Causes and Characteristics of Earthquakes in Southern California

Earthquake Faults



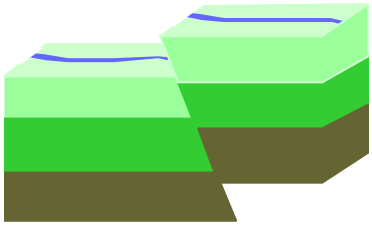
A fault is a fracture along between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.

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.

Dr. Kerry Sieh of Cal Tech has investigated the San Andreas Fault at Pallett Creek. "The record at Pallett Creek shows that rupture has recurred about every 130 years, on average, over the past 1500 years. But actual intervals have varied greatly, from less than 50 years to more than 300. The physical cause of such irregular recurrence remains unknown." [2] Damage from a great quake on the San Andreas would be widespread throughout Southern California.

Earthquake Related Hazards

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

Ground Shaking

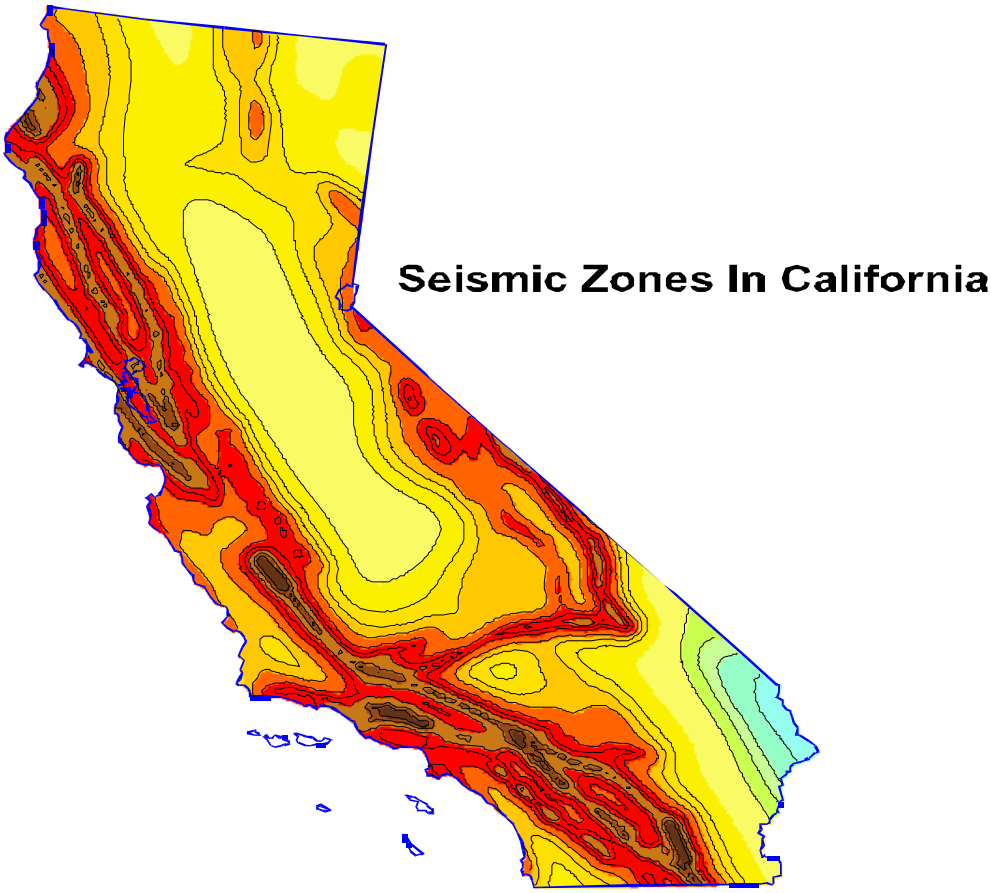
Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake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

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

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

Amplification
Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.[3] Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Map 5-1: Seismic Zones in California



Darker Shaded Areas indicate Greater Potential Shaking

Source: USGS Website

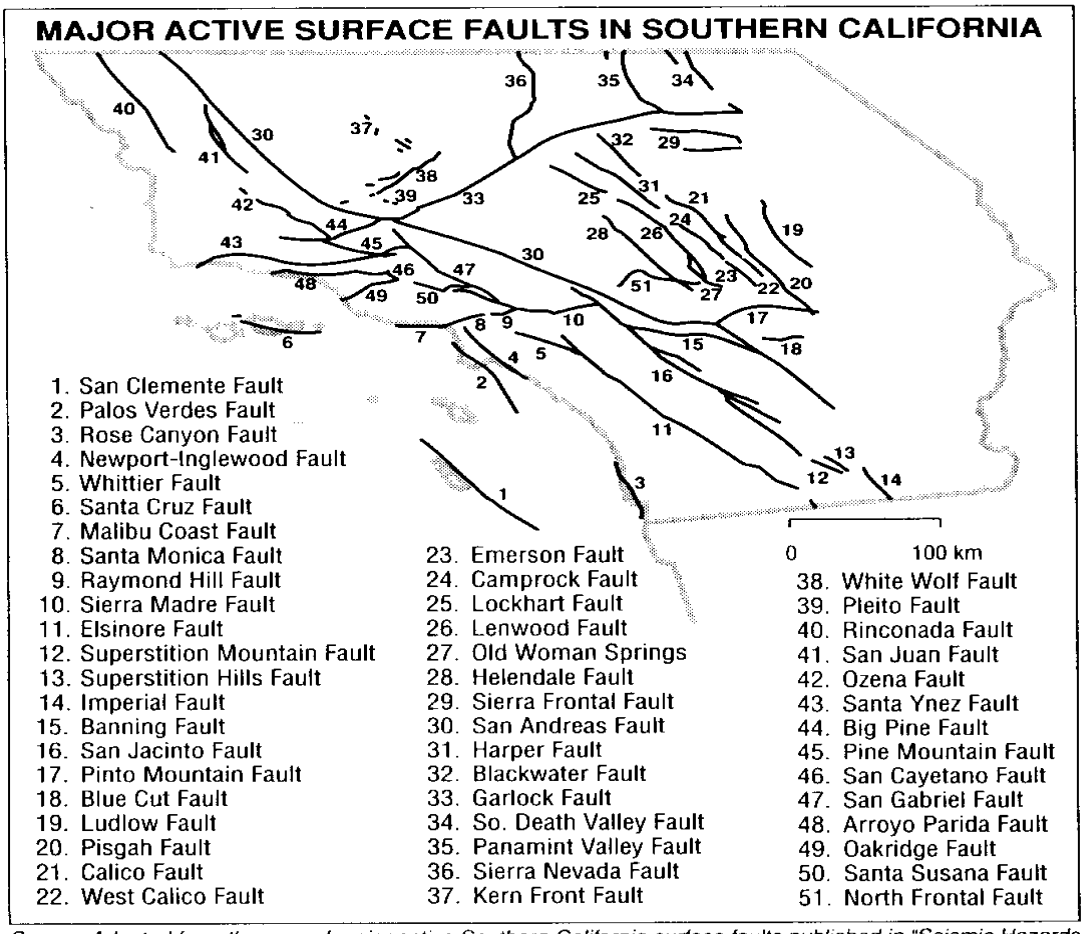
Earthquake Hazard Assessment

Hazard Identification

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. Map 5-2 illustrates the known earthquake faults in Southern California.

Map 5-2: Major Active Surface Faults in Southern California
(Source: City of Whittier Multi-Hazard Functional Plan)



Source: Adapted from the map of major active Southern California surface faults published in "Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024," Southern California Earthquake Center.

According to the City of Whittier General Plan, the City is in the vicinity of several known active and potentially active earthquake faults including the San Andreas, the San Jacinto, Whittier-Elsinore, and the Newport-Inglewood. New faults within the region are continuously being discovered. Scientists have identified almost 100 faults in the Los Angeles area known to be capable of a magnitude 6.0 or greater earthquake. The January 17, 1994 magnitude 6.7 1994 Northridge Earthquake (thrust fault) which produced severe ground motions, caused 57 deaths, 9,253 injuries and left over 20,000 displaced. Scientists have stated that such devastating shaking should be considered the norm near any large thrust earthquake.

Recent reports from scientists of the U.S. Geological Survey and the Southern California Earthquake Center say that the Los Angeles Area could expect one earthquake every year of magnitude 5.0 or more for the foreseeable future. The Southern California Earthquake Data Center's Earthquake Probable Events (Attachment 2) states that the interval between ruptures for the Whittier Fault is unknown; for the Elsinore Fault Zone, is roughly 250 years; for the San Andreas Fault Zone, varies from 140 to over 300 years; and for the San Jacinto Fault Zone, is between 100 to 300 years per segment.

A major earthquake occurring in or near this jurisdiction may cause many deaths and casualties, extensive property damage, fires and hazardous material spills and other ensuing hazards. The effects could be aggravated by aftershocks and by the secondary affects of fire, hazardous material/chemical accidents and possible failure of the waterways and dams. The time of day and season of the year would have a profound effect on the number of dead and injured and the amount of property damage sustained. Such an earthquake would be catastrophic in its affect upon the population and could exceed the response capabilities of the individual cities, Los Angeles County Operational Area and the State of California Emergency Services. Damage control and disaster relief support would be required from other local governmental and private organizations, and from the state and federal governments.

Extensive search and rescue operations would be required to assist trapped or injured persons. Emergency medical care, food and temporary shelter could be required by injured or displaced persons. Identification and burial of many dead persons would pose difficult problems; public health would be a major concern. Mass evacuation may be essential to save lives, particularly in areas downwind from hazardous material releases. Many families would be separated particularly if the earthquake should occur during working hours, and a personal inquiry or locator system could 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.

The economic impact on the City of Whittier from a major earthquake was considerable in terms of loss of employment and loss of tax base. Also, a major earthquake could cause serious damage and/or outage of 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.

In California, each earthquake is followed by revisions and improvements in the Building Codes. 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 Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Surface rupture is the most easily avoided seismic hazard.[4]

The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides.[5] The State Department of Conservation operates the Seismic Mapping Program for California. Extensive information is available at their website:
http://gmw.consrv.ca.gov/shmp/index.htm

Vulnerability Assessment

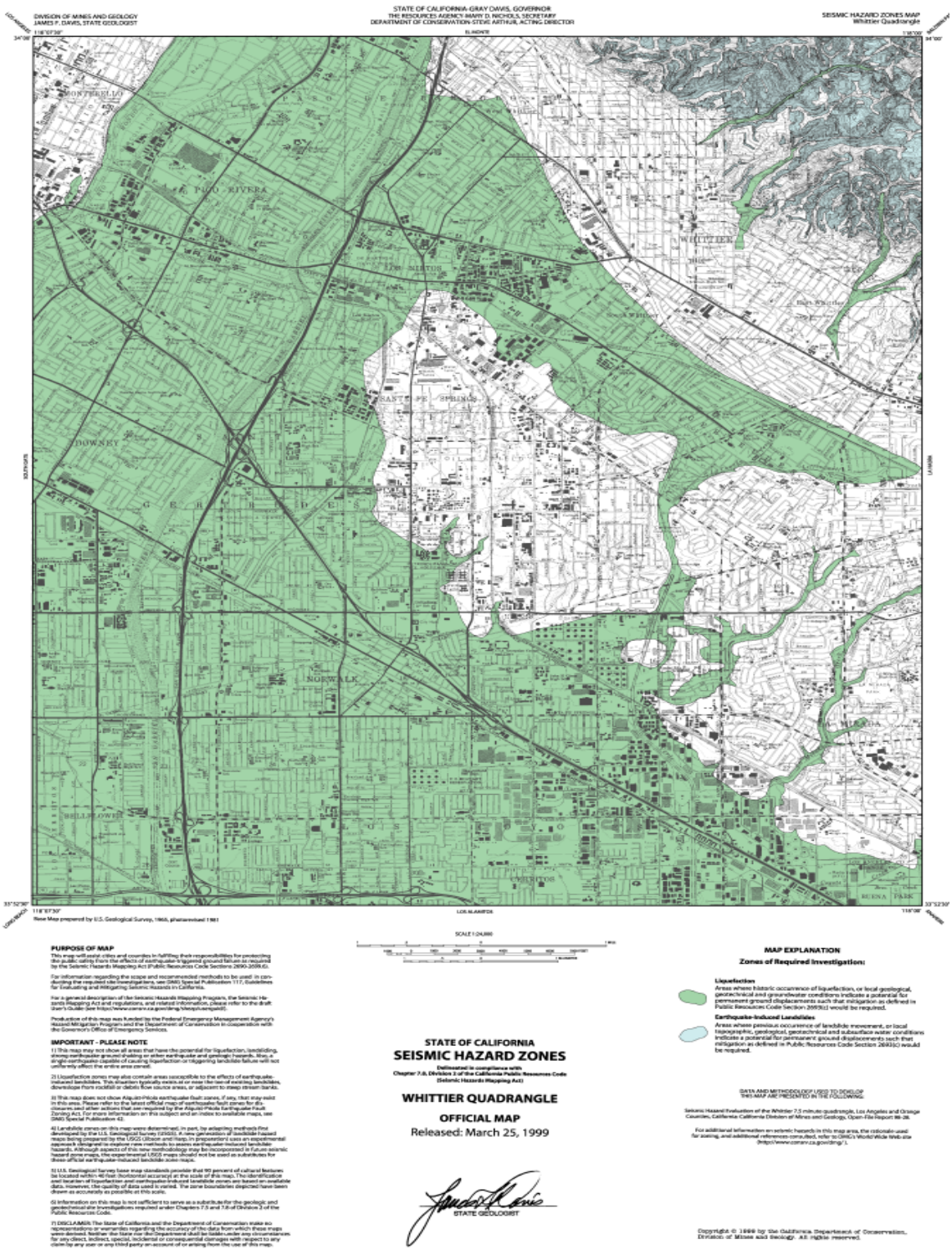
The effects of earthquakes span a large area, and large earthquakes occurring in many parts of the Southern California region would probably be felt throughout the region. However, the degree to which the earthquakes are felt, and the damages associated with them may vary. At risk from earthquake damage 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.

In the City of Whittier, the types of buildings that would be affected by earthquakes primarily include residential and commercial buildings. The critical facilities that could be affected by an earthquake are identified in Table 4-2.

Data were not available to conduct an impact assessment on damages in Whittier associated with earthquakes.

The California Geological Survey has identified areas most vulnerable to liquefaction. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures.

Map 5-3: Liquefaction and EQ-Induced Landslide Potential – Whittier Quadrangle (Source: California Seismic Safety Maps) (Note: a larger version of this map is available in City Hall)



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[6]. 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. FEMA's software program, HAZUS, uses mathematical formulas and information about building stock, local geology and the location and size of potential earthquakes, economic data, and other information to estimate losses from a potential earthquake.[7] The HAZUS software is available from FEMA at no cost.

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. All of the City of Whittier's unreinforced masonry buildings have been retrofitted to Code.

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.

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
The Whittier Narrows Dam is located approximately 4 miles northwest of the City center. It is west of the San Gabriel River flood control channel and the Freeway (SR-605). The dam holds 9.75 million gallons of water. According to the city's General Plan, inundation from flood waters released from the Whittier Narrows Dam includes a limited area of low populated areas in the northwest corner of the city (essentially the City's wellfield and water pumping plant). Flooding from city reservoirs can be prevented by the construction of earthquake resistant dams and reservoirs.

There are a total of 103 dams in Los Angeles County, owned by 23 agencies or organizations, ranging from the Federal government to Homeowner Associations.[8] These dams hold billions of gallons of water in reservoirs. Releases of water from the major reservoirs are designed to protect Southern California from flood waters and to store domestic water. Seismic activity can compromise the dam structures, and the resultant flooding could cause catastrophic flooding. Following the 1971 Sylmar earthquake the Lower Van Norman Dam showed signs of structural compromise, and tens of thousands of persons had to be evacuated until the dam could be drained. The dam has never been refilled.

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

Infrastructure and Communication
Residents in the City of Whittier 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.

Much of the interstate highway system was built in the mid to late 1960's. The bridges in and around the City of Whittier are state, county or privately owned. Caltrans has retrofitted most bridges on the freeway systems; however there are still some county maintained bridges that are not retrofitted. The FHWA requires that bridges on the National Bridge Inventory be inspected every 2 years. Caltrans checks when the bridges are inspected because they administer the Federal funds for bridge projects.

Damage to Lifelines

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, 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 and Essential Facilities

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. Many critical and essential facilities are housed in older buildings that are not constructed up to current engineering practices, but are up to current seismic codes.

Businesses

Seismic activity can cause great loss to businesses, both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to large and small shop owners who may have difficulty recovering from their losses.

Forty percent of businesses do not reopen after a disaster and another twenty-five percent fail within one year according to the Federal Emergency Management Agency (FEMA). Similar statistics from the United States Small Business Administration indicate that over ninety percent of businesses fail within two years after being struck by a disaster.[9]

Individual Preparedness

Because the potential for earthquake occurrences and earthquake related property damage is relatively high in the City of Whittier, 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 may 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 bricks, 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, especially since the City owns and operates its own solid waste landfill. Disasters do not exempt the City of Whittier from compliance with AB 939 regulations.

End Notes

[1] http://pubs.usgs.gov/gip/earthq3/when.html

[2] http://www.gps.caltech.edu/~sieh/home.html

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

[4] http://www.consrv.ca.gov/CGS/rghm/ap/

[5] Ibid

[6] Burby, R. (Ed.) Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities (1998), Washington D.C., Joseph Henry Press.

[7] FEMA HAZUS http://www.fema.gov/hazus/hazus2.htm (May 2001).

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

[9] http://www.chamber101.com/programs_committee/natural_disasters/DisasterPreparedness/Forty.htm

Section 6: Flooding Hazards in the City of Whittier

Table of Contents

Why are Floods a Threat to the City of Whittier?
The City of Whittier is adjacent to the San Gabriel River, which prior to mitigation projects was susceptible to flooding events. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

According to the City of Whittier's Multi-hazard Functional Plan, the City has four areas that are designated as zone "A" by the National Flood Insurance Program. These areas are as follows: 1) the area bounded by Painter Avenue, Broadway, Camilla Street, and East City boundary; 2) west of York Street and North of Mar Vista Street; 3) within the Friendly Hills Golf Country Club south of Mar Vista Street and east of Villa Verde Drive; and 4) La Mirada Creek Flood Control Channel south of Leffingwell Road and east of Pounds Avenue. In light of the FIRM Zone A Floodplain designations located in various areas in the City, the flood threat to the City is considered to be moderate. However, the sizes of the zones present a relatively minor percentage of the City's total land area.

Although not a major river, Turnbull Canyon Creek channel presents the City's most likely scenario for flooding. There are Flood Zone A's directly below the Turnbull Canyon Creek debris basin. In addition, with its low-lying and flat areas, parts of Whittier can also be susceptible to urban flooding.

The City of Whittier most recently experienced destruction due to flooding in 1995, impacting various areas city-wide. In addition to flooding and damage, storms were responsible for large volumes of debris. The City sought and received a Presidential Disaster Declaration to obtain federal assistance for its recovery effort. This flooding event caused $15,000 worth of damage to public facilities.

History of Flooding in the City of Whittier
Floods have affected the citizens of the city since as early as 1907, when it was reported that despite over 18 inches of rain. Since then, flood control projects have been implemented that minimize flood hazards and the number of flood zones in the City.

There are a number of rivers in the Southern California region, but the river with the best recorded history is the Los Angeles River. The flood history of the Los Angeles River is generally indicative of the flood history of much of Southern California.

Historic Flooding in Los Angeles County
Records show that since 1811, the Los Angeles River has flooded 30 times, on average once every 6.1 years. But averages are deceiving, for the Los Angeles basin goes through periods of drought and then periods of above average rainfall. Between 1889 and 1891 the river flooded every year, and from 1941 to 1945, the river flooded 5 times. Conversely, from 1896 to 1914, a period of 18 years, and again from 1944 to 1969, a period of 25 years, the river did not have serious floods.[1]

The City of Whittier is 13 miles east of downtown Los Angeles. It can be affected by the regional heavy rains that brought flooding to Los Angeles. In addition, the towering

mountains that give the Los Angeles region its spectacular views also wring a great deal of rain out of the storm clouds that pass through. Because the mountains are so steep, the rainwater moves rapidly down the slopes and across the coastal plains on its way to the ocean.

> "The Santa Monica, Santa Susana and Verdugo Mountains, which surround three sides of the valley, seldom reach heights above three thousand feet. The Western San Gabriel Mountains, in contrast, have elevations of more than seven thousand feet. These higher ridges often trap eastern-moving winter storms. Although downtown Los Angeles averages just fifteen inches of rain a year, some mountain peaks in the San Gabriels receive more than forty inches of precipitation annually"[2]

However, flooding of the Los Angeles River, given its distance from the City of Whittier, would probably not directly affect the City. Although the San Gabriel River is in closer proximity to a small area of western Whittier, most of the city is at a higher elevation and therefore the impact of river flooding would be very minimal. Data on the impact on Whittier of past San Gabriel River flooding is not available.

What Factors Create Flood Risk?

Flooding occurs when climate, geology, and hydrology combine to create conditions where water flows outside of its usual course. In the City of Whittier, to some extent geography and climate combine to create chronic seasonal flooding conditions. The primary condition that contributes to flooding hazards in Whittier is plugged catch basins.

Winter Rainfall

Over the last 125 years, the average annual rainfall in Los Angeles is 14.9 inches. But the term "average" means very little as the annual rainfall during this time period has ranged from only 4.35 inches in 2001-2002 to 38.2 inches in 1883-1884. In fact, in only fifteen of the past 125 years, has the annual rainfall been within plus or minus 10% of the 14.9 inch average. And in only 38 years has the annual rainfall been within plus or minus 20% of the 14.9 inch average. This makes the Los Angeles basin a land of extremes in terms of annual precipitation.

The City of Whittier is in the eastern section of San Gabriel Valley. It is up against the Puente Hills, which increases the collection of rainwater.

Monsoons

Another relatively regular source for heavy rainfall, particularly in the mountains and adjoining cities is from summer tropical storms. Table 6-1 lists tropical storms that have had significant rainfall in the past century, and the general areas affected by these storms. These tropical storms usually coincide with El Niño years.

Table 6-1: Tropical Cyclones of Southern California

Tropical cyclones that have affected Southern California during the 20th Century			
Month-Year	**Date(s)**	**Area(s) Affected**	**Rainfall**
July 1902	20th & 21st	Deserts & Southern Mountains	up to 2"
Aug. 1906	18th & 19th	Deserts & Southern Mountains	up to 5"
Sept. 1910	15th	Mountains of Santa Barbara County	2"
Aug. 1921	20th & 21st	Deserts & Southern Mountains	up to 2"
Sept. 1921	30th	Deserts	up to 4"
Sept. 1929	18th	Southern Mountains & Deserts	up to 4"
Sept. 1932	28th - Oct 1st	Mountains & Deserts, 15 Fatalities	up to 7
Aug. 1935	25th	Southern Valleys, Mountains & Deserts	up to 2"
Sept. 1939	4th - 7th	Southern Mountains, Southern & Eastern Deserts	up to 7
	11th & 12th	Deserts, Central & Southern Mountains	up to 4"
	19th - 21st	Deserts, Central & Southern Mountains	up to 3"
	25th	Long Beach, W/ Sustained Winds of 50 Mph	5"
		Surrounding Mountains	6 to 12"
Sept. 1945	9th & 10th	Central & Southern Mountains	up to 2"
Sept. 1946	30th - Oct 1st	Southern Mountains	up to 4"
Aug. 1951	27th - 29th	Southern Mountains & Deserts	2 to 5"
Sept. 1952	19th - 21st	Central & Southern Mountains	up to 2"
July 1954	17th - 19th	Deserts & Southern Mountains	up to 2"
July 1958	28th & 29th	Deserts & Southern Mountains	up to 2"
Sept. 1960	9th & 10th	Julian	3.40"
Sept. 1963	17th - 19th	Central & Southern Mountains	up to 7"
Sept. 1967	1st - 3rd	Southern Mountains & Deserts	2"
Oct. 1972	6th	Southeast Deserts	up to 2"
Sept. 1976	10th & 11th	Central & Southern Mountains. Ocotillo, CA was Destroyed 3 Fatalities	6 to 12"
Aug. 1977	n/a	Los Angeles	2"
		Mountains	up to 8"
Oct. 1977	6th & 7th	Southern Mountains & Deserts	up to 2
Sept. 1978	5th & 6th	Mountains	3"
Sept. 1982	24th - 26th	Mountains	up to 4"
Sept. 1983	20th & 21st	Southern Mountains & Deserts	up to 3"
http://www.fema.gov/nwz97/eln_scal.shtm			

Geography and Geology
The greater Los Angeles Basin is the product of rainstorms and erosion for millennia. "Most of the mountains that ring the valleys and coastal plain are deeply fractured faults and, as they (the mountains) grew taller, their brittle slopes were continually eroded. Rivers and streams carried boulders, rocks, gravel, sand, and silt down these slopes to the valleys and coastal plain....In places these sediments are as much as twenty thousand feet thick"[3]

Much of the coastal plain rests on the ancient rock debris and sediment washed down from the mountains. This sediment can act as a sponge, absorbing vast quantities of rain in those years when heavy rains follow a dry period. But like a sponge that is near saturation, the same soil fills up rapidly when a heavy rain follows a period of relatively wet weather. So even in some years of heavy rain, flooding is minimal because the ground is relatively dry. The same amount of rain following a wet period of time can cause extensive flooding.

The greater Los Angeles basin is for all intents and purposes developed. This leaves precious little open land to absorb rainfall. This lack of open ground forces water to remain on the surface and rapidly accumulate. If it were not for the massive flood control system with its concrete lined river and stream beds, flooding would be a much more common occurrence. And the tendency is towards even less and less open land. In-fill building is becoming a much more common practice in many areas. Developers tear down an older home which typically covers up to 40% of the lot size and replacing it with three or four town homes or apartments which may cover 90-95% of the lot.

Another potential source of flooding is "asphalt creep." The street space between the curbs of a street is a part of the flood control system. Water leaves property and accumulates in the streets, where it is directed towards the underground portion of the flood control system. The carrying capacity of the street is determined by the width of the street and the height of the curbs along the street. Often, when streets are being resurfaced, a one to two inch layer of asphalt is laid down over the existing asphalt. This added layer of asphalt subtracts from the rated capacity of the street to carry water. Thus the original engineered capacity of the entire storm drain system is marginally reduced over time. Subsequent re-paving of the street will further reduce the engineered capacity even more.

Flood Terminology

Floodplain
A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. This area, if left undisturbed, acts to store excess flood water. The floodplain is made up of two sections: the floodway and the flood fringe.

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

According to the National Flood Insurance Program, the following Whittier areas lie in 100-year flood zones: 1) the area bounded by Painter Avenue, Broadway, Camilla Street, and East City boundary; 2) west of York Street and North of Mar Vista Street; 3) within the Friendly Hills Golf Country Club south of Mar Vista Street and east of Villa Verde Drive; and 4) La Mirada Creek Flood Control Channel south of Leffingwell Road and east of Pounds Avenue.

Floodway
The floodway is one of two main sections that make up the floodplain. Floodways are defined for regulatory purposes. Unlike floodplains, floodways do not reflect a recognizable geologic feature. For NFIP purposes, floodways are defined as the channel of a river or stream, and the overbank areas adjacent to the channel. The floodway carries the bulk of the flood water downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development or other structures that would obstruct or divert flood flows onto other properties.

The City of Whittier regulations restrict all development in the floodway. The NFIP floodway definition is "the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Floodways are not mapped for all rivers and streams but are generally mapped in developed areas.

Base Flood Elevation (BFE)
The term "Base Flood Elevation" refers to the elevation (normally measured in feet above sea level) that the base flood is expected to reach. Base flood elevations can be set at levels other than the 100-year flood. Some communities choose to use higher frequency flood events as their base flood elevation for certain activities, while using lower frequency events for others. For example, for the purpose of storm water management, a 25-year flood event might serve as the base flood elevation; while the 500-year flood event may serve as base flood elevation for the tie down of mobile homes. The regulations of the NFIP focus on development in the 100-year floodplain.

Characteristics of Flooding
Primarily two types of flooding can affect the City of Whittier: riverine flooding and urban flooding. In addition, any low-lying area has the potential to flood. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system’s capability to remove it.

Riverine Flooding
Riverine flooding, or the overbank flooding of rivers and streams, historically has not been an issue. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers. There are no river basins in the City of Whittier.

Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 100-year flood with flood depths of only one to three feet. These areas are generally flooded by low velocity sheet flows of water.

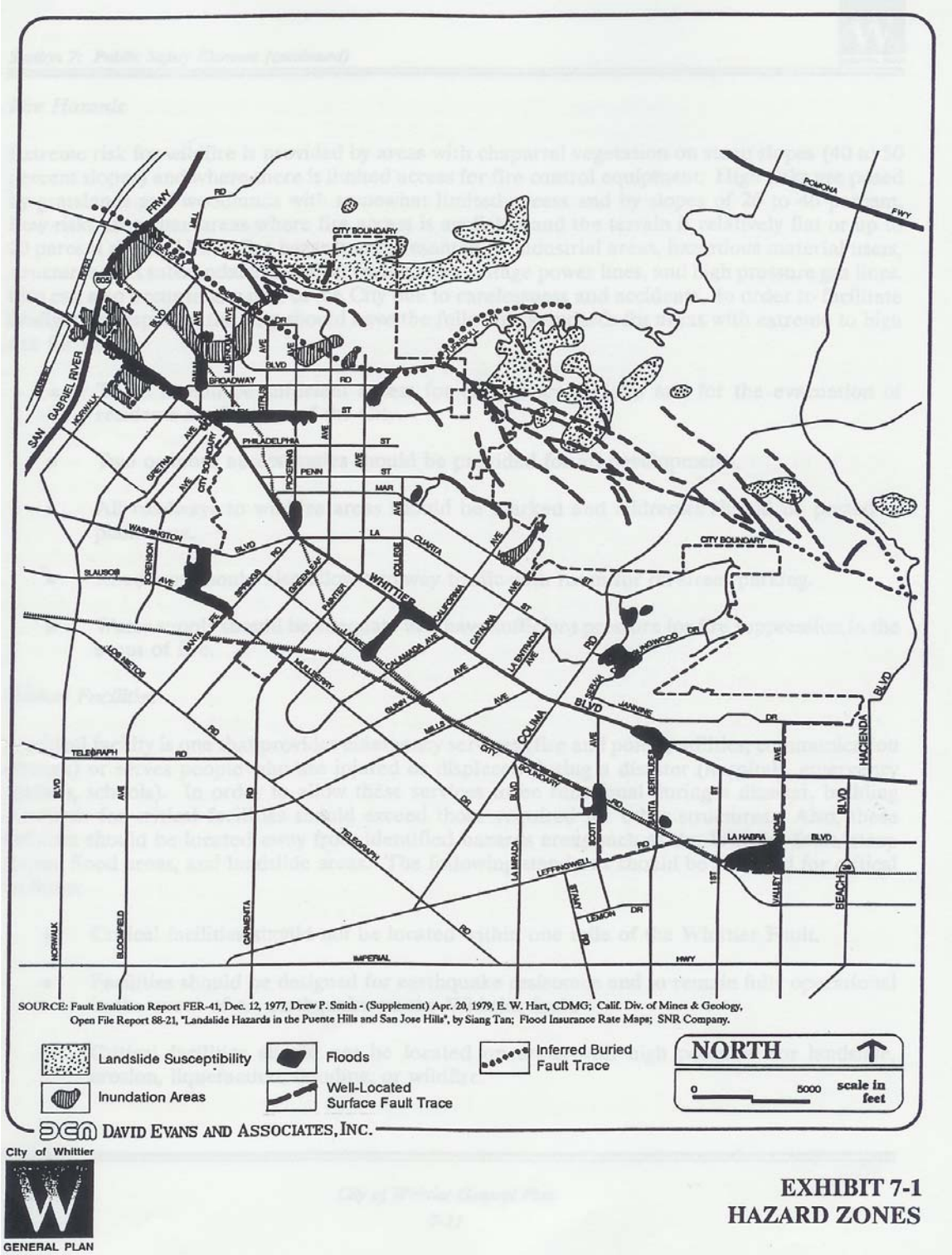
Urban Flooding
As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in flood waters that rise very rapidly and peak with violent force.

Approximately five percent of the area in the City of Whittier has a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water in unnatural channels. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains often back up with vegetative debris causing additional, localized flooding.

Dam Failure Flooding
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 the one dam in the City of Whittier (Hoover Reservoir). As identified in the City's General Plan, within the City limits there are four reservoirs located above the city in the Puente Hills that potentially pose a flood hazard, but only one, Hoover Reservoir, is classified as a dam. The other three reservoirs at high elevations are Painter Reservoir, Greenleaf I Reservoir, and Ocean View Reservoir. In addition, there is also the newly constructed Greenleaf II Reservoir. There are several other water tanks located throughout the City, but they pose very minor flood hazards.

The Whittier Narrows Dam is located approximately 4 miles northwest of the City center. It is west of the San Gabriel River flood control channel and the Freeway (SR-605). The dam holds 9.75 million gallons of water. According to the City's General Plan, inundation from flood waters released from the Whittier Narrows Dam includes a very limited area of low populated areas in the northwest corner of the City (essentially the City's wellfield and water pumping plant).

Map 6-1: City of Whittier Hazard Zones (Floodplains) (Source: City of Whittier General Plan) (Note: Flood areas include areas designated as Flood Zone "A" (100-year flood) and Flood Zone B (500-year flood). A larger version of map is available in the City's General Plan)



Because dam failure can have severe consequences, FEMA requires that all dam owners develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions. Although there may be coordination with county 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 Whittier Narrows Emergency Action Plan.

There have been a total of 45 dam failures in California, since the 19th century. The significant dam failures in Southern California are listed in Table 6-2.

Table 6-2: Dam Failures in Southern California

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

The two most significant dam failures are the St. Francis Dam in 1928 and the Baldwin Hills Dam in 1963.

> "The failure of the St. Francis Dam, and the resulting loss of over 500 lives in the path of a roaring wall of water, was a scandal that resulted in the almost complete destruction of the reputation of its builder, William Mulholland.
>
> Mulholland was an immigrant from Ireland who rose up through the ranks of the city's water department to the position of chief engineer. It was he who proposed, designed, and supervised the construction of the Los Angeles Aqueduct, which brought water from the Owens Valley to the city. The St. Francis Dam, built in 1926, was 180 feet high and 600 feet long; it was located near Saugus in the San Francisquito Canyon.
>
> The dam gave way on March 12, 1928, three minutes before midnight. Its waters swept through the Santa Clara Valley toward the Pacific Ocean,

about 54 miles away. 65 miles of valley was devastated before the water finally made its way into the ocean between Oxnard and Ventura. At its peak the wall of water was said to be 78 feet high; by the time it hit Santa Paula, 42 miles south of the dam, the water was estimated to be 25 feet deep. Almost everything in its path was destroyed: livestock, structures, railways, bridges, and orchards. By the time it was over, parts of Ventura County lay under 70 feet of mud and debris. Over 500 people were killed and damage estimates topped $20 million."[4]

Photo 6-1: Baldwin Hills Dam

Baldwin Hills Dam - Dark spot in upper right hand quadrant shows the beginning of the break in the dam.

The Baldwin Hills dam failed during the daylight hours, and was one of the first disaster events documented by a live helicopter broadcast.

"The Baldwin Hills Dam collapsed with the fury of a thousand cloudbursts, sending a 50-foot wall of water down Cloverdale Avenue and slamming into homes and cars on Dec. 14, 1963.

Five people were killed. Sixty-five hillside houses were ripped apart, and 210 homes and apartments were damaged. The flood swept northward in a V-shaped path roughly bounded by La Brea Avenue and Jefferson and La Cienega boulevards.

> The earthen dam that created a 19-acre reservoir to supply drinking water for West Los Angeles residents ruptured at 3:38 p.m. As a pencil-thin crack widened to a 75-foot gash, 292 million gallons surged out. It took 77 minutes for the lake to empty. But it took a generation for the neighborhood below to recover. And two decades passed before the Baldwin Hills ridge top was reborn.The cascade caused an unexpected ripple effect that is still being felt in Los Angeles and beyond. It foreshadowed the end of urban-area earthen dams as a major element of the Department of Water and Power's water storage system. It prompted a tightening of Division of Safety of Dams control over reservoirs throughout the state.
>
> The live telecast of the collapse from a KTLA-TV helicopter is considered the precursor to airborne news coverage that is now routine everywhere."[5]

Debris Flows

Another flood related hazard that can affect certain parts of the Southern California region are debris flows. Most typically debris flows occur in mountain canyons and the foothills against the San Gabriel Mountains. However, any hilly or mountainous area with intense rainfall and the proper geologic conditions may experience one of these very sudden and devastating events.

> "Debris flows, sometimes referred to as mudslides, mudflows, lahars, or debris avalanches, are common types of fast-moving landslides. These flows generally occur during periods of intense rainfall or rapid snow melt. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that are typically about 10 miles per hour, but can exceed 35 miles per hour. The consistency of debris flow ranges from watery mud to thick, rocky mud that can carry large items such as boulders, trees, and cars. Debris flows from many different sources can combine in channels, and their destructive power may be greatly increased. They continue flowing down hills and through channels, growing in volume with the addition of water, sand, mud, boulders, trees, and other materials. When the flows reach flatter ground, the debris spreads over a broad area, sometimes accumulating in thick deposits that can wreak havoc in developed areas."[6]

The City has two debris basins on Turnbull Canyon Road, one in Worsham Canyon, and one at the end of Bowen Drive, California Avenue, Satinwood Drive, and the east end of Philadelphia Street.

Coastal Flooding

Low lying coastal communities of Southern California have one other source of flooding, coastal flooding. This occurs most often during storms which bring higher than normal tides. Storms, the time of year and the tidal cycle can sometimes work to bring much higher than normal tides which cause flooding in low lying coastal areas. This hazard

however is limited to those areas.

What is the Effect of Development on Floods?

When structures or fill are placed in the floodway or floodplain water is displaced. Development raises the river levels by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. When structures or materials are added to the floodway or floodplain and no fill is removed to compensate, serious problems can arise. Flood waters may be forced away from historic floodplain areas. As a result, other existing floodplain areas may experience flood waters that rise above historic levels. Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention should be given to development that occurs within the floodway to ensure that structures are prepared to withstand base flood events. In highly urbanized areas, increased paving can lead to an increase in volume and velocity of runoff after a rainfall event, exacerbating the potential flood hazards. Care should be taken in the development and implementation of storm water management systems to ensure that these runoff waters are dealt with effectively.

How are Flood-Prone Areas Identified?

Flood maps and Flood Insurance Studies (FIS) are often used to identify flood-prone areas. The NFIP was established in 1968 as a means of providing low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations that focus on building codes and sound floodplain management. NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60, 3) require that all new construction in floodplains must be elevated at or above base flood level.

Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by FEMA which delineates SFHA in communities where NFIP regulations apply. FIRMs are also used by insurance agents and mortgage lenders to determine if flood insurance is required and what insurance rates should apply.

Water surface elevations are combined with topographic data to develop FIRMs. FIRMs illustrate areas that would be inundated during a 100-year flood, floodway areas, and elevations marking the 100-year-flood level. In some cases they also include base flood elevations (BFEs) and areas located within the 500-year floodplain. Flood Insurance Studies and FIRMs produced for the NFIP provide assessments of the probability of flooding at a given location. FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. These studies and maps represent flood risk at the point in time when FEMA completed the studies. However, it is important to note that not all 100-year or 500-year floodplains have been mapped by FEMA. Flood maps cover 100% of the total population in the City of Whittier.

FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed the studies, and does not incorporate

planning for floodplain changes in the future due to new development. Although FEMA is considering changing that policy, it is optional for local communities. The FEMA FIRM map for the City of Whittier was completed in 1981.

Flood Mapping Methods and Techniques
Although many communities rely exclusively on FIRMs to characterize the risk of flooding in their area, there are some flood-prone areas that are not mapped but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and areas susceptible to manmade flooding. About 10% to 20% of all flood-related damage from past floods in the City of Whittier is located outside the boundaries of the FEMA's FIRMs.

Communities find it particularly useful to overlay flood hazard areas on tax assessment parcel maps. This allows a community to evaluate the flood hazard risk for a specific parcel during review of a development request. Coordination between FEMA and local planning jurisdictions is the key to making a strong connection with GIS technology for the purpose of flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI), a private company, have formed a partnership to provide multi-hazard maps and information to the public via the Internet. ESRI produces GIS software, including ArcViewC9 and ArcInfoC9. The ESRI web site has information on GIS technology and downloadable maps. The hazards maps provided on the ESRI site are intended to assist communities in evaluating geographic information about natural hazards. Flood information for most communities is available on the ESRI web site. Visit www.esri.com for more information.

Hazard Assessment

Hazard Identification
Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain (i.e., the area at risk from flooding); (2) the intensity of the flooding that can be expected in specific areas of the floodplain; and (3) the probability of occurrence of flood events. This process usually results in the creation of a floodplain map. Floodplain maps provide detailed information that can assist jurisdictions in making policies and land-use decisions.

Data Sources
The Flood Insurance Rate Maps (FIRM) produced by FEMA for the City of Whittier were completed in 1981 and are accurate for today.

Vulnerability Assessment
Vulnerability assessment is the second step of flood-hazard assessment. It combines the floodplain boundary, generated through hazard identification, with an inventory of the property within the floodplain. Understanding the population and property exposed to natural hazards will assist in reducing risk and preventing loss from future events. Because site-specific inventory data and inundation levels given for a particular flood

event (10-year, 25-year, 50-year, 100-year, 500-year) are not readily available, calculating a community's vulnerability to flood events is not straightforward. The amount of property in the floodplain, as well as the type and value of structures on those properties, should be calculated to provide a working estimate for potential flood losses.

Approximately $20 million dollars worth of property is estimated to be located with the City of Whittier's 100-year floodplain, including 7 acres containing 27 tax lots. This represents 0.07% of the City's total area. The acres are all residential, except for the Friendly Hills Golf Country Club. No critical facilities are included (See Table 4-2).

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 flooding event.

Risk Analysis

Risk analysis is the third and most advanced phase of a hazard assessment. It builds upon the hazard identification and vulnerability assessment. A flood risk analysis for the City of Whittier should include two components: (1) the life and value of property that may incur losses from a flood event (defined through the vulnerability assessment); and (2) the number and type of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The data used to develop these models is based on hydrological analysis of landscape features. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event.

Using GIS technology and flow velocity models, it is possible to map the damage that can be expected from flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties. At the time of publication of this plan, data was insufficient to conduct a risk analysis for flood events in the City of Whittier. However, the current mapping projects will result in better data that will assist in understanding risk. This plan includes recommendations for building partnerships that will support the development of a flood risk analysis in the City of Whittier.

Community Flood Issues

What is Susceptible to Damage during a Flood Event?

The largest impact on communities from flood events is the loss of life and property. During certain years, property losses resulting from flood damage are extensive. Development in the floodplains of the City of Whittier will continue to be at risk from flooding because flood damage occurs on a regular basis throughout the county. Property loss from floods strikes both private and public property. Losses in the City of Whittier over the past 12 years have totaled approximately $250,000.

Property Loss Resulting from Flooding Events
The type of property damage caused by flood events depends on the depth and velocity of the flood waters. Faster moving flood waters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive damage can be caused by basement flooding and landslide damage related to soil saturation from flood events. Most flood damage is caused by water saturating materials susceptible to loss (i.e., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances). In many cases, flood damage to homes renders them unlivable.

Mobilehomes
Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61 % were mobile homes and trailers. Many older mobilehome parks are located in floodplain areas. Mobilehomes have a lower level of structural stability than stick-built homes, and must be anchored to provide additional structural stability during flood events. Because of confusion in the late 1980s resulting from multiple changes in NFIP regulations, there are some communities that do not actively enforce anchoring requirements. Lack of enforcement of mobilehome construction standards in floodplains can contribute to severe damages from flood events.

According to the City of Whittier Planning Division, none of the three mobile home parks in the City have any portion of their property in the 100-year floodplain.

Business/Industry
Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close a business for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Public Infrastructure
Publicly owned facilities are a key component of daily life for all citizens of the county. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as craft public policy that reduces risk to private property from flood events.

Roads
During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Roads systems in the City of Whittier are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Road networks often traverse floodplain and floodway areas. Transportation agencies responsible for road maintenance are typically aware of roads at risk from flooding.

Bridges
Bridges are key points of concern during flood events because they are important links in road networks, river crossings, and they can be obstructions in watercourses, inhibiting the flow of water during flood events. The bridges in the City of Whittier are county, city or privately owned. A county inspector must inspect all state, county, and city bridges every two years. Private bridges are inspected annually by private structural engineers, and the reports are submitted to the City Building Official.

Storm Water Systems
Local drainage problems occur within the City of Whittier. There is a Storm Drain Atlas, and the City of Whittier public works staff is aware of local drainage threats. The problems are present where storm water runoff enters culverts or goes underground into storm drains. Inadequate maintenance can also contribute to the flood hazard in urban areas.

Water/Wastewater Treatment Facilities
The City of Whittier provides water to the residents as part of City services. Certain parts of the City are served by Suburban Water or the San Gabriel Valley Water Company.

Water Quality
Environmental quality control includes monitoring for bacteria, toxins, and pollution.

Flood Endnotes

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1. http://www.lalc.k12.ca.us/target/units/river/tour/hist.html

2. Gumprecht, Blake, 1999, Johns Hopkins University Press, Baltimore, MD.

3. Ibid

4. http://www.usc.edu/isd/archives/la/scandals/st_francis_dam.html

5. http://www.latimes.com/news/local/surroundings/la-me-surround11dec11,0,1754871.story?coll=la-adelphia-right-rail

6. http://www.fema.gov/rrr/talkdiz/landslide.shtm#what

Section 7: Wildland/Urban Interface Fire Hazards in the City of Whittier

Table of Contents

Table of Contents

Why are Wildfires a Threat to Southern California?

For thousands of years, fires have been a natural part of the ecosystem in Southern California. However, wildfires present a substantial hazard to life and property in communities built within or adjacent to hillsides and mountainous areas. There is a huge potential for losses due to wildland/urban interface fires in Southern California. According to the California Division of Forestry (CDF), there were over seven thousand reportable fires in California in 2003, with over one million acres burned.[1] According to CDF statistics, in the October 2003 Firestorms, over 4,800 homes were destroyed and 22 lives were lost.[2]

The urbanized areas of the City located in the Wildland/Urban Interface area face a low-moderate threat from wildfires. The vulnerable areas are not isolated or inaccessible to emergency crews, decreasing the likelihood of a catastrophic wildfire.

The 2003 Southern California Fires

The fall of 2003 marked 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 7-1: October 2003 Firestorm Statistics

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

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

Historic Fires in Southern California

Large fires have been part of the Southern California landscape for millennia. "Written documents reveal that during the 19th century human settlement of southern California altered the fire regime of coastal California by increasing the fire frequency. This was an era of very limited fire suppression, and yet like today, large crown fires covering tens of thousands of acres were not uncommon. One of the largest fires in Los Angeles County (60,000 acres) occurred in 1878, and the largest fire in Orange County's history, in 1889, was over half a million acres."[3]

Table 7-2: Large Historic Fires in California 1961-2003

20 Largest California Wildland Fires (Structures Destroyed)

	Fire Name	Date	County	Acres	Structures	Deaths
1	Tunnel	October 1991	Alameda	1,600	2,900	25
2	Cedar	October 2003	San Diego	273,246	2,820	14
3	Old	October 2003	San Bernardino	91,281	1,003	6
4	Jones	October 1999	Shasta	26,200	954	1
5	Paint	June 1990	Santa Barbara	4,900	641	1
6	Fountain	August 1992	Shasta	63,960	636	0
7	City of Berkeley	September 1923	Alameda	130	584	0
8	Bel Air	November 1961	Los Angeles	6,090	484	0
9	Laguna Fire	October 1993	Orange	14,437	441	0
10	Paradise	October 2003	San Diego	56,700	415	2
11	Laguna	September 1970	San Diego	175,425	382	5
12	Panorama	November 1980	San Bernardino	23,600	325	4
13	Topanga	November 1993	Los Angeles	18,000	323	3
14	49er	September 1988	Nevada	33,700	312	0
15	Simi	October 2003	Ventura	108,204	300	0
16	Sycamore	July 1977	Santa Barbara	805	234	0
17	Canyon	September 1999	Shasta	2,580	230	0
18	Kannan	October 1978	Los Angeles	25,385	224	0
19	Kinneloa	October 1993	Los Angeles	5,485	196	1
19	Grand Prix	October 2003	San Bernardino	59,448	196	0
20	Old Gulch	August 1992	Calaveras	17,386	170	0

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

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

A compilation of the fire history since 1967 within the Puente Hills Landfill Native Habitat Preservation area, north of the Whittier City limits, is included as Table 7-3. Fires that occurred in the hills north of Whittier are in bold print.

Table 7-3: Fire History within the Puente Hills Landfill Native Habitat Preservation Authority Area, 1967-2004

#	*LOCATION*	*DATE*	*ACREAGE*
1	TURNBULL CANYON - ROSE HILLS- (Unincorp)	10-15-67	1741
2	SCHABARUM PARK - EAST SIDE (Rowland Heights)	10-08-67	245
3	MALLAS - SEVENTH AVE. (Hacienda Heights)	07-25-68	107
4	AERA - HARBOR TO 57 FWY (Rowland Heights)	09-27-70	3381
5	HACIENDA BLVD/SKYLINE RD. (La Habra Heights)	09-27-70	176
6	**UNOCAL (Whittier)**	09-28-70	323
7	SCHABARUM PARK - WEST SIDE (Hacienda Heights)	07-01-76	310
8	POWDER CANYON (La Habra Heights)	08-17-78	124
9	**CHEVRON / UNOCAL (Whittier)**	09-16-79	886
10	AERA / 57 FREEWAY (Rowland Heights)	07-30-81	197
11	TURNBULL CANYON – (Hacienda Heights)	07-03-89	1229
12	**CHEVRON - PRESCRIBED BURNS (Whittier)**	1998-1999	247
13	TURNBULL CANYON - ROSE HILLS -(Unincorp)	1998	10
14	MALLAS - SEVENTH AVE. (Hacienda Heights)	1998	1/8
15	**LAS PALOMAS (Whittier)**	1999	1
16	HACIENDA RD/ BUDDHIST TEMPLE (La Habra Heights)	08-1999	1
17	FLAT TOP (La Habra Heights)	07-05-01	1/4
18	POWDER CANYON (La Habra Heights)	11-08-01	1/8
19	POWDER CANYON (La Habra Heights)	11-20-01	8
20	**HELLMAN PARK (Whittier)**	05-11-02	3
21	**TURNBULL CANYON – ORLAERTS (Whittier)**	07-05-03	8
22	SKYLINE / TURNBULL (Hacienda Heights)	05-2003	1/8
23	**HELLMAN PARK (Whittier)**	08-2003	2

24	**COLIMA – UNOCAL (Whittier)**	12-2003	1/8

During the 2002 fire season, more than 6.9 million acres of public and private lands burned in the US, resulting in loss of property, damage to resources and disruption of community services.[4] Taxpayers spent more than $1.6 billion[5] to combat more than 88,400 fires nationwide. Many of these fires burned in wildland/urban interface areas and exceeded the fire suppression capabilities of those areas. Table 7-4 illustrates fire suppression costs for state, private and federal lands.

Table 7-4: National Fire Suppression Costs

Year	Suppression Costs	Acres Burned	Structures Burned
2000	$1.3 billion	8,422,237	861
2001	$0.5 billion	3,570,911	731
2002	$1.6 billion	6,937,584	815

http://research.yale.edu/gisf/assets/pdf/ppf/wildfire_report.pdf

Wildfires in the City of Whittier

In the fall of 1967, hills near Whittier College experienced wildfire that advanced to one hill away from the College. There was severe smoke and roads were closed, but there were no structures involved. In the early 1980's, Turnbull Canyon in the Puente Hills experienced wildfire, but no homes were lost. Turnbull Canyon again experienced wildfire in 1990. The houses that were lost were in the unincorporated county area of Hacienda Heights.

Wildfire Characteristics

There are three categories of interface fire:[6] 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.

> "Past fire suppression is not to blame for causing large shrub land wildfires, nor has it proven effective in halting them." said Dr. Jon Keeley, a USGS fire

> researcher who studies both southern California shrub lands and Sierra Nevada forests. "Under Santa Ana conditions, fires carry through all chaparral regardless of age class. Therefore, prescribed burning programs over large areas to remove old stands and maintain young growth as bands of firebreaks resistant to ignition are futile at stopping these wildfires."[7]

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.

> "When Lewis and Clark explored the Northwest, the forests were relatively open, with 20 to 25 mature trees per acre. Periodically, lightning would start fires that would clear out underbrush and small trees, renewing the forests. Today's forests are completely different, with as many as 400 trees crowded onto each acre, along with thick undergrowth. This density of growth makes forests susceptible to disease, drought and severe wildfires. Instead of restoring forests, these wildfires destroy them and it can take decades to recover. This radical change in our forests is the result of nearly a century of well-intentioned but misguided management."[8]

The Interface

One challenge Southern California faces regarding the wildfire hazard is from the increasing number of houses being built on the urban/wildland interface. Every year the growing population has expanded further and further into the hills and mountains, including forest lands. The increased "interface" between urban/suburban areas and the open spaces created by this expansion has produced a significant increase in threats to life and property from fires and has pushed existing fire protection systems beyond original or current design and capability. Property owners in the interface oftentimes 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."[9]

> "The vegetation of chaparral communities has evolved to a point it requires fire to spawn regeneration. Many species invite fire through the production of plant materials with large surface-to-volume ratios, volatile oils and through periodic die-back of vegetation. These species have further adapted to possess special reproductive mechanisms following fire. Several species produce vast quantities of seeds which lie dormant until fire triggers 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."[10]

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. Residents living adjacent to open space need to adhere to not only the Los Angeles County Fire Department's brush clearance requirements, but also the County's Fuel Modification Plan Guidelines that indicate the appropriate plant species for landscaping.

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.[11] High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The so-called "Santa Ana" winds, which are heated by compression as they flow down to Southern California from Utah, create a particularly high risk, as they can rapidly spread what might otherwise be a small fire.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term drought is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance. Unusually dry winters, or significantly less rainfall than normal, can lead to relatively drier conditions and leave reservoirs and water tables lower. Drought leads to problems with irrigation and may contribute to additional fires, or additional difficulties in fighting fires.

Development

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

Wildfire Hazard Assessment

Wildfire Hazard Identification

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

The type of structures that would be affected by a wildfire in the City of Whittier would depend on the extent of the fire. The immediate wildland/urban interface is residential. The Los Angeles County Fire Department's map (Map 7-1) of the very high fire hazard severity zone includes commercial structures and public facilities as well. However, neither of the City's two hospitals is in the zone (see Table 4-2).

Data were not available to conduct an impact assessment on Whittier damages associated with wildfire.

Table 7-5 illustrates a rating system to identify wildfire hazard risk (with a score of 3 equaling the most danger and a score of 1 equaling the least danger.)

Table 7-5: Sample Hazard Identification Rating System

Category	Indicator	Rating
Roads and Signage	Steep; narrow; poorly signed	3

	One or two of the above	2
	Meets all requirements	1
Water Supply	None, except domestic	3
	Hydrant, tank, or pool over 500 feet away	2
	Hydrant, tank, or pool within 500 feet	1
Location of the Structure	Top of steep slope with brush/grass below	3
	Mid-slope with clearance	2
	Level with lawn, or watered groundcover	1
Exterior Construction	Combustible roofing, open eaves, Combustible siding	3
	One or two of the above	2
	Non-combustible roof, boxed eaves, non-combustible siding	1

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

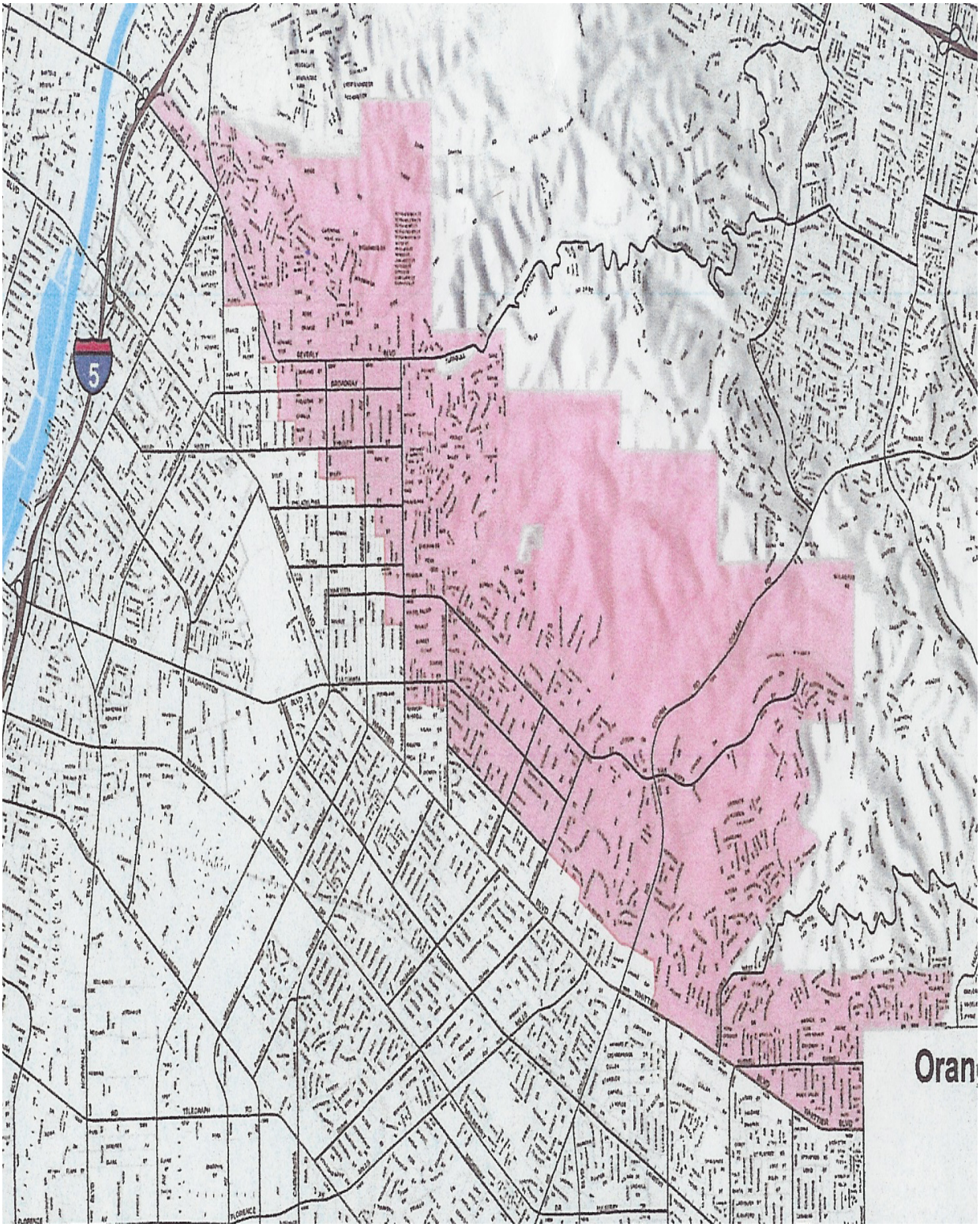
Topographic location, characteristics and fuels
Site/building construction and design
Site/region fuel profile (landscaping)
Defensible space
Accessibility
Fire protection response
Water availability

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.

Wildland/Urban Interface Areas

The shaded area of Map 7-1 is considered to be the very high fire hazard severity zone by the Los Angeles County Fire Department. The actual wildland/urban interface area would be just south of the open, undeveloped areas shown on the map. The City is considered “built-out,” which means that the streets shown in the shaded area of the map have structures that could be impacted in the event of a hillside wildfire that spread south.

Map 7-1: Wildland / Urban Interface Areas Impacting the City of Whittier (Source: Los Angeles County Fire Department – Forestry Division) (Note: A larger version of map is available at City Hall)



Vulnerability and Risk
Southern California residents are served by a variety of local fire departments as well as county, state and federal fire resources. Data that includes the location of interface areas in the county can be used to assess the population and total value of property at risk from wildfire and direct these fire agencies in fire prevention and response.

Key factors included in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence and weather, as well as occurrences of drought.

The National Wildland/Urban Fire Protection Program has developed the Wildland/Urban Fire Hazard Assessment Methodology tool for communities to assess their risk to wildfire. For more information on wildfire hazard assessment refer to http://www.Firewise.org.

Community Wildfire Issues

What is Susceptible to Wildfire?

Growth and Development in the Interface
The hills and mountainous areas of Southern California are considered to be interface areas. The development of homes and other structures is encroaching onto the wildlands and is expanding the wildland/urban interface. The interface neighborhoods are characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation and natural fuels.

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

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

In Whittier, the vulnerable areas are not isolated or inaccessible to emergency crews, thus decreasing the likelihood of a catastrophic wildfire.

Disruption of Critical and Essential 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 during a wildfire event.

Road Access
Road access is a major issue for all emergency service providers. As development encroaches into the rural areas of the county, the number of houses without adequate turn-around space is increasing. In many areas, there is not adequate space for emergency vehicle turnarounds in single-family residential neighborhoods, causing emergency workers to have difficulty doing their jobs because they cannot access houses. As fire trucks are large, firefighters are challenged by narrow roads and limited access. When there is inadequate turn around space, the fire fighters can only work to remove the occupants, but cannot safely remain to save the threatened structures.

Water Supply
Fire fighters in remote and rural areas are faced by limited water supply and lack of hydrants. Rural areas are characteristically outfitted with small diameter pipe water systems, inadequate for providing sustained fire fighting flows.

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

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

Wildfire Endnotes

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

[2] http://www.fire.ca.gov/php/fire_er_content/downloads/2003LargeFires.pdf

[3] http://www.usgs.gov/public/press/public_affairs/press_releases/pr1805m.html

[4] http://www.nifc.gov/stats/wildlandfirestats.html

[5] http://research.yale.edu/gisf/assets/pdf/ppf/wildfire_report.pdf

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

[7] http://www.usgs.gov/public/press/public_affairs/press_releases/pr1805m.html

[8] Overgrown Forests Require Preventive Measures, By Gale A. Norton (Secretary of the Interior), USA Today Editorial, August 21, 2002

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

[10] Ibid

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

Appendix A - Resources

Master Resource Directory

The Resource Directory provides contact information for local, regional, state, and federal programs that are currently involved in hazard mitigation activities. The Hazard Mitigation Advisory Committee may look to the organizations on the following pages for resources and technical assistance. The Resource Directory provides a foundation for potential partners in action item implementation.

The Hazard Mitigation Advisory Committee will continue to add contact information for organizations currently engaged in hazard mitigation activities. This section may also be used by various community members interested in hazard mitigation information and projects.

Advisory Council on Historic Preservation, Western Office of Project Review			
Level: Region	Hazard: Multi	Email address: achp@achp.gov	
12136 Bayaud Ave.		Suite 300	
Lakeview, CO 80228		Ph: 303-969-5110	Fx: 303-969-5115

American Public Works Association			
Level: National	Hazard: Multi	http://www.apwa.net	
2345 Grand Boulevard		Suite 500	
Kansas City, MO 64108-2641		Ph: 816-472-6100	Fx: 816-472-1610
Notes: The American Public Works Association is an international educational and professional association of public agencies, private sector companies, and individuals dedicated to providing high quality public works goods and services.			

Association of State Floodplain Managers			
Level: Federal	Hazard: Flood	www.floods.org	
2809 Fish Hatchery Road			
Madison, WI 53713		Ph: 608-274-0123	Fx:
Notes: The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery			

Building Seismic Safety Council (BSSC)			
Level: National	Hazard: Earthquake	www.bssconline.org	
1090 Vermont Ave., NW		Suite 700	
Washington, DC 20005		Ph: 202-289-7800	Fx: 202-289-109
Notes: The Building Seismic Safety Council (BSSC) develops and promotes building earthquake risk mitigation regulatory provisions for the nation.			
California Department of Transportation (CalTrans)			
Level: State	Hazard: Multi	http://www.dot.ca.gov/	
120 S. Spring Street			
Los Angeles, CA 90012		Ph: 213-897-3656	Fx:
Notes: CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, as well as that portion of the Interstate Highway System within the state's boundaries. Alone and in partnership with Amtrak, Caltrans is also involved in the support of intercity passenger rail service in California.			
California Resources Agency			
Level: State	Hazard: Multi	http://resources.ca.gov/	
1416 Ninth Street		Suite 1311	
Sacramento, CA 95814		Ph: 916-653-5656	Fx:
Notes: The California Resources Agency restores, protects and manages the state's natural, historical and cultural resources for current and future generations using solutions based on science, collaboration and respect for all the communities and interests involved.			
California Division of Forestry (CDF)			
Level: State	Hazard: Multi	http://www.fire.ca.gov/php/index.php	
210 W. San Jacinto			
Perris CA 92570		Ph: 909-940-6900	Fx:
Notes: The California Department of Forestry and Fire Protection protects over 31 million acres of California's privately-owned wildlands. CDF emphasizes the management and protection of California's natural resources.			

California Division of Mines and Geology (DMG)			
Level: State	Hazard: Multi	www.consrv.ca.gov/cgs/index.htm	
801 K Street		MS 12-30	
Sacramento, CA 95814		Ph: 916-445-1825	Fx: 916-445-5718
Notes: The California Geological Survey develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources.			
California Environmental Resources Evaluation System (CERES)			
Level: State	Hazard: Multi	http://ceres.ca.gov/	
900 N St.		Suite 250	
Sacramento, Ca. 95814		Ph: 916-653-2238	Fx:
Notes: CERES is an excellent website for access to environmental information and websites.			
California Department of Water Resources (DWR)			
Level: State	Hazard: Flood	http://wwwdwr.water.ca.gov	
1416 9th Street			
Sacramento, CA 95814		Ph: 916-653-6192	Fx:
Notes: The Department of Water Resources manages the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments.			
California Department of Conservation: Southern California Regional Office			
Level: State	Hazard: Multi	www.consrv.ca.gov	
655 S. Hope Street		#700	
Los Angeles, CA 90017-2321		Ph: 213-239-0878	Fx: 213-239-0984
Notes: The Department of Conservation provides services and information that promote environmental health, economic vitality, informed land-use decisions and sound management of our state's natural resources.			

California Planning Information Network			
Level: State	Hazard: Multi	www.calpin.ca.gov	
		Ph:	Fx:
Notes: The Governor's Office of Planning and Research (OPR) publishes basic information on local planning agencies, known as the California Planners' Book of Lists. This local planning information is available on-line with new search capabilities and up-to-the- minute updates.			
California Preservation Foundation			
Level: State	Hazard: Multi	E-mail: cpf@californiapreservation.org	
5 Third Street		Suite 424	
San Francisco, CA 94103		Ph: 415-495-0349	Fx: 415-495-0265
EPA, Region 9			
Level: Regional	Hazard: Multi	http://www.epa.gov/region09	
75 Hawthorne Street			
San Francisco, CA 94105		Ph: 415-947-8000	Fx: 415-947-3553
Notes: The mission of the U.S. Environmental Protection Agency is to protect human health and to safeguard the natural environment through the themes of air and global climate change, water, land, communities and ecosystems, and compliance and environmental stewardship.			
Federal Emergency Management Agency, Region IX			
Level: Federal	Hazard: Multi	www.fema.gov	
1111 Broadway		Suite 1200	
Oakland, CA 94607		Ph: 510-627-7100	Fx: 510-627-7112
Notes: The Federal Emergency Management Agency is tasked with responding to, planning for, recovering from and mitigating against disasters.			
Federal Emergency Management Agency, Mitigation Division			
Level: Federal	Hazard: Multi	www.fema.gov/fima/planhowto.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			

Floodplain Management Association			
Level: Federal	Hazard: Flood	www.floodplain.org	
P.O. Box 50891			
Sparks, NV 89435-0891		Ph: 775-626-6389	Fx: 775-626-6389
Notes: The Floodplain Management Association is a nonprofit educational association. It was established in 1990 to promote the reduction of flood losses and to encourage the protection and enhancement of natural floodplain values. Members include representatives of federal, state and local government agencies as well as private firms.			

Gateway Cities Partnership			
Level: Regional	Hazard: Multi	www.gatewaycities.org	
7300 Alondra Boulevard		Suite 202	
Paramount, CA 90723		Ph: 562-817-0820	Fx:
Notes: Gateway Cities Partnership is a 501 C 3 non-profit Community Development Corporation for the Gateway Cities region of southeast LA County. The region comprises 27 cities that roughly speaking extends from Montebello on the north to Long Beach on the South, the Alameda Corridor on the west to the Orange County line on the east.			

Governor's Office of Emergency Services (OES)			
Level: State	Hazard: Multi	www.oes.ca.gov	
P.O. Box 419047			
Rancho Cordova, CA 95741-9047		Ph: 916 845- 8911	Fx: 916 845- 8910
Notes: The Governor's Office of Emergency Services coordinates overall state agency response to major disasters in support of local government. The office is responsible for assuring the state's readiness to respond to and recover from natural, manmade, and war-caused emergencies, and for assisting local governments in their emergency preparedness, response and recovery efforts.			

Landslide Hazards Program, USGS			
Level: Federal	Hazard: Landslide	http://landslides.usgs.gov/index.html	
12201 Sunrise Valley Drive		MS 906	
Reston, VA 20192		Ph: 703-648- 4000	Fx:
Notes: The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.			

Los Angeles County Economic Development Corporation			
Level: Regional	Hazard: Multi	www.laedc.org	
444 S. Flower Street		34th Floor	
Los Angeles, CA 90071		Ph: 213-236-4813	Fx: 213- 623-0281
Notes: The LAEDC is a private, non-profit 501 (c) 3 organization established in 1981 with the mission to attract, retain and grow businesses and jobs in the Los Angeles region. The LAEDC is widely relied upon for its Southern California Economic Forecasts and Industry Trend Reports. Lead by the renowned Jack Kyser (Sr. Vice President, Chief Economist) his team of researchers produces numerous publications to help business, media and government navigate the LA region's diverse economy.			
Los Angeles County Public Works Department			
Level: County	Hazard: Multi	http://ladpw.org	
900 S. Fremont Ave.			
Alhambra, CA 91803		Ph: 626-458-5100	Fx:
Notes: The Los Angeles County Department of Public Works protects property and promotes public safety through Flood Control, Water Conservation, Road Maintenance, Bridges, Buses and Bicycle Trails, Building and Safety, Land Development, Waterworks, Sewers, Engineering, Capital Projects and Airports			
National Wildland/Urban Interface Fire Program			
Level: Federal	Hazard: Wildfire	www.firewise.org/	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617 770-0700
Notes: FIREWISE maintains a Website designed for people who live in wildfire- prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.			
National Resources Conservation Service			
Level: Federal	Hazard: Multi	http://www.nrcs.usda.gov/	
14th and Independence Ave., SW		Room 5105-A	
Washington, DC 20250		Ph: 202-720-7246	Fx: 202-720-7690
Notes: NRCS assists owners of America's private land with conserving their soil, water, and other natural resources, by delivering technical assistance based on sound science and suited to a customer's specific needs. Cost shares and financial incentives are available in some cases.			

National Interagency Fire Center (NIFC)			
Level: Federal	Hazard: Wildfire	www.nifc.gov	
3833 S. Development Ave.			
Boise, Idaho 83705-5354		Ph: 208-387- 5512	Fx:
Notes: The NIFC in Boise, Idaho is the nation's support center for wildland firefighting. Seven federal agencies work together to coordinate and support wildland fire and disaster operations.			

National Fire Protection Association (NFPA)			
Level: National	Hazard: Wildfire	http://www.nfpa.org/catalog/home/index.asp	
1 Batterymarch Park			
Quincy, MA 02169-7471		Ph: 617-770-3000	Fx: 617 770-0700
Notes: The mission of the international nonprofit NFPA is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating scientifically-based consensus codes and standards, research, training and education			

National Floodplain Insurance Program (NFIP)			
Level: Federal	Hazard: Flood	www.fema.gov/nfip/	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Mitigation Division manages the National Flood Insurance Program and oversees FEMA's mitigation programs. It has of a number of programs and activities providing citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			

National Oceanic /Atmospheric Administration			
Level: Federal	Hazard: Multi	www.noaa.gov	
14th Street & Constitution Ave NW		Rm 6013	
Washington, DC 20230		Ph: 202-482-6090	Fx: 202-482-3154
Notes: NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.			

National Park Service			
Level: Federal	Hazard: Multi	www.insidenps.gov	
P.O. Box 37127			
Washington DC 20013-7127		Ph: 202-208-4621	Fx: 202-208-7889
National Trust			
Level: Federal	Hazard: Multi	www.nationaltrust.org	
One Sutter Street		Suite 707	
San Francisco, CA 94104		Ph: 415-956-0610	Fx: 415-956-0837
National Weather Service, Office of Hydrologic Development			
Level: Federal	Hazard: Flood	http://www.nws.noaa.gov/	
1325 East West Highway		SSMC2	
Silver Spring, MD 20910		Ph: 301-713-1658	Fx: 301-713-0963
Notes: The Office of Hydrologic Development (OHD) enhances National Weather Service (NWS) products by: infusing new hydrologic science, developing hydrologic techniques for operational use, managing hydrologic development by NWS field office, providing advanced hydrologic products to meet needs identified by NWS customers			
National Weather Service			
Level: Federal	Hazard: Multi	http://www.nws.noaa.gov/	
520 North Elevar Street			
Oxnard, CA 93030		Ph: 805-988- 6615	Fx:
Notes: The National Weather Service is responsible for providing weather service to the nation. It is charged with the responsibility of observing and reporting the weather and with issuing forecasts and warnings of weather and floods in the interest of national safety and economy. Briefly, the priorities for service to the nation are: 1. protection of life, 2. protection of property, and 3. promotion of the nation's welfare and economy.			

San Gabriel Valley Economic Partnership			
Level: Regional	Hazard: Multi	www.valleynet.org	
4900 Rivergrade Road		Suite A310	
Irwindale, CA 91706		Ph: 626-856-3400	Fx: 626-856-5115
Notes: The San Gabriel Valley Economic Partnership is a non-profit corporation representing both public and private sectors. The Partnership is the exclusive source for San Gabriel Valley-specific information, expertise, consulting, products, services, and events. It is the single organization in the Valley with the mission to sustain and build the regional economy for the mutual benefit of all thirty cities, chambers of commerce, academic institutions, businesses and residents.			

Sanitation Districts of Los Angeles County			
Level: County	Hazard: Flood	http://www.lacsd.ora/	
1955 Workman Mill Road			
Whittier, CA 90607		Ph:562-699-7411 x2301	Fx:
Notes: The Sanitation Districts provide wastewater and solid waste management for over half the population of Los Angeles County and turn waste products into resources such as reclaimed water, energy, and recyclable materials.			

Santa Monica Mountains Conservancy			
Level: Regional	Hazard: Multi	http://smmc.ca.gov/	
570 West Avenue Twenty-Six		Suite 100	
Los Angeles, CA 90065		Ph: 323-221-8900	Fx:
Notes: The Santa Monica Mountains Conservancy helps to preserve over 55,000 acres of parkland in both wilderness and urban settings, and has improved more than 114 public recreational facilities throughout Southern California.			

South Coast Air Quality Management District (AQMD)			
Level: Regional	Hazard: Multi	www.aqmd.gov	
21865 E. Copley Drive			
Diamond Bar, CA 91765		Ph: 800-CUT-SMOG	Fx:
Notes: AQMD is a regional government agency that seeks to achieve and maintain healthful air quality through a comprehensive program of research, regulations, enforcement, and communication. The AQMD covers Los Angeles and Orange Counties and parts of Riverside and San Bernardino Counties.			

Southern California Earthquake Center (SCEC)			
Level: Regional	Hazard: Earthquake	www.scec.org	
3651 Trousdale Parkway		Suite 169	
Los Angeles, CA 90089-0742		Ph: 213-740-5843	Fx: 213/740-0011
Notes: The Southern California Earthquake Center (SCEC) gathers new information about earthquakes in Southern California, integrates this information into a comprehensive and predictive understanding of earthquake phenomena, and communicates this understanding to end-users and the general public in order to increase earthquake awareness, reduce economic losses, and save lives.			
Southern California Association of Governments (SCAG)			
Level: Regional	Hazard: Multi	www.scag.ca.gov	
818 W. Seventh Street		12th Floor	
Los Angeles, CA 90017		Ph: 213-236-1800	Fx: 213-236-1825
Notes: The Southern California Association of Governments functions as the Metropolitan Planning Organization for six counties: Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial. As the designated Metropolitan Planning Organization, the Association of Governments is mandated by the federal government to research and draw up plans for transportation, growth management, hazardous waste management, and air quality.			
State Fire Marshal (SFM)			
Level: State	Hazard: Wildfire	http://osfm.fire.ca.gov	
1131 "S" Street			
Sacramento, CA 95814		Ph: 916-445-8200	Fx: 916-445-8509
Notes: The Office of the State Fire Marshal (SFM) supports the mission of the California Department of Forestry and Fire Protection (CDF) by focusing on fire prevention. SFM regulates buildings in which people live, controls substances which may, cause injuries, death and destruction by fire; provides statewide direction for fire prevention within wildland areas; regulates hazardous liquid pipelines; reviews regulations and building standards; and trains and educates in fire protection methods and responsibilities.			
State Historic Preservation Office			
Level: State	Hazard: Multi	www.ohp.parks.ca.gov	
P.O. Box 942896			
Sacramento, CA 94296-0001		Ph: 916-653-5789	Fx: 916-653-9824

The Community Rating System (CRS)			
Level: Federal	Hazard: Flood	http://www.fema.gov/nfip/crs.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within the County would receive reduced NFIP flood insurance premiums if the County implements floodplain management practices that qualify it for a CRS rating. For further information on the CRS, visit FEMA's website.			
United States Geological Survey			
Level: Federal	Hazard: Multi	http://www.usgs.gov/	
345 Middlefield Road			
Menlo Park, CA 94025		Ph: 650-853-8300	Fx:
Notes: The USGS provides reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.			
U.S. Army Corps of Engineers			
Level: Federal	Hazard: Multi	http://www.usace.army.mil	
P.O. Box 532711			
Los Angeles CA 90053- 2325		Ph: 213-452- 3921	Fx:
Notes: The United States Army Corps of Engineers work in engineering and environmental matters. A workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals provide engineering services to the nation including planning, designing, building and operating water resources and other civil works projects.			
USDA Forest Service			
Level: Federal	Hazard: Wildfire	http://www.fs.fed.us	
1400 Independence Ave. SW			
Washington, D.C. 20250-0002		Ph: 202-205-8333	Fx:
Notes: The Forest Service is an agency of the U.S. Department of Agriculture. The Forest Service manages public lands in national forests and grasslands.			

USGS Water Resources			
Level: Federal	Hazard: Multi	www.water.usgs.gov	
6000 J Street		Placer Hall	
Sacramento, CA 95819-6129		Ph: 916-278-3000	Fx: 916-278-3070
Notes: The USGS Water Resources mission is to provide water information that benefits the Nation's citizens: publications, data, maps, and applications software.			
Western States Seismic Policy Council (WSSPC)			
Level: Regional	Hazard: Earthquake	www.wsspc.org/home.html	
125 California Avenue		Suite D201, #1	
Palo Alto, CA 94306		Ph: 650-330-1101	Fx: 650-326-1769
Notes: WSSPC is a regional earthquake consortium funded mainly by FEMA. Its website is a great resource, with information clearly categorized - from policy to engineering to education.			
Westside Economic Collaborative C/O Pacific Western Bank			
Level: Regional	Hazard: Multi	http://www.westside-Ia.or	
120 Wilshire Boulevard			
Santa Monica, CA 90401		Ph: 310-458-1521	Fx: 310-458-6479
Notes: The Westside Economic Development Collaborative is the first Westside regional economic development corporation. The Westside EDC functions as an information gatherer and resource center, as well as a forum, through bringing business, government, and residents together to address issues affecting the region: Economic Diversity, Transportation, Housing, Workforce Training and Retraining, Lifelong Learning, Tourism, and Embracing Diversity.			

Appendix B:

The Public Participation

Public participation is a key component to any strategic planning process. It is very important that such broad-reaching plans not be written in isolation. Agency participation offers an opportunity for impacted departments and organizations to provide expertise and insight into the planning process. Citizen participation offers citizens the chance to voice their ideas, interests, and opinions. The Federal Emergency Management Agency also requires public input during the development of mitigation plans.

The City of Whittier Natural Hazards Mitigation Plan integrates a cross-section of public input throughout the planning process. To accomplish this goal, the City of Whittier Hazard Mitigation Planning Team developed a public participation process through five components: (1) developing a Planning Team comprised of knowledgeable individuals representative of the City, City of Santa Fe Springs, Little Lake City School District, East Whittier City School District, Whittier Union High School District, and Whittier City School District; (2) conducting a survey of "Levels of Concerns" to verify the primary concerns of citizens and business owners as relates to natural hazards; (3) soliciting the assistance of local media representatives and community newsletters to announce the progress of the planning activities and to announce the availability of the Draft Natural Hazards Mitigation Plan including posting the Draft Plan on the City's website; (4) creating opportunities for the citizens and public agencies to review the Draft Natural Hazards Mitigation Plan; (5) conducting public meetings (Planning Commission, Historical Resources Commission, and City Council) where the public had an opportunity to express their views concerning the Draft Natural Hazards Mitigation Plan.

Integrating public participation during the development of the City of Whittier Natural Hazards Mitigation Plan has ultimately resulted in increased public awareness. Through public involvement, the mitigation plan reflects community issues, concerns, and new ideas and perspectives on mitigation opportunities and plan action items.

Working Group

Hazard mitigation in the City of Whittier is overseen by the Hazard Mitigation Working Group, which consists of representatives from various City departments and the Los Angeles County Fire Department. The Working Group members have an understanding of how the community is structured and how residents, businesses, and the environment may be affected by natural hazard events. The Working Group guided the development of the plan, and assisted in developing plan goals and action items, identifying stakeholders and plan reviewers, and sharing local expertise to create a more comprehensive plan. Many of the Working Group members also participated on the Multi-Jurisdictional Planning Team.

Training and Meetings
Following is a listing of the trainings and meetings attended by City of Whittier staff concerning development of the Natural Hazards Mitigation Plan:

Date:	June 5, 2003
Location:	City of Lynwood
Training By:	State OES
Topic:	Local Hazard Mitigation Planning Program Workshop
Attendees:	Wayne Reynolds, Carl Jules, Carl Reese, Dave Edgell, Joe Dyer

Date:	January 20, 2004
Location:	City of Norwalk Sports Complex
Training By:	Mike Martinet, DMAC
Topic:	Hazard Mitigation Plan
Attendees:	Carl Reese, Don Dooley, Dave Collosi, Ann-Marie Hayashi

Date:	March 1, 2004
Location:	City of Whittier
Training By:	Carolyn Harshman presentation on proposal
Topic:	Presentation on FEMA requirements and proposal
Attendees:	Representatives from Santa Fe Springs, Whittier, and WCSD

Date:	April 2, 2004
Location:	City of Whittier
Training By:	Meeting called by Ann-Marie Hayashi
Topic:	Whittier Working Group, gathering required materials and information
Attendees:	Don Dooley, Joe Dyer, Carl Reese, Howard Miller, Bob Chavez, David Mochizuki, Ann-Marie Hayashi

Date:	April 5, 2004
Location:	Santa Fe Springs
Training By:	Carolyn Harshman
Topic:	Pre-Training – DMA2000
Attendees:	Representatives from all 6 agencies on Planning Team

Date:	April 5, 2004
Location:	Santa Fe Springs
Training By:	Carolyn Harshman
Topic:	Kick-off Planning Team Workshop
Attendees:	Representatives from all 6 agencies on Planning Team

Date: April 20, 2004
Location: Whittier, PIH
Training By: Meeting of Community Disaster Preparedness Planning Committee
Topic: Hazard Mitigation Plan covered by Southern Calif. Edison
Attendees: Representatives from various local agencies and organizations

Date: April 21, 2004
Location: Norwalk Sports Center
Training By: Fan Abel
Topic: Area E Meeting, covered Hazard Mitigation Plans
Attendees: Representatives from Area E Cities

Date: May 19, 2004
Location: Bellflower
Training By: Fan Abel
Topic: Area E Meeting, covered Hazard Mitigation Plans
Attendees: Representatives from Area E Cities

Date: June 8, 2004
Location: East Whittier City School District, Education Center
Training By: Carolyn Harshman
Topic: Hazard Mitigation Actions
Attendees: Representatives from all 6 Planning Team agencies

Date: June 8, 2004
Location: East Whittier City School District, Education Center
Training By: Carolyn Harshman
Topic: Discussed Draft Hazard Analysis; Mitigation Actions & Planning Tools
Attendees: Representatives from all 6 Planning Team agencies

Date: August 2, 2004
Location: Whittier City Hall
Training By: Planning Commission Meeting
Topic: City of Whittier's Working Draft Hazard Mitigation Plan
Attendees: Planning Commission, City staff, the public

Date: August 11, 2004
Location: Whittier City Hall
Training By: Historic Resources Commission Meeting
Topic: City of Whittier's Working Draft Hazard Mitigation Plan
Attendees: City Staff, Historic Resources Commission, the public

Date: August 12, 2004
Location: Whittier City Hall
Training By: Whittier Working Group
Topic: Draft Hazard Mitigation Plan edits and revisions
Attendees: City Staff, L.A. Co. Fire Department

Date: September 14, 2004
Location: Whittier City Hall
Training By: Whittier City Council Meeting
Topic: Recommend Adoption of Draft Hazard Mitigation Plan
Attendees: City Staff, City Council, Carolyn Harshman, the public

Training and Meetings Facilitated by Emergency Planning Consultants
Meeting #1: Pre-Training April 5, 2004
The meeting was hosted by the City of Santa Fe Springs. EPC delivered pre-training to the Planning Team and Working Groups. The pre-training consisted of the history of the Disaster Mitigation Act of 2000, the purpose and role of hazard mitigation, and the planning process. The Pre-Training lasted approximately 2 hours.

Meeting #2: Kick-Off Meeting April 5, 2004
EPC facilitated a workshop where participants had an opportunity to learn about various natural hazards, assess and rank the local threats, examine hazard maps, and complete the FEMA Worksheets contained in FEMA 386-2 Understanding Your Risks. Part of the discussion included a presentation by EPC of historical disaster events across the country. Those slides served as a backdrop for discussing potential mitigation activities.

There was an extensive discussion on various methods of engaging the public in the mitigation process. The Planning Team prepared a draft media release and discussed a public opinion survey provided by EPC. EPC committed to revising the media release and survey and distributing electronic copies to each of the Planning Team entities. The Kick-Off Meeting lasted approximately 7 hours.

Meeting #3 Pre-Training: Mitigation June 8, 2004
The meeting was hosted by the City of Whittier and held at the East Whittier City School District Offices. EPC delivered pre-training to the Planning Team. The pre-training consisted of the concepts and issues related to developing mitigation actions. The pre-training lasted approximately 1 hour.

Meeting #4 Mitigation Actions June 8, 2004
EPC delivered the Draft Hazard Analysis and the Planning Team discussed missing information, data, and maps. EPC distributed copies of the Mitigation Actions Planning Tools to assist the Team in developing Goals and Action Items appropriate to their natural hazards. The Planning Tools provided a process for collecting the mitigation actions presently in practice in the City of Whittier, as well as identifying future mitigation actions.

A brainstorming process was then conducted to develop the goals for the Plan. The entire Multi-Jurisdictional Planning Team quickly agreed to adopt the same mitigation goals. Following a discussion of alternative ranking techniques, the Team agreed to cluster the rankings of the hazards and mitigation actions in the following order: #1 Multi-Hazard, #2 Earthquakes, #3 Flooding, and #4 Wildfire.

The next task was to examine a FEMA-approved Mitigation Plan to get an idea of how mitigation actions are written. Each of the jurisdictions was pleased to announce the broad range of mitigation actions already being practiced. The Planning Tools, developed by EPC, consisted of nearly 300 mitigation actions gathered from dozens of Mitigation Plans across the country.

The Planning Team broke into individual jurisdictions to develop their own mitigation actions, utilizing the sample plans and Planning Tools list. Because of the plan samples and Tools, the process of identifying appropriate mitigations actions was accomplished in a very efficient manner.

Throughout the planning process, the consultant reminded the Planning Team of the importance of considering Benefit/Cost issues including: social issues, political realities, economic benefits, and environmental concerns.

Public Meetings
City of Whittier conducted three public meetings where the Draft Natural Hazard Mitigation Plan was presented and discussed. The meetings were held by the Historic Resources Commission, the Planning Commission, and the City Council. At all three meetings, support for the Plan was expressed. The Whittier City Council voted unanimously to adopt the resolution adopting the Plan. A copy of the Resolution adopted is on page Appendix B-17.

Invitation Process
The Hazard Mitigation Working Group identified possible public notice sources. A press release was submitted to the Chamber of Commerce, local daily and monthly print media. Additionally, the Working Group sent letters of invitation or copies of the Draft Plan to 36 Plan Reviewers, representing local school districts, hospitals, utilities, and other jurisdictions and stakeholders. The local community access cable television channel also carried announcements. Notices were also placed in the community newsletters.

The Plan Reviewers were the following agencies and individuals:

Organization	First and Last Names	Title
Cal Domestic Water Company	Che Venegas	Water Superintendent
CALTRANS	Douglas Failing	Director, District 7
Charter Communications	Jerry Mielo	Technical Trainer
City of La Habra	Michael Lee	Emergency Services Coordinator
City of La Habra Heights	John Hendrickson	City Manager

Organization	First and Last Names	Title
City of La Mirada	Andrea Travis	City Manager
City of Pico Rivera	Michael Moore	Acting Deputy Dir. of Public Works
City of Santa Fe Springs	Bryan Collins	Public Safety Officer
City of Santa Fe Springs	Cuong Nguyen	Assistant Planner
City of Santa Fe Springs	Fernando Tarin	Director of Police Services
City of Santa Fe Springs Fire Department	Neal Welland	Fire Chief
City of Whitter	Bob Chavez	Park Director
City of Whittier	Ann-Marie Hayashi	Emergency Services Assistant
City of Whittier	Carl Reese	Building Services Manager
City of Whittier	Dave Mochizuki	Public Works Director
City of Whittier	Don Dooley	Planning Services Manager
City of Whittier	Joe Dyer	Asst. Director of Public Works
City of Whittier	Leon Yehuda	Asst. Director of Public Works
City of Whittier	Nancy Mendez	Assistant City Manager
East Whittier City School District	Steve Ritter	Asst. Superintendent of Business
Friendly Hills Country Club	Dave Goodrich	General Manager
L.A. County Community Development Commission	Carlos Jackson	Executive Director
Los Angeles County Dept. of Public Works, Program Dev't Division	Maged El-Rabaa	
Los Angeles County Fire Department	Edward S. Thacher	Asst. Fire Chief
Los Angeles County Fire Department	Ron Lawrence	Battalion Chief
Presbyterian Intercommunity Hospital	Dana Molina	Administrative Director of Family Practice
Puente Hills Landfill Native Habitat Preservation Authority	Andrea Gullo	Executive Director
Rio Hondo Community College	Rose Marie Joyce	President
San Gabriel Water Company	Robert Young	Safety Coordinator
Southern California Edison Company	Sylvia Southerland	Region Manager
State of California Governor's Office of Emergency Services.	John Rowden	Chief, Hazard Mitigation
Suburban Water Systems	Tim Tillery	Safety Administrator
The Gas Company	Julia Emerson	Public Affairs Manager
Whittier City School District	Bob Mazzeo	Director of Business Projects
Whittier College	Jan Merideth	Exec. Director of Human Resources
Whittier Conservancy	Dorothea Boyd	President
Whittier Historic Neighborhood Association	Carina Sass	President
Whittier Historic Resources Commission	Kyle Koestner	Chair
Whittier Historical Society	Garland Courts	Director/Curator
Whittier Hospital Medical Center	Howard Ternes	Assistant Administrator

Organization	First and Last Names	Title
Whittier Planning Commission	Harry Stone	Chair
Whittier Unified High School District	Sandra Thorstenson	Superintendent
Whittier Uptown Association		

Attachment B-1

Newspaper Clipping Announcing Mitigation Process
Daily News – May 4, 2004

Officials creating disaster procedure

Input being sought from area residents

By Tracy Garcia
STAFF WRITER

WHITTIER — Earthquakes, fires, floods — these are three natural disasters that could realistically cripple the Whittier and Santa Fe Springs areas, city and school officials say.

That is why representatives of both cities and four local school districts are putting their heads together now to come up with the best plan to respond to these kinds of disasters, as well as develop ways to reduce the chances of potential damage.

The cities of Whittier and Santa Fe Springs, and the East Whittier City, Little Lake City, Whittier City and Whittier Union High school districts have been meeting since last month to prepare a new Hazard Mitigation Plan.

Local governments are required now — for the first time ever — to come up with the Hazard Mitigation Plan under new regulations from the Federal Emergency Management Agency, said Ann-Marie Hayashi, emergency services assistant for the city of Whittier.

FEMA has said areas without a hazard mitigation plan may not qualify for federal funds if a natural disaster does occur.

"FEMA's goal is to see how cities deal with natural hazards and that they have a plan to mitigate them, so that if and when a natural disaster strikes, the damage is minimized," Hayashi said.

Most importantly, FEMA has said areas without a hazard mitigation plan may not qualify for federal funds if a natural disaster does occur, officials said.

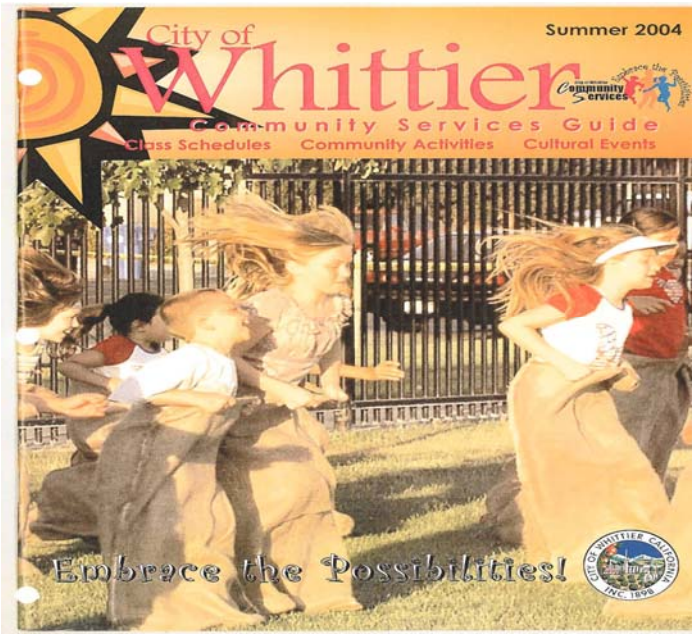
The 15-member group expects to have final drafts available for review by the public at city libraries and school districts in August. Each governing body is expected to approve the document in the fall.

Public participation in the plan is also important, officials said, because residents can alert them to potential problems that they may not have been aware of, such as a street that floods easily. Mailings and Web site postings will be made at a later date to instruct residents on how to participate.

"Awareness is the critical element," said Paul Muschetto, assistant superintendent for the Whittier Union High School District. "For the community, it's beneficial for them to know local agencies are taking the extra step and that in the event of a disaster we will be eligible for

Attachment B-2

Announcement in City Brochure – Summer 2004



City Update

Storm Drains are for Rain...

More than 800,000 people each month drop litter on the ground or out a car window. Litter makes neighborhoods dirty and smelly...and it clogs storm drains causing flooding and ocean pollution.

Remember, put trash where it belongs.

...not litter.

You know those rectangular openings found in curbs throughout the City? They're called "catch basins." Whittier has several hundred of them. Chances are your home or business isn't located too far from one. Catch basins are an important component of our flood control system. Like the one shown here, they come in various sizes and shapes. But their function is the same: to catch storm water and send it to the ocean through an underground network of pipes and tunnels. In Whittier's case, storm water runoff flows into the San Gabriel River—which also acts as a flood control channel—before being discharged into the ocean.

Unfortunately, catch basins also transport polluted runoff to the river and ocean. Runoff, mixed with urban pollutants, creates runoff pollution. Pollutants include **oil and other automotive fluids, paint and construction debris, yard and pet wastes, pesticides, and trash.**

Each day in L.A. County 100 million gallons of polluted urban runoff enter the ocean—untreated—leaving toxic chemicals in our surf and over 4,300 tons of trash on our beaches. Runoff pollution contaminates the ocean, closes beaches, harms aquatic life, and increases the risk of flooding by clogging gutters and catch basins.

Here's what you can do to prevent polluted runoff traveling into the river and ocean:

- Sweep-up trash and debris (never flush with water into the street or catch basin)
- Avoid applying pesticides, fertilizers, and other chemicals during the wet season (October through May)
- Never dump materials into the storm drain system (street, gutters, catch basins)
- Store trash and other pollutant materials in a manner that prevents contact with rain (in a container with a closed lid or under cover)
- Recycle used oil, concrete, broken asphalt, metals, etc.
- Report illicit discharges to 1.888.CLEANLA

Remember to visit the City's website at www.cityofwhittier.org and to watch channel 6 for Charter Cable subscribers, TV6, the City's cable channel for event information and City Council meeting broadcasts.

Local Hazard Mitigation Plan

The City of Whittier has begun the process of preparing a Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The planning document will focus on potential impacts of natural hazards including earthquakes, floods, and wildfires.

For more information, please visit the City's website at www.cityofwhittier.org and click on the News and Events link.

If you'd like to participate in a short City survey on natural hazards, please call the City of Whittier Emergency Preparedness Program at (562) 464-3390 and we will mail you the survey and a stamped return envelope.

The Draft Hazard Mitigation Plan will be completed sometime in August 2004. If you would like to review the document at that time, it will be available at the Whittier Central and Whittwood Branch Public Libraries and at the City Clerk's counter at City Hall. Questions and comments can be emailed to the City at HR@whittierch.org.

Call (562) 464-3430 for information on any program www.cityofwhittier.org

Announcement on City's Website

News and Events

Below is a select listing of News and Community Events taking place in and about the City of Whittier. For a more extensive list of Community Events, please see the Cultural Arts Calendar or visit the Whittier Area Chamber of Commerce web site. Some of the documents listed below require Adobe Acrobat Reader .

Current Programs and Events

Local Hazard Mitigation Plan

The City of Whittier has begun the process of preparing a Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The planning document will focus on potential impacts of natural hazards including earthquakes, floods, and wildfires.

Click here for more information and to participate in a short City survey on natural hazards. Or, please call the City at (562) 464-3390 and we'll mail you the survey and a stamped return envelope.

Dispose of Household Hazardous Waste

Safely dispose your electronic and household hazardous waste by taking them to a free collection event being held on Saturday, May 29, 2004 in Pico Rivera at the Southern California Gas Company at 8101 South Rosemead Blvd. from 9:00 a.m. to 3:00 p.m.

Click here for more information on the City's Waste and Recycling programs.

Street Banner Project

Here Comes the Sun! New street banners designed

More Information and Links

Meeting schedules and agendas for City Council and Board and Commission Meetings are available on line. Click here to see current information.

Get your new or renewed passport at the Whittier Public Library! The Whittier Public Library is an official **Passport Acceptance Facility** of the U.S. Department of State. Located at in the Main Library at 7344 S. Washington Avenue, the office is open Weekdays between 10:00 a.m. and 2:00 p.m., Evenings Monday through Wednesday 5:00 p.m., and 8:00 p.m. and Saturdays (by appointment only) between 10:00 a.m. and 1:00 p.m. Expert assistance and free informational brochures in a comfortable private office all in a great Whittier location. Click here for more information.

Whittier is moving ahead to develop the **Greenway Trail**, a five-mile bicycle/pedestrian trail which will replace an abandoned railroad right-of-way. Click here for more information about this exciting project.

On September 20th Whittier celebrated the

http://www.cityofwhittier.org/content/NE.html?reload_coolmenus 5/11/2004

Disaster Preparedness

The City of Whittier Emergency Preparedness Program is a partnership between all City departments, agencies and organizations in the community and our residents and businesses. The Emergency Preparedness Program, coordinated by the Human Resources Department, can be reached at (562) 464-3390. Some of the popular programs follow:

City Participates with City of Santa Fe Springs and Local School Districts

In compliance with the federal Disaster Management Act of 2000 (DMA 2000), the City has begun the process of preparing a Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The law requires that every local, county and state government:
1) conduct an assessment of the natural hazards that pose a threat to the jurisdiction
2) determine the potential financial impact of these hazards;
3) create a plan to mitigate these hazards; and
4) implement the plan to reduce the impacts of natural disasters.

The City of Whittier is one of six local jurisdictions that are working together as a Planning Team to develop their respective Plans. The other jurisdictions are the City of Santa Fe Springs, Whittier City School District, East Whittier City School District, Whittier Union High School District, and Little Lake School District. It is anticipated that the Draft Plan will be completed sometime in August 2004. Interested parties are invited to review the document at that time at the Whittier Central and Whittwood Branch Public Libraries or at the City Clerk counter at City Hall. Comments on the Draft Plan can be submitted by calling the Whittier Emergency Preparedness Program at (562) 464-3390, or by emailing the City by clicking on the envelope

The City invites you to complete a short survey on natural hazards. Please call the Human Resources Department at (562) 464-3390 and we'll mail you the survey and a stamped return envelope.

Emergency Preparedness Classes

The City, assisted by the L.A. County Fire

Volunteer Disaster Service Workers

Interested in registering as a Disaster Service Worker for the City of Whittier? ***YOU*** can help in your community!

The City is always looking for volunteers who have various skills and experience including but not limited to: Equipment Mechanic, Plumber, Carpenter, Electrician, Certified Building Inspector, Veterinarian, Heavy Equipment Operator, or Bilingual Interpreter, just to name a few. Volunteer Disaster Service Workers would be called upon by the City to assist as needed in the event of a disaster.

Your City needs you! Interested volunteers please pre-register in person with the Human Resources Department at City Hall, 13230 Penn Street, Monday through Friday, 8 AM to 5 PM, or call for a registration form. Please contact the Human Resources Department for more information at 464-3390.

Disaster Communications Service (DCS Amateur Radio Operators)

The City is always looking for amateur radio operators that are interested in participating with the Disaster Communications Service (DCS). DCS volunteers use their amateur radio skills to assist the City of Whittier, the Whittier school districts, both Whittier hospitals, and nearby cities in the event of a disaster.

Attachment B-5

News Release to Media Announcing Mitigation Project

NEWS RELEASE

May 4, 2004
Contact: Ann-Marie Hayashi (562) 464-3390

CITY OF WHITTIER PREPARES HAZARD MITIGATION PLAN DOCUMENT

Plan to Cover Natural Hazards Impacting the Community

The City of Whittier is preparing a Local Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The Plan is being prepared with assistance from Emergency Planning Consultants. Whittier is part of a Multi-Jurisdictional Planning Team which includes the City of Santa Fe Springs, Whittier City School District, East Whittier City School District, Whittier Union High School District, and Little Lake School District. The Planning Team was created to better utilize the resources of the various jurisdictions and to more effectively address the hazards that impact the entire region.

The Plan will focus on potential impacts of natural hazards including earthquakes, floods, and wildfires. A copy of the Draft Plan will be available for review at the Whittier Central and Whittwood Branch Public Libraries during the month of August. Following the review period, the Plan will be forwarded to the City Council for approval.

For more information, please go to the City's website at www.CityofWhittier.org and click on News and Events. If you'd like to participate in a short City survey on natural hazards, please call the City of Whittier Emergency Preparedness Program at (562) 464-3390 and a copy will be mailed to you along with a stamped return envelope.

Attachment B-6

Cable Channel Screen Inviting Public Participation

Attachment B-7

Flyer Distributed at Public Counters and to City's Local Access Cable Station

PARTICIPATE IN A CITY SURVEY ON NATURAL HAZARDS

Help the City develop its Local Hazard Mitigation Plan, which will identify ways to minimize potential damage from natural hazards.

Visit the City's website: www.cityofwhittier.org and click on "News and Events" for more information.

To participate in a short City survey on natural hazards, call the Whittier Emergency Preparedness Program at (562) 464-3390. We will mail you the survey and a stamped return envelope.

Thank you for your interest and participation!

Attachment B-8
Whittier Police Department - Neighborhood Watch Newsletter

Local Hazard Mitigation Plan

As required by FEMA, the City of Whittier has begun the process of preparing a Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The planning document will focus on potential impacts of natural hazards including earthquakes, floods, and wildfires.

For more information, please go to the City's website at www.CityofWhittier.org and click on News and Events. If you'd like to participate in a short City survey on natural hazards, please call the City of Whittier Emergency Preparedness Program at (562) 464-3390 and we'll mail you the survey and a stamped return envelope.

The Draft Hazard Mitigation Plan will be completed sometime in August 2004. If you would like to review the document at that time, it will be available at the Whittier Central and Whittwood Branch Public Libraries and at the City Clerk counter at City Hall. Questions and comments can be emailed to the City at HR@cityofwhittier.org.

WHITTIER Area Chamber of Commerce

BUSINESS FOCUS

1914 90th 2004

City of Whittier Prepares Hazard Mitigation Plan Document

Plan to Cover Natural Hazards Impacting the Community

The City of Whittier has begun the process of preparing a Hazard Mitigation Plan that will identify ways to minimize potential damage from natural hazards before a disaster occurs. The Plan is being prepared by the City of Whittier with assistance from Emergency Planning Consultants. The City is part of a Multi-Jurisdictional Planning Team which includes the City of Santa Fe Springs, Whittier City School District, East Whittier City School District, Whittier Union High School District, and Little Lake School District. The Planning Team was created in an effort to better utilize the resources of the various jurisdictions and to more effectively address the hazards that impact the entire region.

The planning document will focus on potential impacts of natural hazards including earthquakes, floods, and wildfires. Upon completion of the Draft Local Hazard Mitigation Plan, a copy of the document will be available for review at the Whittier Central and Whittwood Branch Public Libraries during the month of August. Following the review period, the Plan will be forwarded to the City Council for approval.

For more information, please go to the City's website at www.CityofWhittier.org and click on News and Events. If you'd like to participate in a short City survey on natural hazards, please call the City of Whittier Emergency Preparedness Program at (562) 464-3390 and a copy will be mailed to you along with a stamped return envelope.

Questions and comments can be emailed to the City at HR@cityofwhittier.org.

Appendix C:

Economic Analysis of Natural Hazard Mitigation Projects

Benefit/Cost Analysis is a key mechanism used by the California Office of Emergency Services (OES), the Federal Emergency Management Agency, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

This Appendix outlines several approaches for conducting economic analysis of natural hazard mitigation projects. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies. Information in this section is derived in part from: Federal Emergency Management Agency Publication 331, Report on Costs and Benefits of Natural Hazard Mitigation.

This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to provide the details of economic analysis methods that can be used to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?
Mitigation activities reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred.

Evaluating natural hazard mitigation provides 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. Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, police, utilities, and schools.

Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce “ripple-effects” throughout the community, greatly increasing the disaster’s social and economic consequences.

While not easily accomplished, there is value, from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

What are Some Economic Analysis Approaches for Mitigation Strategies?
The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. The distinction between the two methods is the way in which the relative costs and benefits are measured. Additionally, there are varying approaches to assessing the value of mitigation for public sector and private sector activities.

Benefit/Cost Analysis
Benefit/Cost Analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost 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. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoided future damages, and risk.

In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented (i.e., if net benefits exceed net costs, the project is worth pursuing). A project must have a benefit/cost ratio greater than 1 in order to be funded.

Cost-Effectiveness Analysis
Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

Investing in public sector mitigation activities
Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions that involve a diverse set of beneficiaries and non-market benefits.

Investing in private sector mitigation activities
Private sector mitigation projects may occur on the basis of one of two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost

effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to

Estimating the costs and benefits of a hazard mitigation strategy can be a complex process.

Employing the services of a specialist can assist in this process.

prospective purchasers. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

How can an Economic Analysis be Conducted?

Benefit/cost analysis and cost-effectiveness analysis are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating alternative mitigation activities is outlined below:

1. Identify the Alternatives: Alternatives for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation project can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits: Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate alternative. Potential economic criteria to evaluate alternatives include:

- **Determine the project cost.** This may include initial project development costs, and repair and operating costs of maintaining projects over time.

- **Estimate the benefits.** Projecting the benefits or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.

- Consider costs and benefits to society and the environment. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.

- Determine the correct discount rate. Determination of the discount rate can just be the risk-free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Alternatives: Once costs and benefits have been quantified, economic analysis tools can rank the alternatives. Two methods for determining the best alternative given varying costs and benefits include net present value and internal rate of return.

- Net present value. Net present value is the value of the expected future returns of an investment minus the value of expected future cost expressed in today's dollars. If the net present value is greater than the project costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.

- Internal Rate of Return. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project.

Once the mitigation projects are ranked on the basis of economic criteria, decision-makers can consider other factors, such as risk; project effectiveness; and economic, environmental, and social returns in choosing the appropriate project for implementation.

How are Benefits of Mitigation Calculated?

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owner as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

- Building damages avoided
- Content damages avoided
- Inventory damages avoided
- Rental income losses avoided

- Relocation and disruption expenses avoided
- Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

- Commodity and resource prices
- Availability of resource supplies
- Commodity and resource demand changes
- Building and land values
- Capital availability and interest rates
- Availability of labor
- Economic structure
- Infrastructure
- Regional exports and imports
- Local, state, and national regulations and policies
- Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. Many communities are looking towards developing multi-objective projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability of project implementation.

Resources

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Appendix D:
Acronyms

Federal Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ATC	Applied Technology Council
b/ca	benefit/cost analysis
BFE	Base Flood Elevation
BLM	Bureau of Land Management
BSSC	Building Seismic Safety Council
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CRS	Community Rating System
DOE	Department of Energy
EDA	Economic Development Administration
EPA	Environmental Protection Agency
ER	Emergency Relief
EWP	Emergency Watershed Protection (NRCS Program)
FAS	Federal Aid System
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance (FEMA Program)
FTE	Full Time Equivalent
GIS	Geographic Information System
GNS	Institute of Geological and Nuclear Sciences (International)
GSA	General Services Administration
HAZUS	Hazards U.S.
HMGP	Hazard Mitigation Grant Program
HMST	Hazard Mitigation Survey Team
HUD	Housing and Urban Development (United States, Department of)
IBHS	Institute for Business and Home Safety
ICC	Increased Cost of Compliance
IHMT	Interagency Hazard Mitigation Team
NCDC	National Climate Data Center
NFIP	National Flood Insurance Program
NFPA	National Fire Protection Association
NHMP	Natural Hazard Mitigation Plan (also known as "409 Plan")
NIBS	National Institute of Building Sciences
NIFC	National Interagency Fire Center
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
SBA	Small Business Administration

SHMO	State Hazard Mitigation Officer
TOR	Transfer of Development Rights
UGB	Urban Growth Boundary
URM	Unreinforced Masonry
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFA	United States Fire Administration
USFS	United States Forest Service
USGS	United States Geological Survey
WSSPC	Western States Seismic Policy Council

California Acronyms

A&W	Alert and Warning
AA	Administering Areas
AAR	After Action Report
ARC	American Red Cross
ARP	Accidental Risk Prevention
ATC20	Applied Technology Council20
ATC21	Applied Technology Council21
BCP	Budget Change Proposal
BSA	California Bureau of State Audits
CAER	Community Awareness & Emergency Response
CalARP	California Accidental Release Prevention
CalBO	California Building Officials
CalEPA	California Environmental Protection Agency
CalREP	California Radiological Emergency Plan
CALSTARS	California State Accounting Reporting System
CalTRANS	California Department of Transportation
CBO	Community Based Organization
CD	Civil Defense
CDF	California Department of Forestry and Fire Protection
CDMG	California Division of Mines and Geology
CEC	California Energy Commission
CEPEC	California Earthquake Prediction Evaluation Council
CESRS	California Emergency Services Radio System
CHIP	California Hazardous Identification Program
CHMIRS	California Hazardous Materials Incident Reporting System
CHP	California Highway Patrol
CLETS	California Law Enforcement Telecommunications System
CSTI	California Specialized Training Institute
CUEA	California Utilities Emergency Association
CUPA	Certified Unified Program Agency
DAD	Disaster Assistance Division (California Office of Emergency Services)
DFO	Disaster Field Office

DGS	California Department of General Services
DHSRHB	California Department of Health Services, Radiological Health Branch
DO	Duty Officer
DOC	Department Operations Center
DOF	California Department of Finance
DOJ	California Department of Justice
DPA	California Department of Personnel Administration
DPIG	Disaster Preparedness Improvement Grant
DR	Disaster Response
DSA	Division of the State Architect
DSR	Damage Survey Report
DSW	Disaster Service Worker
DWR	California Department of Water Resources
EAS	Emergency Alerting System
EDIS	Emergency Digital Information System
EERI	Earthquake Engineering Research Institute
EMA	Emergency Management Assistance
EMI	Emergency Management Institute
EMMA	Emergency Managers Mutual Aid
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EPEDAT	Early Post Earthquake Damage Assessment Tool
EPI	Emergency Public Information
EPIC	Emergency Public Information Council
ESC	Emergency Services Coordinator
FAY	Federal Award Year
FDAA	Federal Disaster Assistance Administration
FEAT	Governor's Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FFY	Federal Fiscal Year
FIR	Final Inspection Reports
FIRESCOPE	Firefighting Resources of Southern California Organized for Potential Emergencies
FMA	Flood Management Assistance
FSR	Feasibility Study Report
FY	Fiscal Year
GIS	Geographical Information System
HAZMAT	Hazardous Materials
HAZMIT	Hazardous Mitigation
HAZUS	Hazards United States (an earthquake damage assessment prediction tool)
HAD	Housing and Community Development
HEICS	Hospital Emergency Incident Command System
HEPG	Hospital Emergency Planning Guidance
HIA	Hazard Identification and Analysis Unit
HMEP	Hazardous Materials Emergency Preparedness

HMGP	Hazard Mitigation Grant Program
IDE	Initial Damage Estimate
IA	Individual Assistance
IFG	Individual & Family Grant (program)
IRG	Incident Response Geographic Information System
IPA	Information and Public Affairs (of state Office of Emergency Services)
LAN	Local Area Network
LEMMA	Law Enforcement Master Mutual Aid
LEPC	Local Emergency Planning Committee
MARAC	Mutual Aid Regional Advisory Council
MHFP	Multi-Hazard Functional Plan
MHID	Multi-Hazard Identification
MOU	Memorandum of Understanding
NBC	Nuclear, Biological, Chemical
NEMA	National Emergency Management Agency
NEMIS	National Emergency Management Information System
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Association
NPP	Nuclear Power Plant
NSF	National Science Foundation
NWS	National Weather Service
OA	Operational Area
OASIS	Operational Area Satellite Information System
OCC	Operations Coordination Center
OCD	Office of Civil Defense
OEP	Office of Emergency Planning
OES	California Governor's Office of Emergency Services
OSHPD	Office of Statewide Health Planning and Development
OSPR	Oil Spill Prevention and Response
PA	Public Assistance
PC	Personal Computer
PDA	Preliminary Damage Assessment
PIO	Public Information Office
POST	Police Officer Standards and Training
PPA/CA	Performance Partnership Agreement/Cooperative Agreement (FEMA)
PSA	Public Service Announcement
PTAB	Planning and Technological Assistance Branch
PTR	Project Time Report
RA	Regional Administrator (OES)
RADEF	Radiological Defense (program)
RAMP	Regional Assessment of Mitigation Priorities
RAPID	Railroad Accident Prevention & Immediate Deployment
RDO	Radiological Defense Officer
RDMHC	Regional Disaster Medical Health Coordinator
REOC	Regional Emergency Operations Center
REPI	Reserve Emergency Public Information

RES	Regional Emergency Staff
RIMS	Response Information Management System
RMP	Risk Management Plan
RPU	Radiological Preparedness Unit (OES)
RRT	Regional Response Team
SAM	State Administrative Manual
SARA	Superfund Amendments & Reauthorization Act
SAVP	Safety Assessment Volunteer Program
SBA	Small Business Administration
SCO	California State Controller's Office
SEMS	Standardized Emergency Management System
SEPIC	State Emergency Public Information Committee
SLA	State and Local Assistance
SONGS	San Onofre Nuclear Generating Station
SOP	Standard Operating Procedure
SWEPC	Statewide Emergency Planning Committee
TEC	Travel Expense Claim
TRU	Transuranic
TTT	Train the Trainer
UPA	Unified Program Account
UPS	Uninterrupted Power Source
USAR	Urban Search and Rescue
USGS	United States Geological Survey
WC	California State Warning Center
WAN	Wide Area Network
WIPP	Waste Isolation Pilot Project

Appendix E

Glossary

Acceleration	The rate of change of velocity with respect to time. Acceleration due to gravity at the earth's surface is 9.8 meters per second squared. That means that every second that something falls toward the surface of earth its velocity increases by 9.8 meters per second.
Asset	Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.
Base Flood	Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.
Base Flood Elevation (BFE)	Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.
Bedrock	The solid rock that underlies loose material, such as soil, sand, clay, or gravel.
Building	A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.
Coastal High Hazard Area	Area, usually along an open coast, bay, or inlet that is subject to inundation by storm surge and, in some instances, wave action caused by storms or seismic sources.
Coastal Zones	The area along the shore where the ocean meets the land as the surface of the land rises above the ocean. This land/water interface includes barrier islands, estuaries, beaches, coastal wetlands, and land areas having direct drainage to the ocean.
Community Rating System (CRS)	An NFIP program that provides incentives for NFIP communities to complete activities that reduce flood hazard risk. When the community completes specified activities, the insurance premiums of policyholders in these communities are reduced.
Computer-Aided Design And Drafting (CADD)	A computerized system enabling quick and accurate electronic 2-D and 3-D drawings, topographic mapping, site plans, and profile/cross-section drawings.
Contour	A line of equal ground elevation on a topographic (contour) map.

Critical Facility	Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.
Debris	The scattered remains of assets broken or destroyed in a hazard event. Debris caused by a wind or water hazard event can cause additional damage to other assets.
Digitize	To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer applications.
Displacement Time	The average time (in days) which the building's occupants typically must operate from a temporary location while repairs are made to the original building due to damages resulting from a hazard event.
Duration	How long a hazard event lasts.
Earthquake	A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.
Erosion	Wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm or over a period of years, through the action of wind, water, or other geologic processes.
Erosion Hazard Area	Area anticipated being lost to shoreline retreat over a given period of time. The projected inland extent of the area is measured by multiplying the average annual long-term recession rate by the number of years desired.
Essential Facility	Elements important to ensure a full recovery of a community or state following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.
Extent	The size of an area affected by a hazard or hazard event.
Extratropical Cyclone	Cyclonic storm events like Nor'easters and severe winter low-pressure systems. Both West and East coasts can experience these non-tropical storms that produce gale-force winds and precipitation in the form of heavy rain or snow. These cyclonic storms, commonly called Nor'easters on the East Coast because of the direction of the storm winds, can last for several days and can be very large – 1,000-mile wide storms are not uncommon.
Fault	A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.

Federal Emergency Management Agency (FEMA)	Independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.
Fire Potential Index (FPI)	Developed by USGS and USFS to assess and map fire hazard potential over broad areas. Based on such geographic information, national policy makers and on-the-ground fire managers established priorities for prevention activities in the defined area to reduce the risk of managed and wildfire ignition and spread. Prediction of fire hazard shortens the time between fire ignition and initial attack by enabling fire managers to pre-allocate and stage suppression forces to high fire risk areas.
Flash Flood	A flood event occurring with little or no warning where water levels rise at an extremely fast rate.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.
Flood Depth	Height of the flood water surface above the ground surface.
Flood Elevation	Elevation of the water surface above an established datum, e.g. National Geodetic Vertical Datum of 1929, North American Vertical Datum of 1988, or Mean Sea Level.
Flood Hazard Area	The area shown to be inundated by a flood of a given magnitude on a map.
Flood Insurance Rate Map (FIRM)	Map of a community, prepared by the Federal Emergency Management Agency that shows both the special flood hazard areas and the risk premium zones applicable to the community.
Flood Insurance Study (FIS)	A study that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.
Floodplain	Any land area, including watercourse, susceptible to partial or complete inundation by water from any source.
Frequency	A measure of how often events of a particular magnitude are expected to occur. Frequency describes how often a hazard of a specific magnitude, duration, and/or extent typically occurs, on average. Statistically, a hazard with a 100-year recurrence interval is expected to occur once every 100 years on average, and would have a 1 percent chance – its probability – of happening in any given year. The reliability of this information varies depending on the kind of hazard being considered.

Fujita Scale of Tornado Intensity	Rates tornadoes with numeric values from F0 to F5 based on tornado wind speed and damage sustained. An F0 indicates minimal damage such as broken tree limbs or signs, while and F5 indicated severe damage sustained.
Functional Downtime	The average time (in days) during which a function (business or service) is unable to provide its services due to a hazard event.
Geographic Area Impacted	The physical area in which the effects of the hazard are experienced.
Geographic Information Systems (GIS)	A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.
Ground Motion	The vibration or shaking of the ground during an earthquake. When a fault ruptures, seismic waves radiate, causing the ground to vibrate. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter, but soft soils can further amplify ground motions
Hazard	A source of potential danger or adverse condition. Hazards in this how to series will include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.
Hazard Event	A specific occurrence of a particular type of hazard.
Hazard Identification	The process of identifying hazards that threaten an area.
Hazard Mitigation	Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.
Hazard Profile	A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.
HAZUS (Hazards U.S.)	A GIS-based nationally standardized earthquake loss estimation tool developed by FEMA.

Hurricane	An intense tropical cyclone, formed in the atmosphere over warm ocean areas, in which wind speeds reach 74-miles-per-hour or more and blow in a large spiral around a relatively calm center or "eye." Hurricanes develop over the north Atlantic Ocean, northeast Pacific Ocean, or the south Pacific Ocean east of 160°E longitude. Hurricane circulation is counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.
Hydrology	The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.
Infrastructure	Refers to the public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams.
Intensity	A measure of the effects of a hazard event at a particular place.
Landslide	Downward movement of a slope and materials under the force of gravity.
Lateral Spreads	Develop on gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies in a seismic event. The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.
Liquefaction	Results when the soil supporting structures liquefies. This can cause structures to tip and topple.
Lowest Floor	Under the NFIP, the lowest floor of the lowest enclosed area (including basement) of a structure.
Magnitude	A measure of the strength of a hazard event. The magnitude (also referred to as severity) of a given hazard event is usually determined using technical measures specific to the hazard.
Mitigation Plan	A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the state and includes a description of actions to minimize future vulnerability to hazards.
National Flood Insurance Program (NFIP)	Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 CFR §60.3.

National Geodetic Vertical Datum of 1929 (NGVD)	Datum established in 1929 and used in the NFIP as a basis for measuring flood, ground, and structural elevations, previously referred to as Sea Level Datum or Mean Sea Level. The Base Flood Elevations shown on most of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency are referenced to NGVD.
National Weather Service (NWS)	Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.
Nor'easter	An extra-tropical cyclone producing gale-force winds and precipitation in the form of heavy snow or rain.
Outflow	Follows water inundation creating strong currents that rip at structures and pound them with debris, and erode beaches and coastal structures.
Planimetric	Describes maps that indicate only man-made features like buildings.
Planning	The act or process of making or carrying out plans; the establishment of goals, policies and procedures for a social or economic unit.
Probability	A statistical measure of the likelihood that a hazard event will occur.
Recurrence Interval	The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any given year.
Repetitive Loss Property	A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.
Replacement Value	The cost of rebuilding a structure. This is usually expressed in terms of cost per square foot, and reflects the present-day cost of labor and materials to construct a building of a particular size, type and quality.
Richter Scale	A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.
Risk	The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.
Riverine	Of or produced by a river.
Scale	A proportion used in determining a dimensional relationship; the ratio of the distance between two points on a map and the actual distance between the two points on the earth's surface.

Scarp	A steep slope.
Scour	Removal of soil or fill material by the flow of flood waters. The term is frequently used to describe storm-induced, localized conical erosion around pilings and other foundation supports where the obstruction of flow increases turbulence.
Seismicity	Describes the likelihood of an area being subject to earthquakes.
Special Flood Hazard Area (SFHA)	An area within a floodplain having a 1 percent or greater chance of flood occurrence in any given year (100-year floodplain); represented on Flood Insurance Rate Maps by darkly shaded areas with zone designations that include the letter A or V.
Stafford Act	The Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-107 was signed into law November 23, 1988 and amended the Disaster Relief Act of 1974, PL 93-288. The Stafford Act is the statutory authority for most Federal disaster response activities, especially as they pertain to FEMA and its programs.
State Hazard Mitigation Officer (SHMO)	The representative of state government who is the primary point of contact with FEMA, other state and Federal agencies, and local units of government in the planning and implementation of pre- and post-disaster mitigation activities.
Storm Surge	Rise in the water surface above normal water level on the open coast due to the action of wind stress and atmospheric pressure on the water surface.
Structure	Something constructed. (See also Building)
Substantial Damage	Damage of any origin sustained by a structure in a Special Flood Hazard Area whereby the cost of restoring the structure to its before-damaged condition would equal or exceeds 50 percent of the market value of the structure before the damage.
Super Typhoon	A typhoon with maximum sustained winds of 150 mph or more.
Surface Faulting	The differential movement of two sides of a fracture – in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults.
Tectonic Plate	Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.
Topographic	Characterizes maps that show natural features and indicate the physical shape of the land using contour lines. These maps may also include manmade features.

Tornado	A violently rotating column of air extending from a thunderstorm to the ground.
Tropical Cyclone	A generic term for a cyclonic, low-pressure system over tropical or subtropical waters.
Tropical Depression	A tropical cyclone with maximum sustained winds of less than 39 mph.
Tropical Storm	A tropical cyclone with maximum sustained winds greater than 39 mph and less than 74 mph.
Tsunami	Great sea wave produced by submarine earth movement or volcanic eruption.
Typhoon	A special category of tropical cyclone peculiar to the western North Pacific Basin, frequently affecting areas in the vicinity of Guam and the North Mariana Islands. Typhoons whose maximum sustained winds attain or exceed 150 mph are called super typhoons.
Urban Flooding	Sometimes referred to as ponding, due to debris accumulation on storm drains, flood control channels, and catch basins.
Vulnerability	Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.
Vulnerability Assessment	The extent of injury and damage that may result from a hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.
Water Displacement	When a large mass of earth on the ocean bottom sinks or uplifts, the column of water directly above it is displaced, forming the tsunami wave. The rate of displacement, motion of the ocean floor at the epicenter, the amount of displacement of the rupture zone, and the depth of water above the rupture zone all contribute to the intensity of the tsunami.
Wave Run-up	The height that the wave extends up to on steep shorelines, measured above a reference level (the normal height of the sea, corrected to the state of the tide at the time of wave arrival).
Wildfire	An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

Zone	A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Attachment 2

Earthquake Probable Events

Southern California Earthquake Data Center

Elsinore Fault Zone

TYPE OF FAULTING: right-lateral strike-slip
LENGTH: about 180 km (not including the Whittier, Chino, and Laguna Salada faults)
NEARBY COMMUNITIES: Temecula, Lake Elsinore, Julian
LAST MAJOR RUPTURE: May 15, 1910; Magnitude 6 -- no surface rupture found
SLIP RATE: roughly 4.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: roughly 250 years
PROBABLE MAGNITUDES: M_W6.5 - 7.5
MOST RECENT SURFACE RUPTURE: 18th century A.D.(?)

San Andreas Fault Zone

TYPE OF FAULT: right-lateral strike-slip
LENGTH: 1200 km
550 km south from Parkfield; 650km northward
NEARBY COMMUNITY: Parkfield, Frazier Park, Palmdale, Wrightwood, San Bernardino, Banning, Indio
LAST MAJOR RUPTURE: January 9, 1857 (Mojave segment); April 18, 1906 (Northern segment)
SLIP RATE: about 20 to 35 mm per year
INTERVAL BETWEEN MAJOR RUPTURES: average of about 140 years on the Mojave segment; recurrence interval varies greatly -- from under 20 years (at Parkfield only) to over 300 years
PROBABLE MAGNITUDES: M_W6.8 - 8.0

San Jacinto Fault Zone

TYPE OF FAULTING : right-lateral strike-slip; minor right-reverse
LENGTH: 210 km, including Coyote Creek fault
NEARBY COMMUNITIES: Lytle Creek, San Bernardino, Loma Linda, San Jacinto, Hemet, Anza, Borrego Springs, Ocotillo Wells
MOST RECENT SURFACE RUPTURE: within the last few centuries; April 9, 1968, M_w6.5 on Coyote Creek segment
SLIP RATE: typically between 7 and 17 mm/yr
INTERVAL BETWEEN SURFACE RUPTURES: between 100 and 300 years, per segment
PROBABLE MAGNITUDES: M_w6.5 - 7.5

Whittier Fault

TYPE OF FAULTING: right-lateral strike-slip with some reverse slip
LENGTH: about 40 km
NEARBY COMMUNITIES: Yorba Linda, Hacienda Heights, Whittier
MOST RECENT SURFACE RUPTURE: Holocene
SLIP RATE: between 2.5 and 3.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: unknown
PROBABLE MAGNITUDES: M_W6.0 - 7.2
OTHER NOTES: The Whittier fault dips toward the northeast.

Attachment 1

Ranking Your Hazards

It is important to keep in mind that your rankings should be based on a hazard event that would overwhelm your jurisdiction's ability to respond effectively.

For each hazard listed assign a score. Place a number in the appropriate box.

Hazard Scoring	
1	An event of that magnitude is not likely to occur
2	There is a slight chance that an event of that magnitude will occur
3	It is possible that an event of that magnitude will occur
4	An event of that magnitude has occurred here in the past and is likely to occur again
5	There is a high probability that an event of that magnitude will occur

Identify any additional hazards for the jurisdiction at the end of the list labeled as "Other Hazard."

Hazard	***Score***
Flooding	
Wildfire	
Earthquakes	
Windstorm	
Earth Movement (Landslide/Debris Flow)	
Tsunami	
Other Hazard _____	
Other Hazard _____	
Other Hazard _____	
Other Hazard _____	
Other Hazard _____	
Other Hazard _____	
Other Hazard _____	