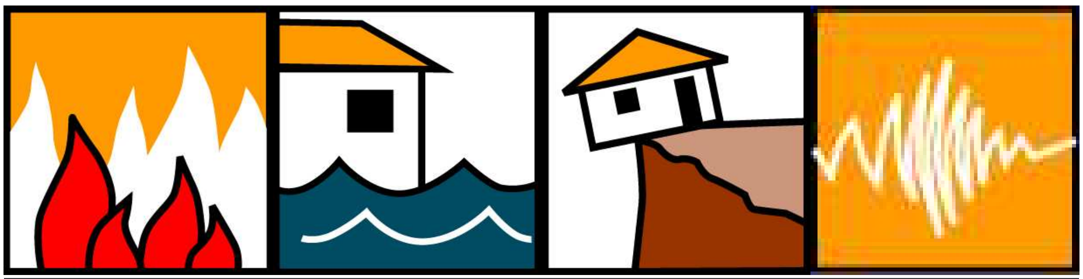
City of Manhattan Beach



Hazard Mitigation Plan

Draft November 5, 2008

Prepared under contract with:

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Special Recognition

Special Thanks
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Mapping
Maps were acquired from City of Manhattan Beach and the Los Angeles County Hazard Mitigation Plan, as well as other public maps available on the Internet.

Planning Guidance Materials
The Disaster Management Area Coordinators (DMAC) of Los Angeles County prepared planning guidance materials that were utilized by the City of Manhattan Beach in preparing this Natural Hazards Mitigation Plan. The guidance materials were based on the Clackamas County (Oregon) Natural Hazards Mitigation Plan. The City appreciates the efforts of both DMAC and Clackamas County.

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City of Manhattan Beach Natural Hazards Mitigation Plan

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Note: The maps in this plan were provided by the City of Manhattan Beach, Los Angeles Natural Hazards Mitigation Plan, or were acquired from public Internet sources. Care was taken in the creation of the maps contained in this Plan, however they are provided "as is". The City of Manhattan Beach cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products (the maps). Although information from land surveys may have been used in the creation of these products, in no way does this product represent or constitute a land survey. Users are cautioned to field verify information on this product before making any decisions.

PART I: MITIGATION ACTIONS

Executive Summary: Hazard Mitigation Action Plan

The City of Manhattan Beach Hazard Mitigation Plan (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 Manhattan Beach in reducing risk and preventing loss from future hazard events. The action items address multi-hazard issues, as well as activities for Earthquake, Flood, Landslide, and Tsunami.

How is the Plan Organized?

The Mitigation Plan contains a five-year action plan matrix, background on the purpose and methodology used to develop the mitigation plan, a profile of the City of Manhattan Beach, sections on five hazards that occur within the City, and a number of appendices. All of the sections are described in detail in Section 1: Introduction.

Who Participated in Developing the Plan?

The City of Manhattan Beach Hazard Mitigation Plan is the result of a collaborative planning effort between City of Manhattan Beach citizens, public agencies, and regional and state organizations. Public participation played a key role in development of goals and action items. A project Planning Team guided the process of developing the plan and consisted of the following representatives:

Hazard Mitigation Planning Team
City of Manhattan Beach
Frank Chiella, Fire Department, Chair
Scott Ferguson, Fire Department
Ken Shuck, Fire Department
Dennis Groat, Fire Department
Richard Thompson, Community Development Department
Laurie Jester, Community Development Department
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Dale Reissig, Police Department
Randy Leaf, Police Department
Derrick Abell, Police Department
Rod Uyeda, Police Department

Lindy Coe-Juell, City Manager's Office
Bonnie Shrewsbury, Public Works Department

What is the Plan Mission?

The mission of the City of Manhattan Beach Hazard Mitigation Plan is to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from 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 in creating a more sustainable community.

What are the Plan Goals?

The plan goals describe the overall direction that City of Manhattan Beach can take to work toward mitigating risk from hazards. The goals are stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items.

Protect Life and Property

Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to 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 and encouraging preventative measures for existing development in areas vulnerable to natural hazards.

Enhance Public Awareness

Develop and implement education and outreach programs to increase public awareness of the risks associated with hazards.

Provide information on tools; partnership opportunities, and funding resources to assist in implementing mitigation activities.

Protect Natural Systems

Balance natural resource management and land use planning with hazard mitigation to protect life, property, and the environment.

Preserve, rehabilitate, and enhance natural systems to serve hazard mitigation functions.

Encourage 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, county, and regional hazard mitigation activities.

Strengthen 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 hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Encourage Public Participation

Include public participation in future updates of the plan to obtain input and identify priorities in developing goals for reducing risk and preventing loss from hazards in the City.

How are the Action Items Organized?

The Mitigation Actions Matrix lists activities that the City agencies and citizens can engage in to reduce risk. Each action item includes an estimate of the timeline for implementation.

The action items are organized within the following Matrix, which lists all of the multi-hazard and hazard-specific action items included in the mitigation plan. Data collection and research and the public participation process resulted in the development of these action items (see Appendix B: Public Participation Process). The matrix includes the following information for each action item:

Funding Source. The actions items will be funded through a variety of sources, possibly including: operating budget/general fund, development fees, Community Development Block Grant (CDBG), Hazard Mitigation Grant Program (HMGP), other grants, private funding, Capital Improvement Plan (CIP), and other funding opportunities.

Coordinating Organization. The Mitigation Actions Matrix assigns primary responsibility for each of the action items. The hierarchies of the assignments vary – some are positions, others departments, and other committees. No matter, the primary responsibility for implementing the action items falls to the entity shown as the "Coordinating Organization". The coordinating organization is the 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.

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 six areas:

Protect Life and Property
Enhance Public Awareness
Protect Natural Systems
Encourage Partnerships and Implementation
Strengthen Emergency Services
Encourage Public Participation

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

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

Plan Adoption

Adoption of the Mitigation Plan by the City'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 Manhattan Beach Hazard Mitigation Plan. The governing body has the responsibility and authority to promote sound public policy regarding natural hazards. The local agency governing body will have the authority to periodically update the plan as it is revised to meet changes in the natural hazard risks and exposures in the City. The approved Mitigation Plan will be significant in the future growth and development of the City.

Coordinating Body

The City of Manhattan Beach Hazard Mitigation Advisory Committee (Committee) will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The City Manager will assign representatives from the following departments/divisions to serve on the Committee: Fire, Police, Public Works, Engineering, Building & Safety, and Community Development.

Convener

The City Council will adopt the City of Manhattan Beach Hazard Mitigation Plan and the Hazard Mitigation Advisory Committee will take responsibility for plan maintenance and implementation. The Chair of the Hazard Mitigation Planning Team will serve as a convener to facilitate the 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 Committee members.

Implementation through Existing Programs

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

Economic Analysis of Mitigation Projects

At the Hazard Mitigation Advisory Committee's first meeting, the Committee will utilize the completed STAPLEE (Social, Technical, Administrative, Political, Legal, Environmental, Economic) Tool (Attachment 1) as a guide in implementing the Mitigation Plan.

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 Manhattan Beach 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 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. Committee members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan. The City Manager will have authority to update and revise the plan as needed.

Continued Public Involvement

City of Manhattan Beach is dedicated to involving the public directly in the continual review and updates to the Mitigation Plan. Copies of the plan will be available at Fire Department, Community Development Department, Library, City Clerk, and Website.

Table 1: Mitigation Actions Matrix

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)							
MH-1 Integrate goals/action items into General Plan, Municipal Code, Capital Improvement Plan and other regulatory or policy documents and programs, as appropriate.	Public Works (PW), Community Development (ComDev)	CIP – 2008 Annually	X	X	X	X	X
MH-2 Identify and pursue funding opportunities to develop and implement local hazard mitigation activities.	Fire, PW	CIP – 2008 Annually	X		X	X	X
MH-3 Retrofit essential city buildings with automatic fire sprinkler systems to limit damage from fires caused by earthquakes and other natural disasters.	Fire, PW	2008-2009	X	X			X
MH-4 Develop inventories of critical facilities and infrastructure, assess structural vulnerability to the identified hazards and prioritize mitigation projects.	Fire, Police, PW	Ongoing	X				X
MH-5 Strengthen emergency services preparedness and response by coordinating emergency services with natural hazard mitigation programs and enhancing public education on a regional scale.	Fire, Police	Ongoing				X	X
MH-6 Develop, enhance and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.	Fire, Police, PW	Ongoing		X			
MH-7 Evaluate current hazard warning systems to ensure effectiveness and efficiently increase coordination between local jurisdictions and emergency service providers.	Fire, Police	Ongoing				X	X
MH-8 Update policy for government to determine what reconstruction criteria should be applied to structures damaged during a disaster. Update building and reconstruction policies and requirement in the local government building code for post-disaster situations.	Building & Safety	Ongoing	X				

Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
			Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
MH-9 Review priorities and publish for restoration of the community's infrastructure and vital public facilities following a disaster.	PW	Ongoing	X				X
MH-10 Provide information on MB website that includes information specific to residents, building codes, and information on damage prevention. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices. E.g. How to secure a bookcase; How to make a family notification and evacuation plan.	Building & Safety	Ongoing		X			
MH-11 Provide a program to minimize the impact on utilities based on all possible disasters (may require redundant or quick-replacement systems).	Engineering	Completed 2004	X				
MH-12 Inspect fire hydrants and conduct fire-flow tests on a regular basis.	Fire, PW	Annually	X				X
MH-13 Incorporate the Los Angeles Regional Uniform Codes Program into the City's Municipal Code, making the Municipal Code building regulations more stringent than the current adopted state codes. To be implemented on an on-going basis.	Building & Safety	2008	X			X	X
MH-14 Continue participation in local mutual aid agreements for emergency response with other jurisdictions.	Fire, Police, PW	Ongoing				X	X
MH-15 Ensure availability/effective response of emergency and disaster relief services for the community after a major emergency.	Fire	2006	X	X		X	X
MH-16 Implement and coordinate existing local, state and federal disaster preparedness resources and emergency mobilization/evacuation plans to assure their continued adequacy and effectiveness.	Fire	2006	X	X		X	X
MH-17 Work with the Manhattan Beach Unified School District (MBUSD) in teaching children to respond appropriately in emergency and to threats to personal safety.	Fire	Ongoing	X	X		X	X
MH-18 Continue to operate the Community Alert Network (CAN) and Reverse 911 which provides immediate notification to residents when a disaster strikes.	Fire	Ongoing	X	X			X

Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
			Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
MH-19 Alert residents to dangers that household items can pose during a natural hazard/disaster. The following are measures homeowners can take: repair electrical wiring and leaky gas connections, secure shelving, move heavy/large objects to lower shelves, hang pictures and mirrors away from beds, brace overhead light fixtures, secure water heater, repair foundation/ceiling cracks, store weed-killers, pesticides, flammable products away from heat sources, place oily polishing rags or waste in covered metal cans, clean and repair chimneys, flue pipes, vent connections and gas vents.	Fire, Building & Safety, Police	Ongoing	X	X	X		X
MH-20 Adopt effective land-use regulations and building codes and continue to discourage new construction or development in identified hazard areas without first implementing appropriate remedial measures.	ComDev, Building & Safety	Building Codes Adopted 2008 General Plan 2003	X	X		X	
Earthquake Action Items (EQ)							
EQ-1 City reservoirs and the elevated water tank have been evaluated and seismically retrofitted.	PW	Inspect Annually	X				
EQ-2 Un-reinforced masonry buildings have been inventoried and retrofitted in accordance with UBC standards.	Building & Safety	Completed	X				
EQ-3 Identify and require analysis and modification, as needed, of structures that may fall into categories that are vulnerable to damage from earthquakes, such as pre-cast concrete, soft-story structures, and non-ductile concrete frame buildings.	Building & Safety	Ongoing	X	X		X	
EQ-4 Encourage the adoption of building codes and design standards that incorporate the most recent seismic requirements.	Building & Safety	2008	X	X		X	X
EQ-5 Continually maintain, monitor, and update all relevant geologic and seismic related ordinances, regulations, and codes, to maximize awareness and planning for emergency response efforts.	Building & Safety	Ongoing	X	X		X	X

Action Item	Coordinating Organization	Timeline	Plan Goals Addressed				
			Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
EQ-6 Inform the public about earthquake safety, hazards and risks which may include: City newsletters & website, cable TV, Reverse 911 or other communication methods that explain the City's Emergency Response Plan, Emergency Operations Center, and appropriate procedures and phone numbers to call if a disaster occurs.	Fire	Ongoing	X	X		X	X
EQ-7 Promote the collection of relevant data on local groundwater levels and areas susceptible to liquefaction, as a basis for future refinements of liquefaction policies or procedures in the City.	ComDev	Completed (Safety Element of General Plan 2003)	X	X			
EQ-8 Support the improved delineation of potential liquefaction zones and strengthen the justification for geotechnical site investigations.	ComDev	Completed (Safety Element of General Plan 2003)	X	X			
EQ-9 Support the development of methods to quantify ground deformation associated with the occurrence of liquefaction.	ComDev	Completed (Safety Element of General Plan 2003)	X		X		
Flood Action Items (FLD)							
FLD-1 Review proposed development and require detention basins, where necessary, to reduce flooding risks.	Building & Safety	Ongoing (plan check process)	X		X	X	X
FLD-2 Continue working with Los Angeles County to increase storm drain capacity and efficiency.	PW	Ongoing	X		X	X	X
FLD-3 Continue to pursue all capital improvement projects related to improvement, maintenance for water related infrastructure.	PW	Ongoing	X		X		
FLD-4 Prepare an inventory of major urban drainage problems, and identify causes and potential mitigation measures for urban drainage problem areas.	PW	Completed Comm. Safety Element of General Plan 2003	X	X	X	X	X

Action Item	Coordinating Organization	Timeline	Plan Goals Addressed: Protect Life and Property	Public Awareness	Natural Systems	Partnerships and Implementation	Emergency Services
FLD-5 Review proposed development and require retention basins, where necessary, to reduce flooding risks. Ensure critical facilities have proper storm water drainage to prevent local flooding.	PW	Ongoing	X	X	X	X	X
FLD-6 Encourage green building practices to increase permeable surfaces.	ComDev	Ongoing		X	X	X	
Landslide Action Items (LND)							
LND-1 Establish a method to inform and notify the public about tell-tale signs that a landslide is imminent so that personal safety measures may be taken.	Fire	2008	X	X	X	X	X
LND-2 Consider Installation of signs warning the public of landslide danger in the vicinity of Sand Dune Park.	PW	2008	X	X			X
LND-3 Erosion control maintenance at Sand Dune Park.	PW	Ongoing	X				
Tsunami Action Items (TSU)							
TSU-1 Initiate a tsunami awareness program. Provide education to those specifically living or working within the areas of Manhattan Beach at risk of tsunami inundation. Publish tsunami information and post on the City's website for general dissemination.	Fire, Police	2008	X	X			X
TSU-2 Consider Installation of signs along the coast directing people away from the ocean to flee a tsunami.	PW	2008	X	X			X
TSU-3 Investigate a local tsunami warning system that would utilize sirens from fire and police department's equipment.	Fire, Police, PW	2008	X	X			X
TSU-4 Develop Tsunami Warning Plan to establish improved communications between with local agencies and universities.	Fire, Police		X	X		X	
TSU-5 Study feasibility of a warning system for "local tsunami" caused by close-to-shore underwater landslides.	Fire, Police		X	X		X	

SECTION 1: INTRODUCTION

Throughout history, the structures and occupants of the City of Manhattan Beach have dealt with the various natural hazards affecting the area, including Earthquake, Flood, Landslide, and Tsunami.

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

The City of Manhattan Beach is located in the southwestern quadrant of Los Angeles County. The City is characterized by the unique and attractive landscape. However, the potential impacts of hazards associated with the terrain make the environment and its occupants vulnerable to disasters.

The City is subject to Earthquake, Flood, Landslide, and Tsunami. 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 disasters.

Why Develop a Mitigation Plan?

As the costs of damage from disasters continue to increase, the City realizes the importance of identifying effective ways to reduce vulnerability to disasters. Hazard Mitigation Plans assist communities in reducing risk from natural hazards by identifying resources, information, and strategies for risk reduction, while helping to guide and coordinate mitigation activities throughout the City.

The plan provides a set of action items to reduce risks from 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 hazards.

The resources and information within the Mitigation Plan:

(1) Establish a basis for coordination and collaboration among agencies and the public of the City of Manhattan Beach,
(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 Multi-Hazard Functional Plan, City's General Plan and Capital Improvement Plan.

Whom Does the Mitigation Plan Affect?

The City of Manhattan Beach Hazard Mitigation Plan affects the entire City. Map 1-1 shows the areas contained within the boundaries of the City of Manhattan Beach. The resources and background information in the plan are applicable City-wide. The goals and recommendations contained in this plan will lay groundwork for other local mitigation plans and partnerships.

Map 1-1
Map of City of Manhattan Beach
(Source: City of Manhattan Beach General Plan)

Hazard Land Use Policy in California

Planning for 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.

Planning for hazards requires a thorough understanding of the various hazards facing the City and region as a whole. Additionally, it's important to take an inventory of the structures and contents of various City holdings. These inventories should include the compendium of hazards facing the city, 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 each local jurisdiction. 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 identification of hazards and 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, and state property, 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 and serves local water needs by providing technical assistance.

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. The City of Manhattan Beach conducted data research and analysis, participated in Planning Team meetings, and developed the final mitigation plan. The research methods and various contributions to the plan include:

Input from the Hazard Mitigation Planning Team:

The Hazard Mitigation Planning Team convened five 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 four entities, including:

City of Manhattan Beach
Community Development Department
Police Department
Public Works Department
City Manager's Office

Stakeholder interviews:

Stakeholder interviews were conducted during the workshops and meetings identified above. The interviews identified common concerns related to natural hazards and identified key long and short-term activities to reduce risk from natural hazards. Additional Stakeholders interviewed included the Los Angeles County Disaster Management Area Coordinator.

State and federal guidelines and requirements for mitigation plans

The following are the Federal requirements for approval of a Hazard 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, other 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 natural hazard exposures in the City
- ♦ A comprehensive mitigation strategy, which describes the goals and 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 Mitigation Plan into other planning mechanisms.
- ♦ Formal adoption by the City Council.
- ♦ Plan Review by both State OES and FEMA.

♦ Plan approval by 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, and the City Council public meeting. In addition, the makeup of a Hazard Mitigation 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
City of Long Beach (California) Natural Hazards Mitigation Plan
San Diego County (California) Multi-Jurisdictional Hazard Mitigation Plan
City of Hermosa Beach (California) Natural Hazards Mitigation Plan
Los Angeles County (California) Hazard Mitigation Plan

Hazard specific research: City staff collected data and compiled research on four hazards: Earthquake, Flood, Landslide, and Tsunami. Research materials came from the City General Plan, the City's Threat Assessment contained in the Multi-Hazard Functional Plan, and state agencies including OES and CDF. The City of Manhattan Beach staff conducted research by referencing historical local newspapers, interviewing long time residents, long time City of Manhattan Beach employees and locating City of Manhattan Beach information in existing documents. The City of Manhattan Beach staff identified current mitigation activities, resources and programs, and potential action items from research materials and stakeholder interviews.

Public Input

The City of Manhattan Beach encouraged public participation and input in the Hazard Mitigation Plan by posting its activities on the internet and conducting a Community Workshop. Following are comments gathered during the Community Workshop: #1 increase level of knowledge concerning threats associated with close-to-shore underwater landslides ("local tsunamis"), #2 improve tsunami warning systems, #3 decrease surface runoff by encouraging use of "green" construction standards (e.g. grass crete for driveways), #4 increase public awareness campaigns so that individuals can take more personal responsibility for disaster preparedness. Participants were encouraged to review public copies of the Draft Plan and to participate in the City Council public meeting which was held on November 5, 2008. Following is a summary of the public comments gathered during the City Council meeting:

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The resources and information cited in the Mitigation Plan provide a strong local perspective and help identify strategies and activities to make City of Manhattan Beach more disaster resistant.

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. 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 the City 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 the City of Manhattan Beach.

The Mitigation Plan and plan maintenance is organized into three parts. Part I contains an Executive Summary, Introduction, and Plan Maintenance. Part II contains Community 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. The plan action items are included in this section, and address multi-hazard issues, as well as hazard-specific activities that can be implemented to reduce risk and prevent loss from future natural hazard events. The Executive Summary also contains the Mitigation Actions Matrix.

Section 1: Introduction

The Introduction describes the background and purpose of developing the mitigation plan for the City of Manhattan Beach.

Section 2: Plan Maintenance

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

Part II: Hazard Analysis

This section provides information on the process used to develop goals and action items that cut across the four natural hazards addressed in the mitigation plan.

Section 3: Community Profile

The section presents the history, geography, demographics, and socioeconomics of the City of Manhattan Beach. It provides valuable information on the demographics and history of the region.

Section 4: Risk Assessment

This section provides information on hazard identification, vulnerability and risk associated with hazards in the City of Manhattan Beach.

Sections 5-8: Hazard-Specific Information

Hazard-Specific Section on the four 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: Flood
Section 7: Landslide
Section 8: Tsunami

Each Hazard-Specific Section includes information on the history, hazard causes, hazard characteristics, and hazard assessment.

Part III: Resources

The plan appendices are designed to provide users of the City of Manhattan Beach Hazard 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: Master Resource Directory

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

Appendix B: Public Participation Process

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.

Attachment 1: STAPLEE Prioritization Tool

This tool assesses each of the mitigation action items according to the following indicators: Social, Technical, Administrative, Political, Legal, Environmental, and Economic. STAPLEE will assist the Planning Team in prioritizing the various mitigation actions.

SECTION 2: PLAN MAINTENANCE

The Plan Maintenance section of this document details the formal process that will ensure that the City of Manhattan Beach Hazard Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the Plan annually and producing a plan revision every five years. This section describes how the City will integrate public participation throughout the plan maintenance process. Finally, this section includes an explanation of how the City of Manhattan Beach intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the City General Plan, Capital Improvement Plans, and Building and Safety Codes.

Monitoring and Implementing the Plan

Plan Adoption

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

Coordinating Body

A City of Manhattan Beach Hazard Mitigation Advisory Committee will be responsible for coordinating implementation of plan action items and undertaking the formal review process. The City will assign representatives including, but not limited to, the following departments:

Hazard Mitigation Advisory Committee
City of Manhattan Beach
Fire Department, Chair
Community Development Department
Police Department
Public Works Department
Engineering Division
Building & Safety Division

In order to make the Committee as broad and useful as possible, the City Manager may choose to involve other relevant organizations and agencies in hazard mitigation. These additional appointments could include:

A representative from the American Red Cross
A representative from a local government emergency response agency

The Hazard Mitigation Advisory Committee will meet at least once a year. 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 City of Manhattan Beach Natural Hazard Mitigation Plan. Following adoption, 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 Hazard Mitigation Advisory Committee members.

Implementation through Existing Programs

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

The City of Manhattan Beach Building & Safety Division is responsible for adhering to the State of California's Building & Safety Codes, and local amendments. 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 majority of the goals and action items in the Mitigation Plan may be achieved through activities recommended in the City's Capital Improvement Plans (CIP). The Public Works Department develops the CIP and reviews it on an annual basis. Upon annual review of the CIP, the Hazard Mitigation Advisory Committee will identify areas that the Natural Hazards Mitigation Plan action items are consistent with CIP 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 City planning documents and procedures.

Economic Analysis of Mitigation Projects

At the Hazard Mitigation Advisory Committee's first meeting, the Committee will utilize the STAPLEE (Social, Technical, Administrative, Political, Legal, Environmental, Economic) Tool (Attachment 1) to guide the implementation of the Mitigation Plan.

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.

Given federal funding, the Hazard Mitigation Advisory Committee will 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 City of Manhattan Beach 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 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 department (coordinating organization) 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 the appropriate members of the Committee. 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. The City Manager will have authority to update and amend the Mitigation Plan. The Hazard Mitigation Advisory Committee will also notify all holders of the City plan when changes have been made. Every five years the updated plan will be submitted to the State Hazard Mitigation Officer for review and the Federal Emergency Management Agency for approval.

Continued Public Involvement

City of Manhattan Beach 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 kept at the Community Development and Fire Departments, City Manager's Office, and Library. The existence and location of these copies will be publicized in the quarterly City newsletter, which reaches every resident and employee in the City. The plan also includes the address and the phone number of the Community Development Department which is 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.

A public meeting will also be held after each annual evaluation or when 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 Community Development Department will be responsible for using City resources to publicize the annual public meetings and maintain public involvement through the public access channel, web page, and newspapers.

STAPLEE

One method of assessing the costs and benefits associated with mitigation actions is through FEMA's STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) tool. STAPLEE is a systematic approach for weighing strengths and weaknesses of various mitigation actions. Each of the STAPLEE categories can be assessed in terms of opportunities and constraints. The completed STAPLEE tool is located at the back of the Plan in Attachment 1**.**

PART II: HAZARD ANALYSIS

SECTION 3: COMMUNITY PROFILE

Why Plan for Hazards in City of Manhattan Beach?

Natural, technological, and human-caused hazards impact residents, property, the environment, and the economy of City of Manhattan Beach. Earthquake, Flood, Landslide, and Tsunami may expose the City of Manhattan Beach to the financial and emotional costs of recovering after natural disasters. The risk associated with hazards increases as more people move to areas affected by hazards.

The inevitability of 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 hazard events. Identifying the risks posed by 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 hazard mitigation plan that addresses the potential impacts of hazard events.

Geography and the Environment

City of Manhattan Beach has an area of 3.88 square miles and is located in southwestern Los Angeles County. (Source: http://www.census.gov/)

Elevations in the City range from a high of 245 feet above sea level to a low of sea level. The terrain of the community is a combination of hills and flat areas. (Source: Manhattan Beach General Plan)

Community Profile

Since its beginnings as a City in 1912, Manhattan Beach has attracted residents, businesses, and visitors to the sandy shoreline, the temperate climate, and small-town character of this coastal jewel. Manhattan Beach faces the Pacific Ocean near the southerly end of Santa Monica Bay. It is part of the highly urbanized South Bay region, with neighbors including El Segundo to the north, Hawthorne and Redondo Beach to the east, and Hermosa Beach to the south.

The City of Manhattan Beach is a compact coastal community that offers the benefits of living in a temperate type of climate. The City is characterized by 2.1 miles of beach front that makes the area so attractive and popular. The City has an area of 3.88 square miles. The City is located southwest of Los Angeles on the southerly end of the Santa Monica Bay and is 3 miles south of the Los Angeles International Airport. The City is generally bounded by the cities of El Segundo to the north, Hawthorne to the east, Redondo Beach to the east and south, and Hermosa Beach to the south.

The City is served by the Interstate 405 Freeway (San Diego Freeway) and Interstate 105 (Glenn Anderson Freeway) freeways. The City is served by one major regional arterial, Sepulveda Boulevard (State Route 1, which runs north to south), and four other major arterials, including Rosecrans Avenue, Artesia Boulevard and Manhattan Beach Boulevard which run east to west and Aviation Boulevard which runs north to south.

The City is made up of several distinct neighborhoods that people recognize: the Sand Section, Downtown, North End/El Porto, the Tree Section, the Hill Section, Manhattan Village and the Eastside. Within some of these neighborhoods are smaller, more defined areas with their own unique characteristics and each of these areas often do not have a district boundary. Generally, the Beach Area and Tree Section are characterized by their density, having a lot of people within a small area. These neighborhoods are concentrated into compact neighborhoods.

Topographic elevations in the City range from a high of 245 feet to a low of mean sea level. The terrain of the City is a combination of hills and flat areas.

Climate

Temperatures in the City of Manhattan Beach vary from around 49 degrees in the winter months to 75 degrees in the summer months. However the temperatures can vary over a wide range, particularly when the Santa Ana winds blow, bringing higher temperatures, very low humidity, and strong winds. (Source: CityTownInfo.com)

Rainfall in the region averages 13.1 inches per year. But the term "average" means very little in Los Angeles County 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. (Los Angeles County)

Furthermore, actual rainfall in the Southern California region tends to fall in large amounts during sporadic and often heavy storms rather than consistently over storms at somewhat regular intervals. 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

Like any other area, the characteristics of the minerals and soils present in the City of Manhattan Beach indicates 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.

Sand dunes have also played a significant role in the history of the area. During the 1920's, the community experienced major growth that included restaurants, housing tracts, hotels, and businesses. Sand was hauled away in railcars daily for the next 10 years to remove the massive sand dunes standing 50 to 70 feet in height behind the beaches. Some of the sand was used to build the Memorial Coliseum in Los Angeles and was also sent across seas on barges to build the beach in Waikiki, Hawaii. Evidence of the large sand dunes remains today at Sand Dune Park.

Other Significant Geologic Features

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

Although no surface faults are known to pass through Manhattan Beach, the City does lie above the Compton Thrust Fault. This type of fault does not rupture all the way up to the surface, so there is no evidence of it on the ground. It is "buried" under the uppermost layers of rock in the crust. In addition, several regional potentially active faults nearby can produce enough shaking to significantly damage structures and cause loss of life.

The Los Angeles Basin has a history of powerful and relatively frequent earthquakes, dating back to the 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 Earthquake and the 1994 Northridge Earthquake.

The soil types in Manhattan Beach can be categorized as one of two main types. The areas near the coast line, at the western portion of the city, consists of fine grain sandy soil with small areas of fine grain silty sand that is naturally well compacted.

The second type is located at the eastern portion of the city, and consists of a small portion of clay with mostly fine silty sand that is fairly compacted with stable moisture content.

With the exception of Sand Dune Park area, and the area located west of the Strand, there are no expansive soils or soils with liquefaction characteristics that exist in Manhattan Beach, as stated by the geologic maps, which are provided by the Division of Mines and Geology of the California Department of conservation.

In addition, many areas in the Los Angeles Basin have sandy soils that may be subject to liquefaction. The City has two liquefaction zones that are documented and mapped. These two areas are Sand Dune Park and the beach, both of which are not zoned for any development. The beach is under the separate jurisdiction of Los Angeles County.

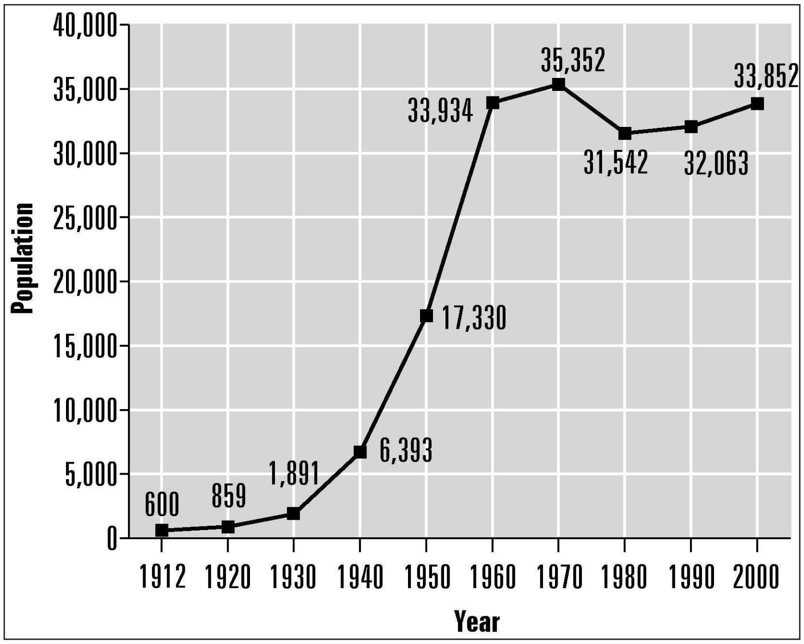
The City has only one area with land movement potential, Sand Dune Park. Historically, Manhattan Beach has had several sand dunes as typical throughout the coastal area, the sand dune at this park is the last remaining natural sand dune in the City. This sand dune, which is exceptionally high, has been converted to a public recreational use.

Population and Demographics

The City of Manhattan Beach encompasses an area of 3.88 square miles and experienced its greatest growth in population between 1930 and 1960. The City has a current population of 33,852 (Source: 2000 Census), which represents an increase of 5.28% since 1990. The City's population is expected to increase at a modest rate incrementally in the future due to the fact that there is virtually no vacant land in the City that may be developed with new housing.

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

Historic City of Manhattan Beach Population
(Source: General Plan)



According the 2000 Census, the demographic make up of the City is as follows:

	City of Manhattan Beach
Caucasian	89%
African American	0.6%
Asian	6%
Native American	0.2%
Other	4.2%

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

The percentage of citizens living in poverty in the City of Manhattan Beach is about 3.2% according to the 2000 Census.

Disaster case studies have shown that 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.

Land and Development

The City of Manhattan Beach 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
(Source: http://censtats.census.gov/data/CA/1600645400.pdf and Manhattan Beach General Plan – Land Use Element)

	City of Manhattan Beach
Development Type	
Residential	69.7%
Commercial	10.3%
Industrial	3.6%
Public Facilities	7.0%
Parks & Open Space	7.3%
Other Uses	2.1%
Housing Type	
Single-Family	98.4%
Multi-Residential (20+ units)	1.4%
Mobile Homes	0.2%
Housing Statistics	
Total Available Housing Units	15,094
Owner-Occupied Housing	9,440
Average Household Size	2.34
Average Home Value	672,600

Employment and Industry
(Source: 2000 Census)

City of Manhattan Beach	
Principal Activities	**Employment**
Management (professional and related occupations)	64.3%
Service Occupations	6.3%
Sales and Office Occupations	24.4%
Construction	2.9%

Production, Transportation, and Material Moving	2.1%

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 Manhattan Beach. However, the City of Manhattan Beach meets its public transportation needs through a mixture of a regional transit system (MTA), and various City contracted bus systems. MTA provides both bus and light rail service to the City of Manhattan Beach and to the Los Angeles County metropolitan area. In addition to this service, the City promotes alternative transportation activities.

As stated in the City's General Plan, the City of Manhattan Beach is served by the 405 and 105, connecting the City to adjoining parts of 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. Hazards can disrupt automobile traffic and shut down local and regional transit systems.

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 five levels of a risk assessment are as follows:

1) Hazard Identification

The Planning Team considered a range of natural hazards facing the region including: Earthquakes, Flooding, Landslide, Tsunami, Windstorm, Drought, and a range of Technological/Human-Caused Hazards. The attached Ranking Your Hazards-Figure 4-1 was used by the Team to prioritize the natural hazards with the highest probability of impacting the City of Manhattan Beach. The Team agreed that any hazard receiving a Team score higher than "3" would be included in the Natural Hazards Mitigation Plan. Utilizing the ranking technique, the Team identified Earthquake, Flood, Landslide, and Tsunami as the most prominent hazards facing the City.

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 Manhattan Beach identified five major hazards that affect this geographic area. These hazards – Earthquake, Flood, Landslide, and Tsunami - 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 Manhattan Beach utilizing the maps contained in the City's General Plan, City's Multi-Hazard Functional Plan, and the County's Hazard Mitigation Plan. The vulnerabilities posed by these hazards are depicted on Table 4-1.

2) Profiling Hazard Events

This process describes the causes and characteristics of each hazard and what part of the City's facilities, 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.

Table 4-1:
Vulnerability: Location, Extent, and Probability*

	Location (Where)	**Extent (How Big an Event)**	**Probability (How Often)***
Hazard			
Earthquake	Entire Project Area	The Southern California Earthquake Center (SCEC) in 1995 concluded that there is an 80-90 % probability that an earthquake of M7.0 or greater will hit Southern California before 2024.[1]	Moderate
Flood	Coastal and other Isolated Areas	Coastal Flooding: Coastal Areas Urban Flooding: Urbanized Areas	Moderate

Hazard	Location (Where)	Extent (How Big an Event)	Probability (How Often)*
Hazard			
Landslide (Rain-Induced)	Sand Dune Park	Damage could impact the Park	Low
Tsunami	Coast	Up to 40 foot run-up along coastal region.	Low
* Probability is defined as: Low = 1:500 years, Moderate = 1:100 years, High = 1:10 years			
[1] State of California Hazard Mitigation Plan			

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 4-3 at the end of this section.

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. For each hazard where data was available, quantitative estimates for potential losses have been included in the hazard assessment. Data was not available to make vulnerability determinations in terms of dollar losses. The Mitigation Actions Matrix (Executive Summary – Table 1) includes an action item to conduct such an assessment in the future.

5) Assessing Vulnerability/ Analyzing Development Trends

This step provides a general description of City facilities and contents in relation to the identified hazards 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 the City of Manhattan Beach 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 the City of Manhattan Beach 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 (Executive Summary – Table 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.

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 four hazards profiled in the mitigation plan, including Earthquake, Flood, Landslide, and Tsunami. The Federal criteria for risk assessment and information on how the City of Manhattan Beach Hazard Mitigation Plan meets those criteria is outlined in Table 4-2 below.

Table 4-2: 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 include 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 within the City. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses	The Risk Assessment Section of this mitigation plan identifies key critical facilities that provide services to the City and includes a map of these facilities. 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 Community Profile Section of this plan provides a description of the population trends and transportation patterns.

Critical and Essential Facilities

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include: local government 911 centers, local government emergency operations centers, schools (hosting shelters), local police and fire stations, local public works facilities, local communications centers, hospitals, bridges and major roads, 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 City services or that may significantly impact the City's ability to recover from the disaster. These facilities may include: buildings such as jails, law enforcement center, public services building, community corrections center, courthouses, and juvenile services buildings or other public facilities such as schools. The following Table 4-3 illustrates the critical and essential facilities providing services to the City of Manhattan Beach. Note that secondary impacts associated with earthquake hazards have been included on a site-by-site basis.

Table 4-3: City of Manhattan Beach Critical and Essential Facilities Vulnerable to Hazards
(X = site's risk rating is "possible, likely, or highly likely")
(Key: EQ = Earthquake, Fld = Flood, Lnd = Landslide, Tsu = Tsunami)

EQ	Fld	Lnd	Tsu	Facility	Address
X	X			City Hall	1400 Highland Avenue
X	X	X		Public Works Yard	3621 Bell Avenue
X	X			Library (LA County)	1320 Highland Avenue
X	X			Creative Arts Center	1560 Manhattan Beach Boulevard
X				Joslyn Community Center	1601 Valley Drive
X	X			National Guard Armory (Federal)	3601 Bell Avenue
X				Water Tower	Rowell Avenue/ 6th Street
X	X			Mira Costa High School	700 South Peck Avenue
X				Manhattan Beach Middle School	1501 Redondo Avenue
X	X			Grandview Elementary	455 24th Street
X				Pacific Elementary	1431 15th Street
X	X			Robinson Elementary	80 S. Morningside Drive
X				Meadows Elementary	1200 Meadows Avenue
X				Pennekamp Elementary	110 South Rowell Avenue
X				Manhattan Beach Transition School	1435 15th Street
X	X			Fire Station 1/Police Station	420 15th Street
X				Fire Station 2	1400 Manhattan Beach Boulevard
X				Ross Manhattan Terrace (Senior Housing)	3400 Valley Drive
X				Manhattan Village Senior Villas	1300 Park View Avenue
X	X			Manhattan Heights Center	1600 Manhattan Beach Boulevard
X				Northrop Grumman	3001 Aviation Boulevard

Summary

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

Figure 4-1:

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
Earthquake	**3**
Flooding	**3**
Landslide (Rain-Induced)	**3**
Tsunami	**3**
Windstorm	**1**
Drought	**1**
Other Hazard: Terrorism	**1**
Other Hazard: Hazardous Materials	**1**
Other Hazard: Urban Fire	**1**

SECTION 5: EARTHQUAKE HAZARDS

Why Are Earthquakes a Threat to the City of Manhattan Beach

The most recent significant earthquake event affecting Southern California was the January 17th 1994 Northridge Earthquake. At 4:31 A.M. on Monday, January 17, a moderate but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures. The City of Manhattan Beach was impacted by the 1994 Northridge Earthquake, however there was no significant damage to the City.

Within Southern California 57 people were killed and more than 1,500 people seriously injured during the Northridge Earthquake. For days afterward, thousands of homes and businesses were without electricity; tens of thousands had no gas; and nearly 50,000 had little or no water. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. About 66,500 buildings were inspected. Nearly 4,000 were severely damaged and over 11,000 were moderately damaged. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Extensive damage was caused by ground shaking, but earthquake triggered liquefaction and dozens of fires also caused additional severe damage. This extremely strong ground motion in large portions of Los Angeles County resulted in record economic losses.

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

Historical and geological records show that California has a long history of seismic events. Southern California is probably best known for the San Andreas Fault, a 400 mile long fault running from the Mexican border to a point offshore, west of San Francisco. "Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 130 year intervals on the Southern San Andreas Fault. As the last large earthquake on the Southern San Andreas Fault occurred in 1857, that section of the fault is considered a likely location for an earthquake within the next few decades." (Source: USGS http://pubs.usgs.gov/gip/earthq3/when.html)

But San Andreas 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 October 1987 Whittier Narrows Earthquake.

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 Southern California. Seismologists believe that a 6.0 earthquake on the Newport-Inglewood Fault would result in far more death and destruction than a "great" quake on the San Andreas, because the San Andreas Fault 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 Region
(Source: U.S. Geological Survey)

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	1952	Kern County
1858	San Bernardino Region	1954	West of Wheeler Ridge
1862	Old Town San Diego	1971	San Fernando
1892	San Jacinto/Elsinore Fault	1973	Point Mugu
1893	Pico Canyon	1986	Coastal San Diego
1894	Lytle Creek Region	1986	North Palm Springs
1894	East of San Diego	1987	Whittier Narrows
1899	Lytle Creek Region	1992	Landers
1899	San Jacinto and Hemet	1992	Big Bear
1907	San Bernardino Region	1994	Northridge
1910	Glen Ivy Hot Springs	1999	Hector Mine

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 are 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 (M7.9) and the Owens Valley in 1872 (M7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. In more recent times two M7.3 earthquakes struck Southern California, in Kern County (1952) and Landers (1992). The damage from these four large earthquakes was limited because they 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. Table 5-1 describes the historical earthquake events that have affected Southern California.

Measuring and Describing Earthquakes

An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the Earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. They usually occur without warning and, after just a few seconds, can cause massive damage and extensive casualties. Common effects of earthquakes are ground motion and shaking, surface fault ruptures, and ground failure. Ground motion is 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. Soft soils can further amplify ground motions. The severity of these effects is dependent on the amount of energy released from the fault or epicenter. One way to express an earthquake's severity is to compare its acceleration to the normal acceleration due to gravity. The acceleration due to gravity is often called "g". A 100% g earthquake is very severe. More damage tends to occur from earthquakes when ground acceleration is rapid.

Peak ground acceleration (PGA) is a measure of the strength of ground movement. PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity (980 cm/sec/sec). PGA is used to project the risk of damage from future earthquakes by showing earthquake ground motions that have a specified probability (10%, 5%, or 2%) of being exceeded in 50 years. These ground motion values are used for reference in construction design for earthquake resistance. The ground motion values can also be used to assess relative hazard between sites, when making economic and safety decisions. Another tool used to describe earthquake intensity is the Richter Scale. The Richter Scale was devised as a means of rating earthquake strength and is an indirect measure of seismic energy released. The scale is logarithmic with each one-point increase corresponding to a 10-fold increase in the amplitude of the seismic shock waves generated by the earthquake. In terms of actual energy released, however, each one-point increase on the Richter scale corresponds to about a 32-fold increase in energy released. Therefore, a Magnitude 7 (M7) earthquake is 100 times (10 X 10) more powerful than a M5 earthquake and releases 1,024 times (32 X 32) the energy. An earthquake generates different types of seismic shock waves that travel outward from the focus or point of rupture on a fault. Seismic waves that travel through the earth's crust are called body waves and are divided into primary (P) and secondary (S) waves. Because P waves move faster (1.7 times) than S waves they arrive at the seismograph first. By measuring the time delay between arrival of the P and S waves and knowing the distance to the epicenter, seismologists can compute the Richter Scale magnitude for the earthquake.

The Modified Mercalli Scale (MMI) is another means for rating earthquakes, but one that attempts to quantify intensity of ground shaking. Intensity under this scale is a function of distance from the epicenter (the closer to the epicenter the greater the intensity), ground acceleration, duration of ground shaking, and degree of structural damage. This rates the level of severity of an earthquake by the amount of damage and perceived shaking (Table 5-2).

Table 5-2: Earthquake Magnitude and Intensity Comparison (Source: Manhattan Beach General Plan)

Descriptor	Magnitude	Intensity	Description
Very Minor	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
Minor	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
Light	4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
Moderate	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
Strong	6.0 - 6.9	VIII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
Major Great	7.0 -7.9 8.0 and higher	X - XII	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges

Descriptor	Magnitude	Intensity	Description
			destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: United States Geological Survey (USGS) National Earthquake Information Center, (http://neic.usgs.gov/neis/general/handouts/mag_vs_int.html), October 2002.

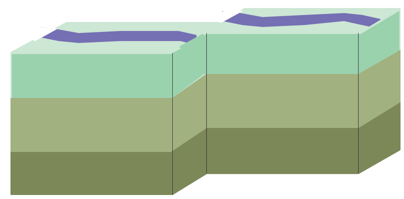
Figure 5-1: Causes and Characteristics of Earthquakes in Southern California

Earthquake Faults

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

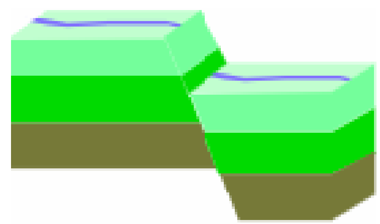
Strike-slip

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.



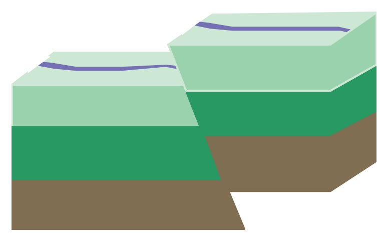
Dip-slip

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

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." 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.

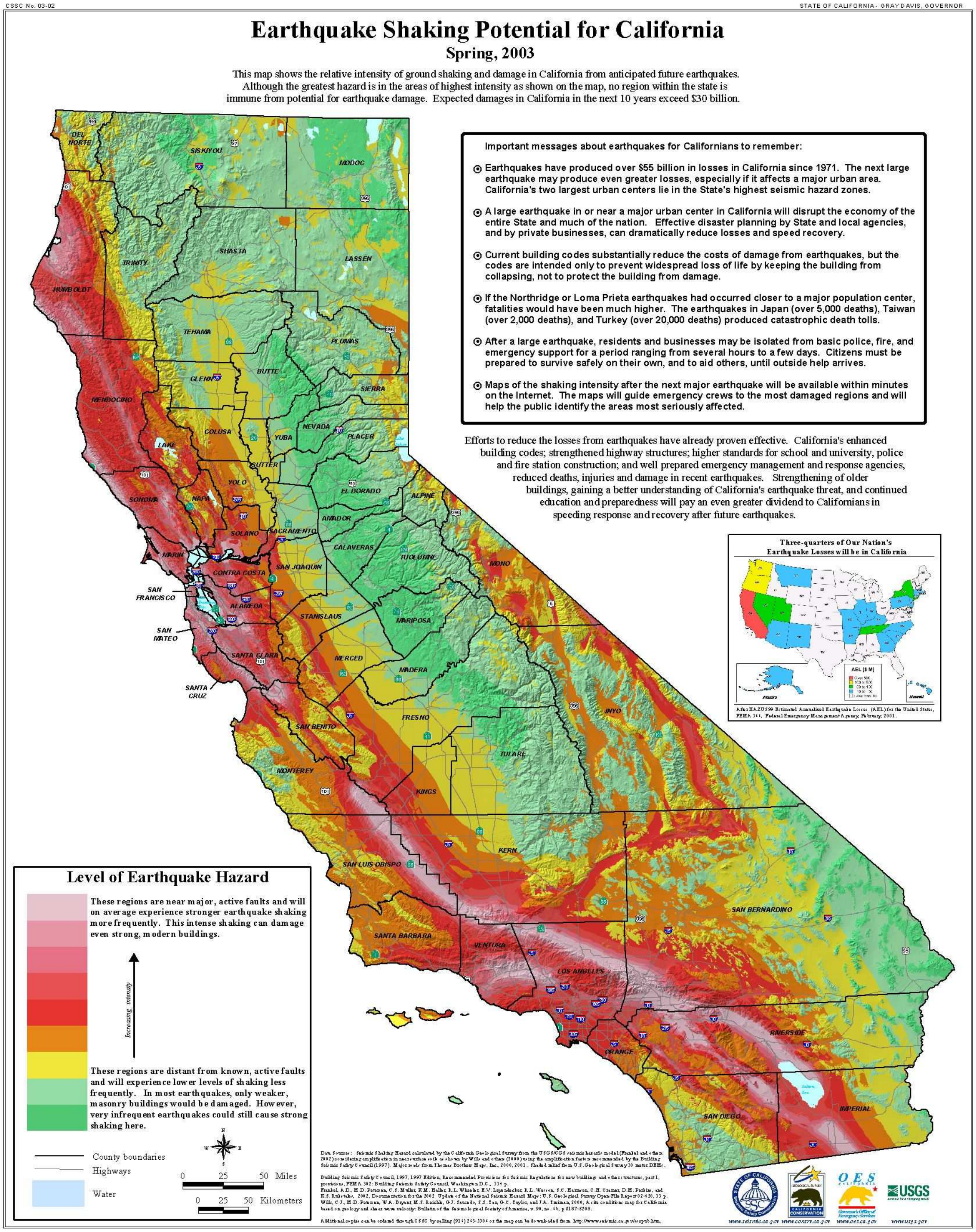
Ground Shaking
Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where 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. Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

Map 5-1: Earthquake Shaking Potential for California
(Source: www.seismic.ca.gov/pub/shaking_18x23.pdf)



Earthquake Hazard Assessment

Hazard Identification

Map 5-2 Southern California Earthquake Faults plots the various major faults in Southern California. The Southern California Earthquake Data Center predicts that somewhere in Southern California will likely experience a Magnitude 7.0 or greater earthquake about seven times each century. About half of these will probably be on the San Andreas "system" (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%.

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: Los Angeles Basin Earthquake Fault Map
(Source: Manhattan Beach General Plan)

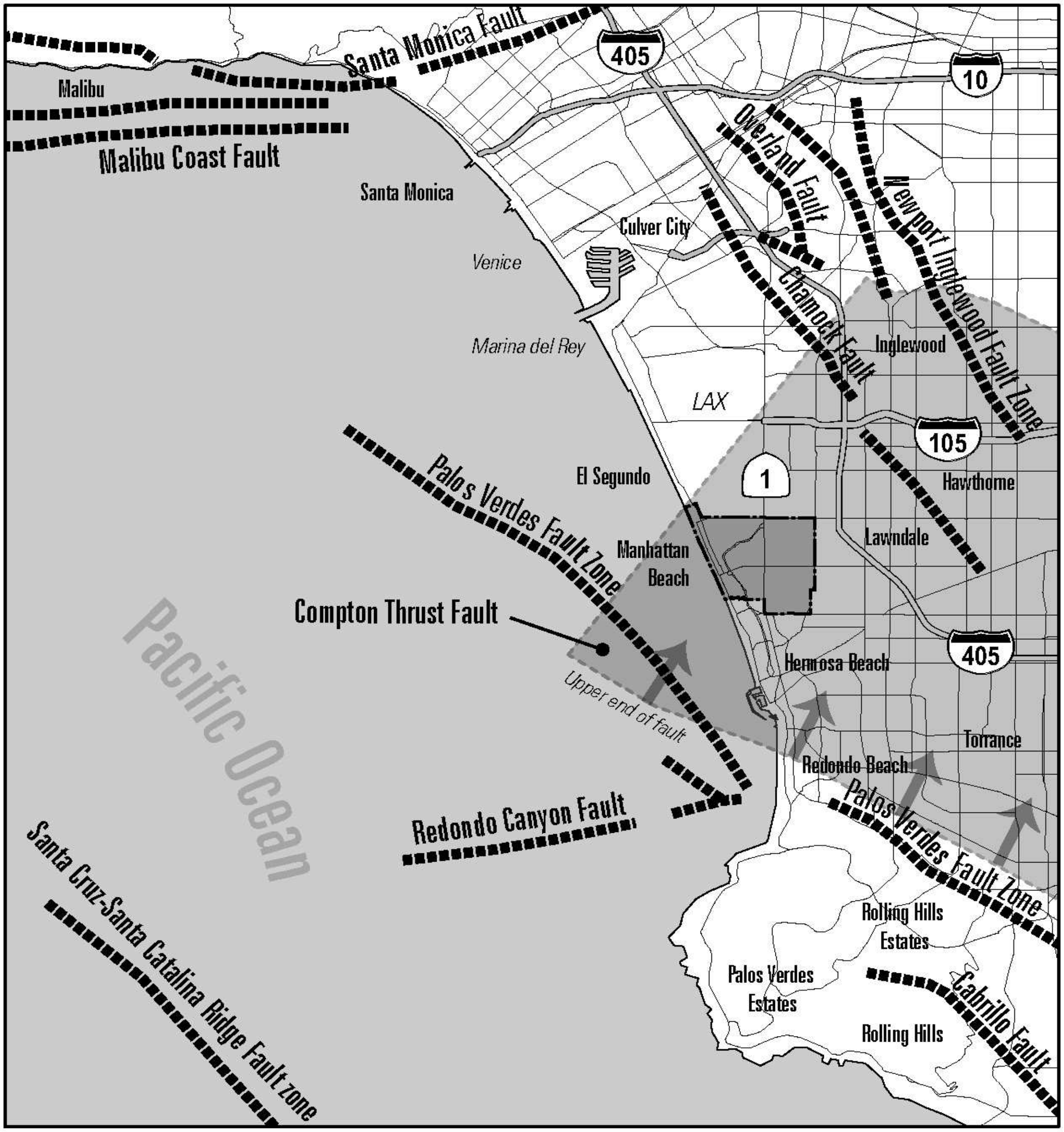


Table 5-3: Magnitude and Intensity of Maximum Credible Earthquake for Faults Potentially Impacting Manhattan Beach

Regional Fault Name	Distance to Manhattan Beach (miles)	Magnitude of MCE	Intensity Range of MCE (1)	Last Major Rupture
Compton Thrust Fault(2)	0.0	6.8	VIII-IX	N/A
Palos Verdes Fault	2.0 offshore 4.0 onshore	7.1	X-XII	Holocene(3), offshore
Newport-Inglewood Fault	4.5	6.9	VIII-IX	March 10, 1933, 6.4M – Long Beach Earthquake
Santa Monica Fault	11.0	6.6	VIII-IX	Late Quaternary(4)
Malibu Coast Fault	15.0	6.7	VIII-IX	Holocene, in part; otherwise Late Quaternary
San Andreas	47.0	7.1-7.8	X-XII	January 9, 1857 (Mojave segment); April 18, 1906 (Northern segment)

Source: Southern California Earthquake Data Center, http://www.scecdc.scec.org/.

Notes: (1) Intensity in Manhattan Beach will vary greatly depending on where the epicenter of the earthquake is located. The closer the epicenter is to Manhattan Beach, the higher the intensity scale.

(2) A specific kind of reverse fault in which the dip of the fault is less than 45 degrees over much if not all of its length. It is characterized not so much by vertical displacement, but by horizontal compression.

(3) Holocene: The most recent geologic era; from about 10,000 years ago to the present.

(4) Quaternary: Late Quaternary refers to the time between 700,000 years ago and the present day.

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

The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. 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.

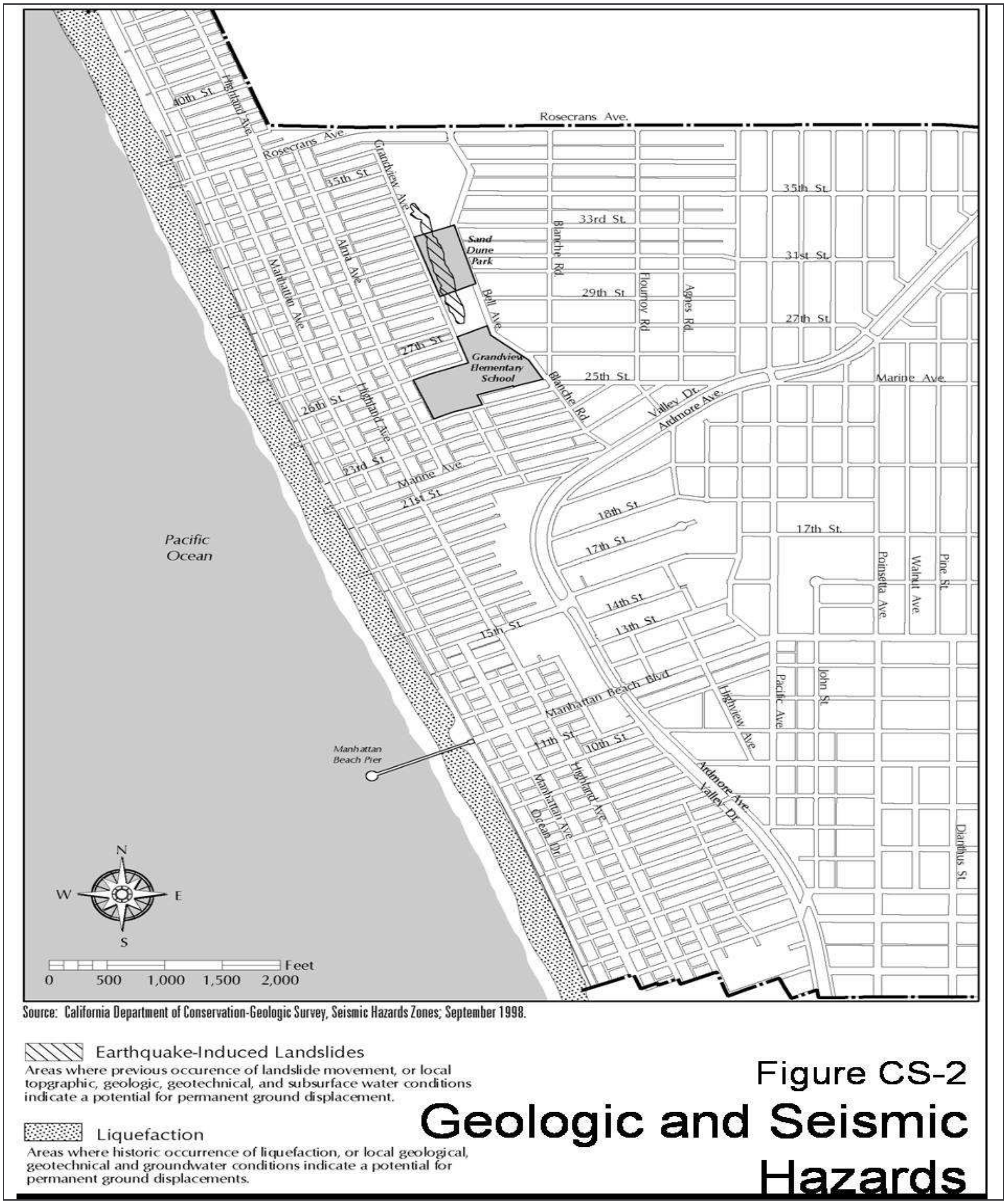
The California Geological Survey has identified areas most vulnerable to liquefaction. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Map 5-3 identifies areas in the City of Manhattan Beach that are subject to liquefaction and landslides associated with earthquake activities. All of the liquefaction prone areas are located in the coastal locations in the City.

Several major active faults exist in Los Angeles County, including the San Andreas, Newport Inglewood, Elsinore, San Jacinto, Whittier, Norwalk, Compton Thrust, Palos Verdes, and Santa Monica. The Compton Thrust or Palos Verdes Fault are considered to be the greatest potential threat to the City of Manhattan Beach, due to there proximity to the City. (Source: Southern California Earthquake Data Center).

People and Property at Risk

The level of damage in the City resulting from an earthquake will depend upon the magnitude of the event, the epicenter distance from the City, the response of geologic materials, and the strength and construction quality of structures. While ground shaking itself can cause damage, related effects such as liquefaction, landslides, and tsunami inundation are also of concern.

Map 5-3: Liquefaction and Earthquake – Induced Landslide Areas in the City of Manhattan Beach
(Source: Manhattan Beach General Plan)



Risk Analysis

Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Factors included in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region. This type of analysis can generate estimates of the damages to the region due to an earthquake event in a specific location. 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. 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 1994 Northridge Earthquake, Santa Monica suffered extensive damage, even though there was a range of mountains between it and the origin of the earthquake.

Damages from a large earthquake almost anywhere in Southern California are likely to run into the billions of dollars. Although building codes are some of the most stringent in the world, tens of thousands of older existing buildings were built under much less rigid codes. California has laws affecting un-reinforced 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. The City of Manhattan Beach has no unreinforced masonry buildings.
(Source: http://www.seismic.ca.gov/pub/CSSC_2005-02_URM.pdf)

In 1986, California enacted a law that required local governments in Seismic Zone 4 to inventory unreinforced masonry (URM) buildings, to establish a URM loss reduction program and report progress to the state by 1990. Each local government was allowed to tailor their program to their own specifications.

URM Law

California's main effort to reduce these earthquake losses is the URM Law. Passed in 1986, this state law requires 365 local governments in the highest Seismic Zone 4 (ICBO, 1985) to do three things:

- Inventory URM buildings within each jurisdiction
- Establish loss reduction programs for URM buildings by 1990
- Report progress to the California Seismic Safety Commission

In addition, the law recommends that local governments:

- Establish seismic retrofit standards
- Adopt mandatory strengthening programs
- Enact measures to reduce the number of occupants in URM buildings.

This law can be found in Section 8875 et seq, of California's Government Code (CA, 1986). It allows each local government to choose its own type of loss reduction program. This leeway is, in part, intended to allow for each jurisdiction to take political, economic, and social priorities into account. The evidence suggests that individual communities pursued earthquake loss reduction programs best suited to their own local priorities reflecting the local balance of safety versus economy (CSSC, 1995-05). California's Seismic Safety Commission monitors local government efforts to comply with this law and reports to the state's Legislature. This report updates the Commission's prior Year 2003 status report (SSC, 2003-03).

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.

City 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 region.

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 Manhattan Beach, many buildings were built before 1993 when building codes were not as strict. City structures are built in compliance with State of California building standards, not those controlled by the local jurisdictions.

To date, the City has retrofitted 100% of proposed structures. Given the retrofitting program, the number of buildings at risk has been decreased significantly. Even though the critical facilities may be better off that does not change the fact that people live in un-reinforced masonry buildings vulnerable to damage from earthquakes. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of un-reinforced masonry buildings.

Infrastructure and Communication
Residents in the City of Manhattan Beach 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.

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 Services
Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the City. These facilities and their services need to be functional

after an earthquake event. See Section 4: Risk Assessment for critical and essential facilities vulnerable to earthquakes.

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. These closures can also have a significant impact on local school districts.

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. These businesses could easily be providers of services to the City. These disruptions would also impact the City.

Individual Preparedness
Because the potential for earthquake occurrences and earthquake related property damage is relatively high in the City of Manhattan Beach, 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. Disasters do not exempt the City of Manhattan Beach from compliance with AB 939 regulations.

SECTION 6: FLOOD HAZARDS

Why are Floods a Threat to the City of Manhattan Beach?

Flooding poses a threat to life and safety, and can cause severe damage to public and private property. There are various locations throughout the City that are threatened by flooding due to localized flooding.

History of Flooding in the City of Manhattan Beach

City of Manhattan Beach has no significant history of flooding however the City is susceptible to localized urban flooding caused by heavy rains, as shown in Map 6-1.

Historic Flooding in Los Angeles County

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.

Average annual precipitation in Los Angeles County ranges from 13 inches on the coast to approximately 40 inches on the highest point of the Peninsular Mountain Range that transects the county. Several factors determine the severity of floods, including rainfall intensity and duration. A large amount of rainfall over a short time span can result in flash flood conditions. A sudden thunderstorm or heavy rain, dam failure, or sudden spills can cause flash flooding. The National Weather Service's definition of a flash flood is a flood occurring in a watershed where the time of travel of the peak of flow from one end of the watershed to the other is less than six hours.

Table 6-1: Historical Records of Large Floods in Los Angeles County
(Source: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~ShowEvent~192429)

Date	Loss Estimation	Source of Estimate	Comments
1995	$ 50 million	National Oceanic & Atmospheric Association	Flash Flood
1995	$ 50 thousand	National Oceanic & Atmospheric Association	Flood/Flash Flood
2005	$ 1 million	National Oceanic & Atmospheric Association	Flash Flood

Naturally, this rainfall moves rapidly downstream, often with severe consequences for anything in its path. In extreme cases, flood-generated debris flows will roar down a canyon at speeds near 40 miles per hour with a wall of mud, debris and water tens of feet high.

In Southern California, floods, debris flows, persons buried alive under tons of mud and rock and persons swept away to their death in a river flowing at thirty-five miles an hour occur on a regular basis.

What Factors Create Flood Risk?
Flooding occurs when climate, geology, and hydrology combine to create conditions where water flows outside of its usual course.

Winter Rainfall
Over the last 125 years, the average annual rainfall in the region is 13.1 inches. But the term "average" means very little because there is a fluctuation rate in the coastal rains as high as thirty percent in forty-five out of every one hundred years, which is coupled with a highly seasonal rainfall pattern with only fifteen percent falling during the hottest six months of the year.

Monsoons
Another relatively regular source for heavy rainfall, particularly in nearby mountains and foothills is from summer tropical storms. Table 6-2 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 6-2: Tropical Cyclones of Southern California
(Source: http://en.wikipedia.org/wiki/List_of_California_hurricanes)

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	up to 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	up to 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"

Month-Year	Date(s)	Area(s) Affected	Rainfall
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	up to 3.40”
Sept. 1963	17th - 19th	Central & Southern Mountains	up to 7”
Sept. 1967	1st - 3rd	Southern Mountains & Deserts	up to 2”
Oct. 1972	6th	Southeast Deserts	up to 2”
Sept. 1976	10th & 11th	Central & Southern Mountains. Ocotillo was Destroyed 3 Fatalities	6 to 12”
Aug. 1977	n/a	Los Angeles	up to 2”
		Mountains	up to 8”
Oct. 1977	6th & 7th	Southern Mountains & Deserts	up to 2”
Sept. 1978	5th & 6th	Mountains	up to 3”
Sept. 1982	24th - 26th	Mountains	up to 4”
Sept. 1983	20th & 21st	Southern Mountains & Deserts	up to 3”
Oct. 1987	5th - 12th	Camp Pendleton (north San Diego County)	Up to 2”
Sept. 1997	25th & 26th	Southern California and Arizona	New record for Arizona Mogollon Rim set at 12.01”

Geography and Geology

The greater Southern California region 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”

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.

As a region, the majority of buildable portions of Los Angeles County are developed. This leaves very 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 flood control systems including concrete lined river and stream beds, flooding would be a much more common occurrence. 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.

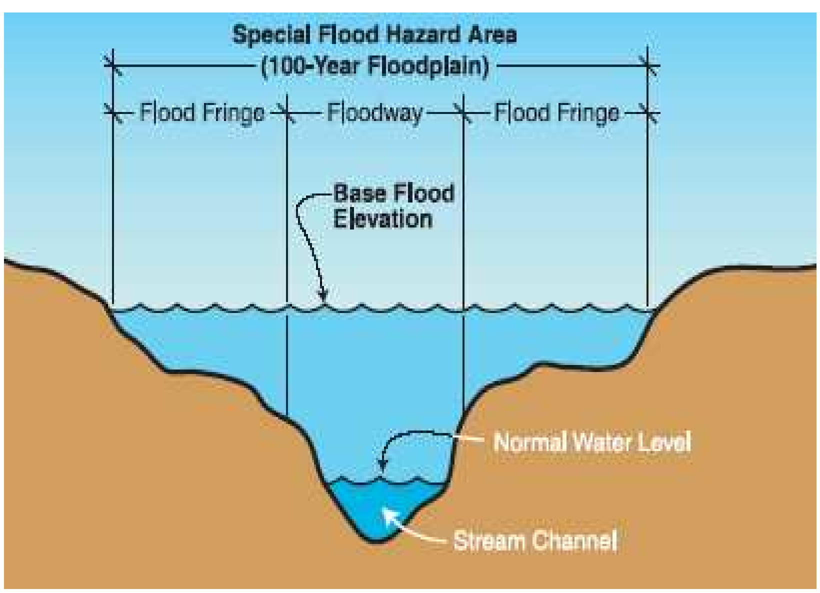
Another potential source of flooding is "asphalt creep." The street space between the curbs of a street is a part of the flood control system. Water leaves property and accumulates in the streets, where it is directed towards the underground portion of the flood control system. The carrying capacity 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. Schematic 6-1 Floodplain and Floodway shows the relationship of the floodplain and the floodway.

Schematic 6-1: Floodplain and Floodway
(Source: FEMA How-To-Guide Assessing Hazards)



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 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.

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 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
Urban flooding is the biggest flooding threat to the City. In addition, any low-lying areas have a potential for ponding. 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.

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.

The City of Manhattan Beach has a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water in unnatural channels. Storm drains may back up with vegetative debris causing additional, localized flooding. Map 6-1 illustrates the local urban flooding areas in the City of Manhattan Beach.

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.

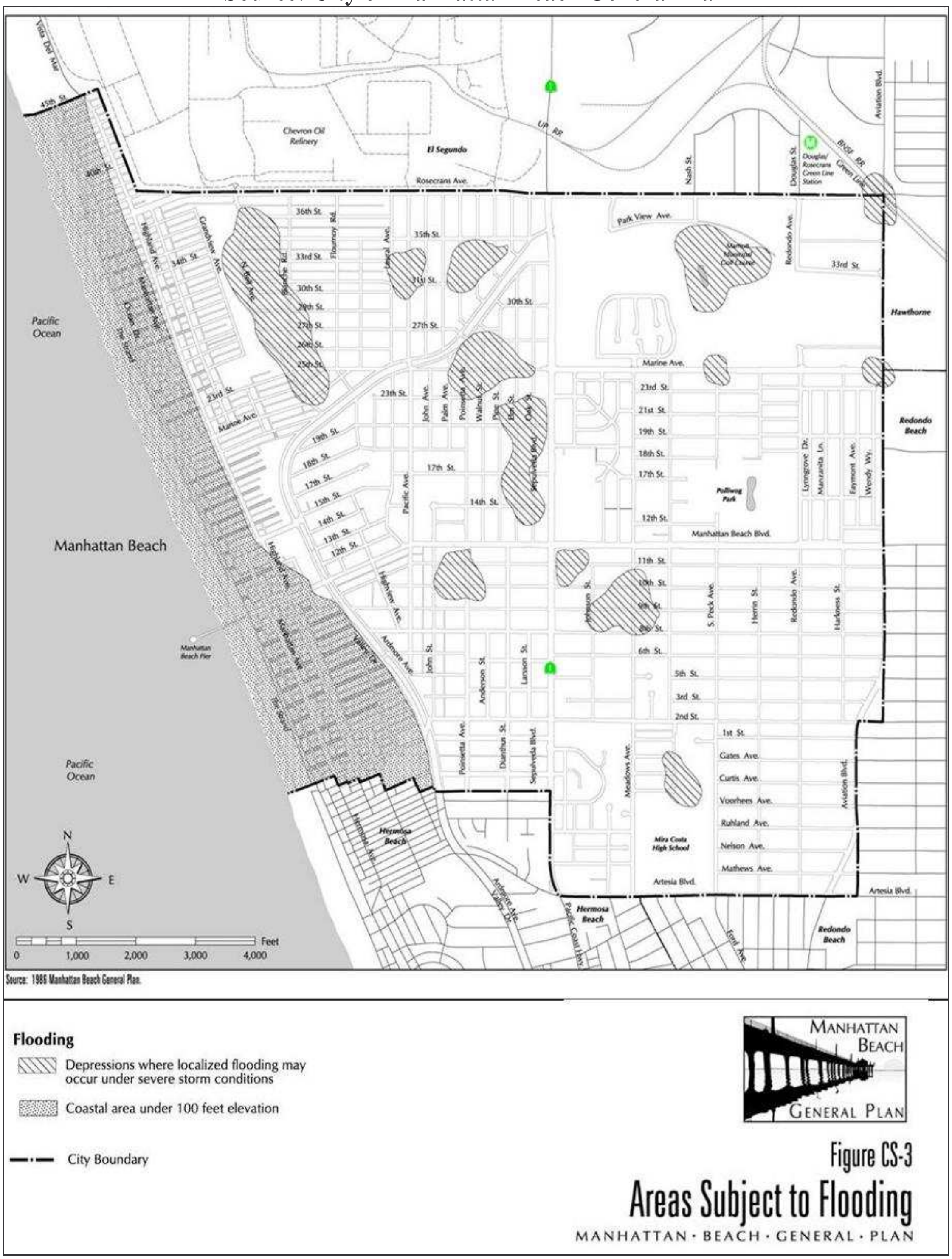
> "Debris flows, sometimes referred to as mudslides, mudflows, lahars, or debris avalanches, are common types of fast-moving landslides. These flows generally occur during periods of intense rainfall or rapid snow melt. They usually start on steep hillsides as shallow landslides that liquefy and accelerate 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." (Source: http://www.redcross.org/static/file_cont211_lang0_96.pdf)

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. Map 6-1 illustrates the local coastal flooding areas in the City of Manhattan Beach.

Map 6-1: City of Manhattan Beach Flood Areas
Source: City of Manhattan Beach General Plan



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 Special Flood Hazard Area (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.

Hazard Assessment

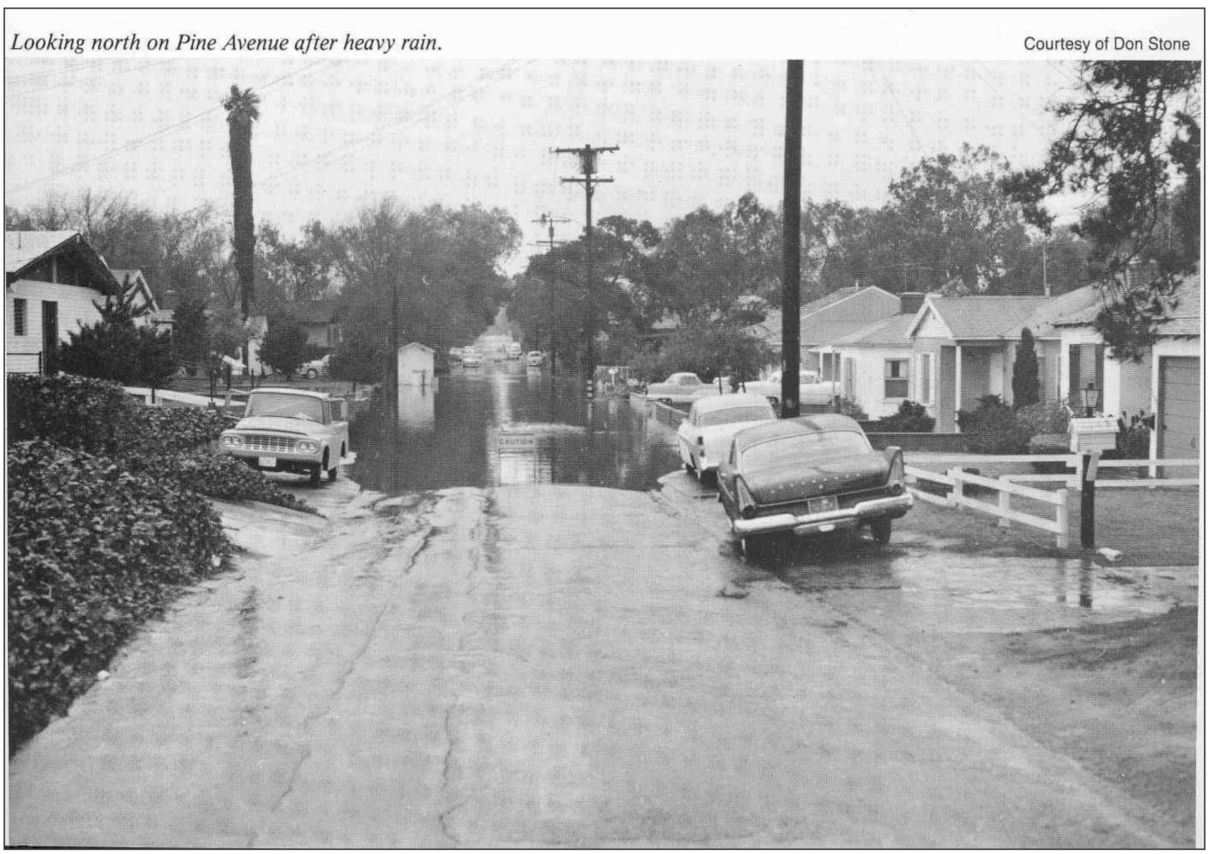
Hazard Identification
Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain (i.e., the area at risk from flooding); (2) the intensity of the flooding that can be expected in specific areas of the floodplain; 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.

Historically, flooding in the City has been the result of heavy rainstorms with specific damages occurring along the coastal areas and low lying parts of the City. One of the earliest recorded natural hazards to damage the City was in approximately 1913 which damaged the City pier and other structures near the ocean.

Flooding occurs when climate, geology and hydrology combine to create conditions where water flows outside of its usual course. Flooding can cause severe damage to private and public property, and is a threat to life and safety.

No portions of Manhattan Beach lie within any federally designated flood zone. Under average rainstorms, the City's infrastructure normally prevents flooding. Localized small-scale flooding represents the only concern. Historically, localized flooding during heavier storms has resulted in some property damage. For example, the Southern California area received some of the heaviest rain on record in 2004-05. This heavy rain produced flooding around the Polliwog Park neighborhood. The lake at Polliwog Park, which acts as a natural detention basin, overflowed due to extensive rain causing some flooding within a 1 block radius around the park.

Photo 6-1: Manhattan Beach Flooding
(Source: Don Stone)



Looking north on Pine Avenue after heavy rain. Courtesy of Don Stone

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,

and 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.

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 Manhattan Beach 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.

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.

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.

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. Road systems in the City of Manhattan Beach 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.

Water/Wastewater Treatment Facilities
The City of Manhattan Beach receives its water services from the Public Works Department, Utilities Division.

Water Quality
Flood-related environmental quality problems could potentially include bacteria, toxins, and pollution. These conditions would need to be addressed during the response and recovery phases of disaster management.

SECTION 7: LANDSLIDES

Why are Landslides a Threat to the City of Manhattan Beach

There is no history of significant landslides in the City of Manhattan Beach. However, the City's General Plan identifies the north end of Sand Dune Park as being "susceptible to land movement or unstable soils". Several homes are located atop Sand Dune Park.

Landslides occur when masses of rock, earth, or debris move down a slope, including rock falls, deep failure of slopes, and shallow debris flows. The most common cause of a landslide is an increase in the down slope gravitational stress applied to slope materials (oversteepening). This may be produced either by natural processes or by man's activities. Undercutting of a valley wall by stream erosion or of a sea cliff by wave erosion are ways in which slopes may be naturally oversteeped. Other ways include excessive rainfall or irrigation on a cliff or slope. Another type of soil failure is slope wash, the erosion of slopes by surface-water runoff. The intensity of slope wash is dependent on the discharge and velocity of surface runoff and on the resistance of surface materials to erosion. Surface runoff and velocity is greatly increased in urban and suburban areas due to the presence of roads, parking lots, and buildings, which have zero filtration capacities and provide generally smooth surfaces that do not slow down runoff.

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

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

Historic Southern California Landslides

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

1956 Portuguese Bend
Cost, $14.6 million (2000 Dollars) California Highway 14, Palos Verdes Hills. Land use on the Palos Verdes Peninsula consists mostly of single-family homes built on large lots, many of which have panoramic ocean views. All of the houses were constructed with individual septic systems, generally consisting of septic tanks and seepage pits. Landslides have been active here for thousands of years, but recent landslide activity has been attributed in part to human activity. The Portuguese Bend landslide began its modern movement in August 1956, when displacement was noticed at its northeast margin. Movement gradually extended downslope so that the entire eastern edge of the slide mass was moving within 6 weeks. By the summer of 1957, the entire slide mass was sliding towards the sea.

1958-1971 Pacific Palisades
Cost, $29.1 million (2000 Dollars) California Highway 1 and house damaged.

1961 Mulholland Cut
Cost, $41.5 million (2000 Dollars) On Interstate 405, 11 miles north of Santa Monica, Los Angeles County.

1963 Baldwin Hills Dam
Cost, $50 million (1963 Dollars) On December 14, the 650 foot long by 155 foot high earth fill dam gave way and sent 360 million gallons of water in a fifty foot high wall cascading onto the community below, killing five persons.

1969 Glendora
Cost, $26.9 million (2000 Dollars) Los Angeles County, 175 houses damaged, mainly by debris flows.

1969 Seventh Ave., Los Angeles County
Cost, $14.6 million (2000 Dollars) California Highway 60.

1970 Princess Park
Cost, $29.1 million (2000 Dollars) California Highway 14, 10 miles north of Newhall, near Saugus, northern Los Angeles County.

1971 Upper and Lower Van Norman Dams, San Fernando
Cost, $302.4 million (2000 Dollars) Earthquake-induced landslides. Damage due to the February 9, 1971, Magnitude 7.5 San Fernando, Earthquake. The earthquake of February 9 severely damaged the Upper and Lower Van Norman Dams.

1971 Juvenile Hall, San Fernando
Cost, $266.6 million (2000) Landslides caused by the February 9, 1971, San Fernando earthquake. In addition to damaging the San Fernando Juvenile Hall, this 1.2 km-long slide damaged trunk lines of the Southern Pacific Railroad, San Fernando Boulevard, Interstate Highway 5, the Sylmar electrical converter station, and several pipelines and canals.

1977-1980 Monterey Park, Repetto Hills, Los Angeles County
Cost, $14.6 million (2000 Dollars) 100 houses damaged in 1980 due to debris flows.

1978 Bluebird Canyon Orange County
Cost, $52.7 million (2000 Dollars) October 2, 60 houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the 1978 slide area was approximately 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.

1979 Big Rock, California, Los Angeles County
Cost, $1.08 billion (2000 Dollars) California Highway 1 rockslide.

1980 Southern California Slides
Cost, $1.1 billion in damage (2000 Dollars) Heavy winter rainfall in 1979-90 caused damage in six Southern California counties. In 1980, the rainstorm started on February 8. A sequence of 5 days of continuous rain and 7 inches of precipitation had occurred by February 14. Slope failures were beginning to develop by February 15 and then very high-intensity rainfall occurred on

February 16. As much as 8 inches of rain fell in a 6 hour period in many locations. Records and personal observations in the field on February 16 and 17 showed that the mountains and slopes literally fell apart on those 2 days.

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

1983 Big Rock Mesa
Cost, $706 million (2000 Dollars) in legal claims condemnation of 13 houses, and 300 more threatened rockslide caused by rainfall

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

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

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

January 2005 Ventura County
On January 10, 2005, a landslide once again struck the community of La Conchita, killing 10 people and destroying or seriously damaging 36 houses.

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

submarine landslides." (Source: Landslide Hazards, U.S. Geological Survey Fact Sheet 0071-00, Version 1.0, U.S. Department of the Interior - U.S. Geological Survey, http://pubs.usgs.gov/fs/fs-0071-00/)

The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

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

What is a Debris Flow?

A debris or mud flow is a river of rock, earth and other materials, including vegetation that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows often with speeds greater than 20 mile per hour, and can often move much faster. This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Landslide Events and Impacts

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produces conditions conducive to landslides and human activity further exacerbates many landslide problems. Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Even with proper planning, landslides will continue to threaten the safety of people, property, and infrastructure, but without proper planning, landslide hazards will be even more common and more destructive.

The increasing scarcity of buildable land, particularly in urban areas, increases the tendency to build on geologically marginal land. Additionally, hillside housing developments in Southern California are prized for the view lots that they provide.

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

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

Landslide Conditions
Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flow and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.

Wildland fires in hills covered with chaparral are often a precursor to debris flows in burned out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water by creating a waxy-like layer just below the ground surface. Since the water cannot be absorbed into the soil, it rapidly accumulates on slopes, often gathering loose particles of soil in to a sheet of mud and debris. Debris flows can often originate miles away from unsuspecting persons, and approach them at a high rate of speed with little warning.

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

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

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V -shaped valleys, canyon bottoms, and steep stream channels; and
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.
- Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.

Impacts of Development
Although landslides are a natural occurrence, human impacts can substantially affect the potential for landslide failures in the City of Manhattan Beach. Proper planning and geotechnical engineering can be exercised to reduce the threat of safety of people, property, and infrastructure.

Excavation and Grading
Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below new construction sites are indicators of the potential impacts stemming from excavation.

Drainage and Groundwater Alterations
Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area; development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.

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

Landslide Hazard Assessment

Hazard Identification
Landslides and landslide-prone sedimentary formations are present throughout the coastal plain of western Los Angeles County. **Section 5: Earthquake Map 5-3: Liquefaction and Earthquake Landslide-Induced Areas in the City of Manhattan Beach** shows the distribution of probable landslides in City of Manhattan Beach, some of which may have been subsequently verified and stabilized through grading activity. Landslides are considered “potentially active”, meaning they could be reactivated in the future, either by excessive rainfall, introduction of artificial water in the slope (landscaping irrigation/broken water or sewage lines), or improper site design or grading practices. Grading activities must consider these geologic constraints as a condition of project approval. (Source: General Plan)

The General Plan identifies the north end of Sand Dune Park as being the only area in the City that may be prone to landslides due to unstable soils.

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

property at risk from future landslide occurrences.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for landslide events impacting the City, there are many qualitative factors that point to potential vulnerability. Landslides can impact major transportation arteries, blocking residents from essential services.

Although there are no records of past landslide events causing major property damage, it is recommended that the City continue to map and monitor landslide and debris flow areas to prevent or mitigate against future loss.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damages to the City due to a specific landslide or debris flow event. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

Community Landslide Issues

What is Susceptible to Landslides?
Landslides can affect utility services, transportation systems, and critical lifelines. The City may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the City. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service City needs. Loss of electricity has the most widespread impact on other utilities and on the whole City. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.

Another potential impact affecting the City is an earth movement that creeps or slides into a structure or vital open area.

Roads and Bridges
Losses incurred from landslide hazards in communities are often associated with roads. The City of Manhattan Beach, County of Los Angeles, and CalTrans are responsible for maintenance of public roads within the jurisdiction. They are tasked with responding to slides that inhibit the flow of traffic or are damaging a road or a bridge. The road departments do their best to communicate with residents and businesses impacted by landslides. The City, County, and State alleviate problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides. This type of response activity is often the most cost-effective in the short-term, but is only temporary.

Lifelines and Critical Facilities
Lifelines and critical facilities should remain accessible, if possible, during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is critical for hospitals and other emergency facilities. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines that are located in vulnerable soils.

Landslide Mitigation Activities
Landslide mitigation activities include current mitigation programs and activities that are being implemented by local or City organizations.

Community Issues Summary
Although landslides have not posed a significant problem to the City of Manhattan Beach in the past, the hazard-prone areas should continue to be monitored and regulated.

SECTION 8: TSUNAMI HAZARDS

Why Are Tsunamis a Threat to Southern California?

History has shown that the probability of a tsunami in the planning area is an extremely low threat. However, if a tsunami should occur, the consequences would be great. The impact could cause loss of life, destroy thousands of high priced homes and greatly affect the region's downtown and coastal businesses, and have a profound impact on tourism. Even if all residents and visitors were safely evacuated, the damage to property in this densely populated, high property value area would still be tremendous.

California's Tsunamis

"Since 1812, the California coast has had 14 tsunamis with wave heights higher than three feet; six of these were destructive. The Channel Islands were hit by a significant tsunami in the early 1800s. The worst tsunami resulted from the 1964 Alaskan Earthquake and caused 12 deaths and at least $17 million in damages in Northern California."
(Source: http://education.sdsc.edu/optiputer/htmlLinks/california_tsunami.html)

What are Tsunamis?

The phenomenon we call "tsunami" (soo-NAH-mee) is a series of traveling ocean waves of extremely long length generated primarily by earthquakes occurring below or near the ocean floor. Underwater volcanic eruptions and landslides can also generate tsunamis. In the deep ocean, the tsunami waves move across the deep ocean with a speed exceeding 500 miles per hour, and a wave height of only a few inches. Tsunami waves are distinguished from ordinary ocean waves by their great length between wave crests, often exceeding 60 miles or more in the deep ocean, and by the time between these crests, ranging from 10 minutes to an hour.

As they reach the shallow waters of the coast, the waves slow down and the water can pile up into a wall of destruction up to 30 feet or more in height. The effect can be amplified where a bay, harbor or lagoon funnels the wave as it moves inland. Large tsunamis have been known to rise over 100 feet. Even a tsunami 1-3 feet high can be very destructive and cause many deaths and injuries.

Tsunamis typically are classified as either local or distant. Tsunamis from local sources usually result from earthquakes occurring off nearby coasts. Tsunamis from distant sources are the most common type observed along the California Coast. Tsunamis generated by earthquakes in South America and the Aleutian-Alaskan region have posed a greater hazard to the West Coast of the United States than locally generated tsunamis. There is a history of Pacific-wide tsunamis occurring every 10 to 20 years.

What causes Tsunami?

There are many causes of tsunamis but the most prevalent is earthquakes. In addition, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis.

Plate Tectonics

Plate Tectonic Theory is based on an earth model characterized by a small number of lithospheric plates, 40 to 150 miles thick that float on a viscous under-layer called the asthenosphere. These plates, which cover the entire surface of the earth and contain both the continents and sea floor, move relative to each other at rates of up to several inches per year. The region where two plates come in contact is called a plate boundary, and the way in which one plate moves relative to another determines the type of boundary: spreading, where the two plates move away from each other; subduction, where the two plates move toward each other and one slides beneath the other; and transform, where the two plates slide horizontally past each other. Subduction zones are characterized by deep ocean trenches, and the volcanic islands or volcanic mountain chains associated with the many subduction zones around the Pacific Rim are sometimes called the Ring of Fire.

Earthquakes and Tsunamis

An earthquake can be caused by volcanic activity, but most are generated by movements along fault zones associated with the plate boundaries. Most strong earthquakes, representing 80% of the total energy released worldwide by earthquakes, occur in subduction zones where an oceanic plate slides under a continental plate or another younger oceanic plate.

Not all earthquakes generate tsunamis. To generate a tsunami, the fault where the earthquake occurs must be underneath or near the ocean, and cause vertical movement of the sea floor over a large area, hundreds or thousands of square miles. “By far, the most destructive tsunamis are generated from large, shallow earthquakes with an epicenter or fault line near or on the ocean floor.” The amount of vertical and horizontal motion of the sea floor, the area over which it occurs, the simultaneous occurrence of slumping of underwater sediments due to the shaking, and the efficiency with which energy is transferred from the earth’s crust to the ocean water are all part of the tsunami generation mechanism. The sudden vertical displacements over such large areas, disturb the ocean's surface, displace water, and generate destructive tsunami waves.

Although all oceanic regions of the world can experience tsunamis, the most destructive and repeated occurrences of tsunamis are in the Pacific Rim region.

Tsunami Earthquakes

The September 2, 1992 Earthquake (M7.2) was barely felt by residents along the coast of Nicaragua. Located well off-shore, the severity of shaking on a scale of Modified Mercalli I to XII, was mostly II along the coast, and reached III at only a few places. Twenty to 70 minutes after the earthquake occurred, a tsunami struck the coast of Nicaragua with wave amplitudes up to 13 feet above normal sea level in most places and a maximum run-up height of 35 feet. The waves caught coastal residents by complete surprise and caused many casualties and considerable property damage.

This tsunami was caused by a tsunami earthquake, an earthquake that produces an unusually large tsunami relative to the earthquake magnitude. Tsunami earthquakes are characterized by a very shallow focus, fault dislocations greater than several meters, and fault surfaces that are smaller than for a normal earthquake.

Tsunami earthquakes are also slow earthquakes, with slippage along the fault beneath the sea floor occurring more slowly than it would in a normal earthquake. The only known method to quickly recognize a tsunami earthquake is to estimate a parameter called the seismic moment using very long period seismic waves (more than 50 seconds/cycle). Two other destructive and deadly tsunamis from tsunami earthquakes have occurred in recent years in Java, Indonesia (June 2, 1994) and Peru (February 21, 1996).

Less frequently, tsunami waves can be generated from displacements of water resulting from rock falls, icefalls and sudden submarine landslides or slumps. Such events may be caused impulsively from the instability and sudden failure of submarine slopes, which are sometimes triggered by the ground motions of a strong earthquake. For example in the 1980's, earth moving and construction work of an airport runway along the coast of Southern France, triggered an underwater landslide, which generated destructive tsunami waves in the harbor of Thebes. (Source: http://ioc3.unesco.org/itic/contents.php?id=160)

Tsunami Characteristics

How Fast?

Unnoticed tsunami waves can travel at the speed of a commercial jet plane, over 500 miles per hour. They can move from one side of the Pacific Ocean to the other in less than a day. This great speed makes it important to be aware of the tsunami as soon as it is generated. Scientists can predict when a tsunami will arrive at various places by knowing the source characteristics of the earthquake that generated the tsunami and the characteristics of the sea floor along the paths to those places. Tsunamis travel much slower in more shallow coastal waters where their wave heights begin to increase dramatically.

How Big?

Offshore and coastal features can determine the size and impact of tsunami waves. Reefs, bays, entrances to rivers, undersea features and the slope of the beach all help to modify the tsunami as it attacks the coastline. When the tsunami reaches the coast and moves inland, the water level can rise many feet. In extreme cases, water level has risen to more than 50 feet for tsunamis of distant origin and over 100 feet for tsunami waves generated near the earthquake's epicenter. The first wave may not be the largest in the series of waves. One coastal community may see no damaging wave activity while in another nearby community destructive waves can be large and violent. The flooding can extend inland by 1,000 feet or more, covering large expanses of land with water and debris.

How Frequent?

Since scientists cannot predict when earthquakes will occur, they cannot determine exactly when a tsunami will be generated. However, by looking at past historical tsunamis and run-up maps, scientists know where tsunamis are most likely to be generated. Past tsunami height measurements are useful in predicting future tsunami impact and flooding limits at specific coastal locations and communities.

Types of Tsunamis

Pacific-Wide and Regional Tsunamis

Tsunamis can be categorized as "local" and Pacific-Wide. Typically, a Pacific-Wide tsunami is generated by major vertical ocean bottom movement in offshore deep trenches. A "local" tsunami can be a component of the Pacific-Wide tsunami in the area of the earthquake or a wave that is confined to the area of generation within a bay or harbor and caused by movement of the bay itself or landslides.

On December 26, 2004 the second biggest earthquake in recorded history occurred off the coast of Indonesia. The Magnitude 9.3 earthquake unleashed a devastating tsunami that traveled thousands of kilometers across the Indian Ocean, taking the lives of nearly 300,000 people in countries as far apart as Indonesia, the Maldives, Sri Lanka and Somalia. The catastrophe was one of the deadliest events in modern history.

In 1960, a large tsunami caused widespread death and destruction throughout the Pacific was generated by an earthquake located off the coast of Chile. It caused loss of life and property damage not only along the Chile coast but also in Hawaii and as far away as Japan. The Great

Alaskan Earthquake of 1964 killed 106 people and produced deadly tsunami waves in Alaska, Oregon and California.

In July 1993, a tsunami generated in the Sea of Japan killed over 120 people in Japan. Damage also occurred in Korea and Russia but spared other countries since the tsunami wave energy was confined within the Sea of Japan. The 1993 Japan Sea tsunami is known as a "regional event" since its impact was confined to a relatively small area. For people living along the northwestern coast of Japan, the tsunami waves followed the earthquake within a few minutes.

During the 1990's, destructive regional tsunamis also occurred in Nicaragua, Indonesia, the Philippines, Papua New Guinea, and Peru, killing thousands of people. Others caused property damage in Chile and Mexico.

In less than a day, tsunamis can travel from one side of the Pacific to the other. However, people living near areas where large earthquakes occur may find that the tsunami waves will reach their shores within minutes of the earthquake. For these reasons, the tsunami threat to many areas such as Alaska, the Philippines, Japan and the West Coast of the United States can be immediate (for tsunamis from nearby earthquakes which take only a few minutes to reach coastal areas) or less urgent (for tsunamis from distant earthquakes which take from three to 22 hours to reach coastal areas).

History of Regional Tsunamis

Local
A local tsunami (confined to the area of generation within a bay or harbor and caused by movement of the bay itself or local landslides) may be the most serious threat as it strikes suddenly, sometimes before the earthquake shaking stops. Historically, Alaska has had six serious local tsunamis in the last 80 years and Japan has had many more.

Local History of Tsunamis
Tsunamis have been reported since ancient times. They have been documented extensively in California since 1806. Although the majority of tsunamis have occurred in Northern California, Southern California has been impacted as well. In the 1930's, four tsunamis struck the Los Angeles County, Orange County, and San Diego County coastal areas. In Orange County the tsunami wave reached heights of 20 feet or more above sea level. In 1964, following the Alaska Earthquake (Magnitude 8.2), tidal surges of approximately 4 feet to 5 feet hit the Huntington Harbor area causing moderate damage.

Table 8-1: Tsunami Events in California 1930-2004
(Source: Worldwide Tsunami Database www.ngdc.noaa.gov)

Date	Location	Maximum Run-up*(m)	Earthquake Magnitude
08/31/1930	Redondo Beach	6.10	5.2
08/31/1930	Santa Monica	6.10	5.2
08/31/1930	Venice	6.10	5.2
03/11/1933	La Jolla	0.10	6.3
03/11/1933	Long Beach	0.10	6.3
08/21/1934	Newport Beach	12.00	Unknown
02/09/1941	San Diego	Unknown	6.6
10/18/1989	Monterey	0.40	7.1
10/18/1989	Moss Landing	1.00	7.1
10/18/1989	Santa Cruz	0.10	7.1
04/25/1992	Arena Cove	0.10	7.1
04/25/1992	Monterey	0.10	7.1
09/01/1994	Crescent City	0.14	7.1

* Maximum Run-up (M) is the maximum water height above sea level in meters. The run-up is the height the tsunami reached above a reference level such as mean sea level. It is not always clear which reference level was used.

Tsunami Hazard Assessment

Hazard Identification

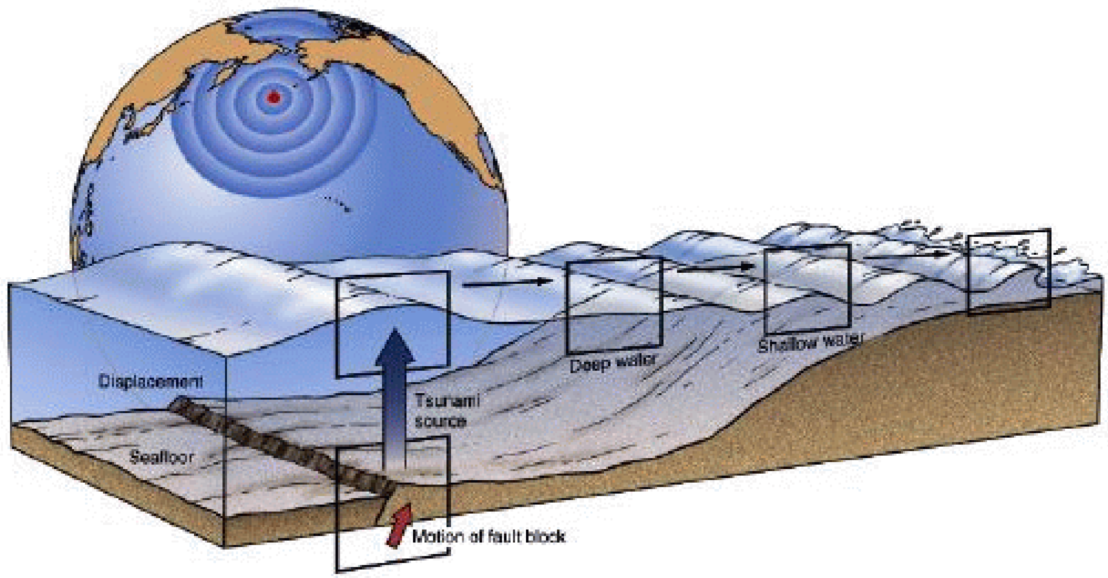
The tsunami threat to the City of Manhattan Beach is considered low, although recent studies indicate a possibility that an off-shore landslide could generate a tsunami that could threaten the coastal areas. Although the risk is considered low, the impacts would be high to the City's coastal areas. There are no critical or essential facilities located in the portion of the City most vulnerable to tsunamis. However, the El Segundo Power Plant and Chevron Refinery are located immediately adjacent to Manhattan Beach's northern boundary. The vulnerability of these facilities to threats associated with tsunami are not known.

Damage Factors of Tsunamis

Tsunamis cause damage in three ways: inundation, wave impact on structures, and erosion.

Strong, tsunami-induced currents lead to the erosion of foundations and the collapse of bridges and sea walls. Flotation and drag forces move houses and overturn railroad cars. Considerable damage is caused by the resultant floating debris, including boats and cars that become dangerous projectiles that may crash into buildings, break power lines, and may start fires. Fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities can cause damage greater than that inflicted directly by the tsunami. Of increasing concern is the potential effect of tsunami draw down, when receding waters uncover cooling water intakes of nuclear power plants. (Source: http://www.prh.noaa.gov/itic/library/about_tsu/faqs.html#1)

Figure 8-1: Tsunami Formation



Tsunamis are due to large off-shore earthquakes and ocean landslides. Dangerous tsunamis would most likely originate in the Aleutian and Chilean offshore submarine trenches.

The City's properties have a west-southwest facing orientation that could be vulnerable to tsunamis or tidal surges from the south and from the west. (Source: General Plan)

Tsunami Watches and Warnings

Warning System
The tsunami warning system in the United States is a function of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service. Development of the tsunami warning system was impelled by the disastrous waves generated in the 1964 Alaska Tsunami, which surprised Hawaii and the U.S. West Coast, taking a heavy toll in life and property.

The disastrous 1964 tsunami resulted in the development of a regional warning system in Alaska. The Alaska Tsunami Warning Center is in Palmer, Alaska. This facility is the nerve center for an elaborate telemetry network of remote seismic stations in Alaska, Washington, California, Colorado, and other locations. Tidal data is also telemetered directly to the ATWC from eight Alaskan locations. Tidal data from Canada, Washington, Oregon, and California are available via telephone, teletype, and computer readout.

Notification
The National Warning System (NAWAS) is an integral part of the Alaska Tsunami Warning Center. Reports of major earthquakes occurring anywhere in the Pacific Basin that may generate seismic sea waves are transmitted to the Honolulu Observatory for evaluation. An Alaska Tsunami Warning Center is also in place for public notification of earthquakes in the Pacific

Basin near Alaska, Canada, and Northern California. The Observatory Staff determines action to be taken and relays warnings over the NAWAS circuits to inform and warn West Coast states. The State NAWAS circuit is used to relay the information to the Los Angeles Operational Area warning center which will in turn relay the information to local warning points in coastal areas. The same information is also transmitted to local jurisdictions over appropriate radio systems, teletype, and telephone circuits to ensure maximum dissemination.

A Tsunami Watch Bulletin is issued if an earthquake has occurred in the Pacific Basin and could cause a tsunami. A Tsunami Warning Bulletin is issued when an earthquake has occurred and a tsunami is spreading across the Pacific Ocean. When a threat no longer exists, a Cancellation Bulletin is issued.

Vulnerability and Risk

With an analysis of tsunami events depicted in the "Local History" section, it can be deduced that a tsunami would significantly impact life, property, infrastructure and transportation.

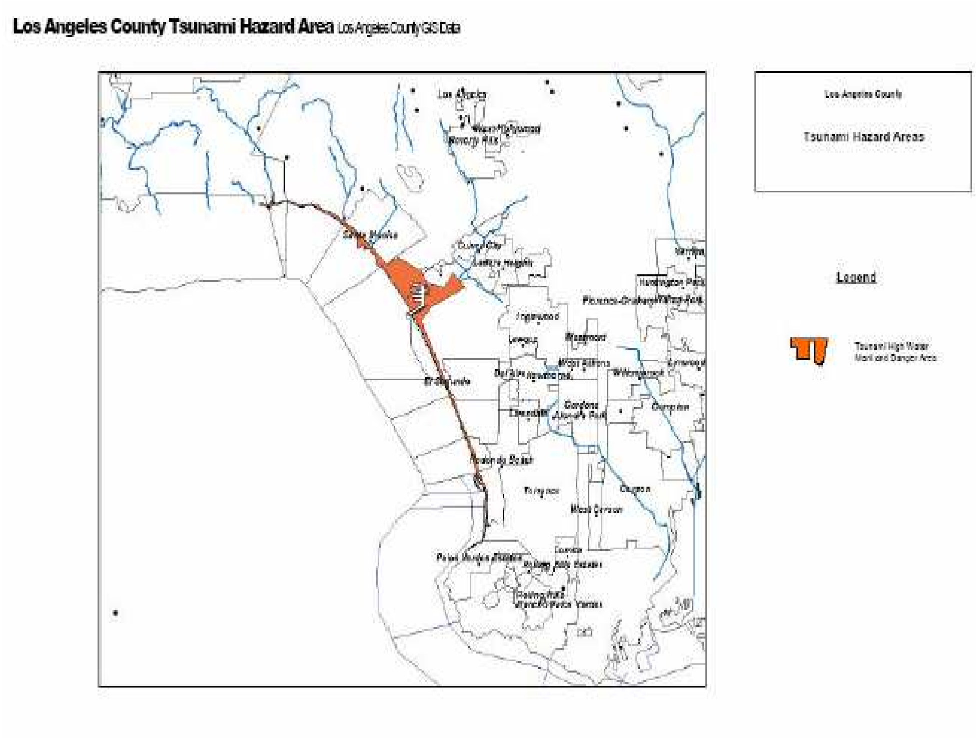
Community Tsunami Issues

What is Susceptible to Tsunami?

As shown on Map 8-1, the greatest vulnerability to tsunami is to properties closest to the coast.

Tsunami "maximum run-up" projections were modeled by the University of Southern California and distributed by the California Office of Emergency Services for the purposes of identifying tsunami hazards. The tsunami model was the result of a combination of inundation modeling and onsite surveys and shows maximum projected inundation levels from tsunamis along the entire coast of Los Angeles County.

Map 8-1: Tsunami Run-Up Map
(Source: Los Angeles County Hazard Mitigation Plan)



Life and Property
Based on the local history events and projected “run-up” modeling of tsunamis, it is estimated that less than 5% of the City would be directly impacted. In addition to direct impacts, the City would be significantly impacted by regional damages to infrastructure.

Even though the risk of tsunami to the region is relatively low, the impacts could be very high. Mitigation measures including public awareness and posting of signs could have significant effects on the survivability of the impacted sites. It is contemplated that the City of Manhattan Beach will initiate a tsunami awareness program in the near future to address the potential threats associated with the tsunami hazard.

Development
Property along the coast could also be devastated. The region’s coastal area is home to millions of dollars worth of residential and commercial structures. In addition, the area is scattered with infrastructure that serves the entire coastal region. A large tsunami could potentially destroy or damage hundreds of properties and spread debris for miles. A tsunami could have a catastrophic impact on the coastal area.

Infrastructure
Tsunamis (and earthquakes) can damage buildings, power lines, and other property and infrastructure due to flooding. Tsunamis can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Damage to public water and sewer systems, transportation networks, and flood channels would greatly impact daily life for residents.

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

PART III: RESOURCES

APPENDIX A: 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 City members interested in hazard mitigation information and projects.

American Public Works Association			
Level: National	Hazard: Multi	http://www.apwa.net	
2345 Grand Boulevard		Suite 500	
Kansas City, MO 64108-2641		Ph: 816-472-6100	Fx: 816-472-1610
Notes: The American Public Works Association is an international educational and professional association of public agencies, private sector companies, and individuals dedicated to providing high quality public works goods and services.			
Association of State Floodplain Managers			
Level: Federal	Hazard: Flood	www.floods.org	
2809 Fish Hatchery Road			
Madison, WI 53713		Ph: 608-274-0123	Fx:
Notes: The Association of State Floodplain Managers is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recovery			
Building Seismic Safety Council (BSSC)			
Level: National	Hazard: Earthquake	www.bssconline.org	
1090 Vermont Ave., NW		Suite 700	
Washington, DC 20005		Ph: 202-289-7800	Fx: 202-289-109
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.			

CalFire			
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: CalFire protects over 31 million acres of California's privately-owned wildlands. California Department of Forestry and Fire Protection 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.			
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.			

Greater Antelope Valley Economic Alliance			
Level: Regional	Hazard: Multi		
42060 N. Tenth Street West			
Lancaster, CA 93534		Ph: 661-945-2741	Fx: 661-945-7711
Notes: The Greater Antelope Valley Economic Alliance, (GA VEA) is a 501 I(6) nonprofit organization with a 501I(3) affiliated organization the Antelope Valley Economic Research and Education Foundation. GA VEA is a public-private partnership of business, local governments, education, non-profit organizations and health care organizations that was founded in 1999 with the goal of attracting good paying jobs to the Antelope Valley in order to build a sustainable economy.			

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 I 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 of which provide citizens Protection, with flood insurance; Prevention, with mitigation measures and Partnerships, with communities throughout the country.			

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

National Weather Service, Office of Hydrologic Development			
Level: Federal	Hazard: Flood	http://www.nws.noaa.gov/	
1325 East West Highway		SSMC2	
Silver Spring, MD 20910		Ph: 301-713-1658	Fx: 301-713-0963
Notes: The Office of Hydrologic Development (OHD) enhances National Weather Service products by: infusing new hydrologic science, developing hydrologic techniques for operational use, managing hydrologic development by NWS field office, providing advanced hydrologic products to meet needs identified by NWS customers			

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 Bay Economic Development Partnership			
Level: Regional	Hazard: Multi	www.southbaypartnership.com	
3858 Carson Street		Suite 110	
Torrance, CA 90503		Ph: 310-792-0323	Fx: 310-543-9886
Notes: The South Bay Economic Development Partnership is a collaboration of business, labor, education and government. Its primary goal is to plan an implement an economic development and marketing strategy designed to retain and create jobs and stimulate economic growth in the South Bay of Los Angeles County.			

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.			

The Community Rating System (CRS)			
Level: Federal	Hazard: Flood	http://www.fema.gov/nfip/crs.shtm	
500 C Street, S.W.			
Washington, D.C. 20472		Ph: 202-566-1600	Fx:
Notes: The Community Rating System (CRS) recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. Property owners within the County would receive reduced NFIP flood insurance premiums if the County implements floodplain management practices that qualify it for a CRS rating. For further information on the CRS, visit FEMA's website.			

United States Geological Survey			
Level: Federal	Hazard: Multi	http://www.usgs.gov/	
345 Middlefield Road			
Menlo Park, CA 94025		Ph: 650-853-8300	Fx:
Notes: The USGS provides reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.			
US Army Corps of Engineers			
Level: Federal	Hazard: Multi	http://www.usace.army.mil	
P.O. Box 532711			
Los Angeles CA 90053- 2325		Ph: 213-452- 3921	Fx:
Notes: The United States Army Corps of Engineers work in engineering and environmental matters. A workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals provide engineering services to the nation including planning, designing, building and operating water resources and other civil works projects.			
USDA Forest Service			
Level: Federal	Hazard: Wildfire	http://www.fs.fed.us	
1400 Independence Ave. SW			
Washington, D.C. 20250-0002		Ph: 202-205-8333	Fx:
Notes: The Forest Service is an agency of the U.S. Department of Agriculture. The Forest Service manages public lands in national forests and grasslands.			
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: 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. Public 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 Manhattan Beach Hazard Mitigation Plan integrated a cross-section of public input throughout the planning process. To accomplish this goal, the Planning Team developed a public participation process through five components: (1) developing a Planning Team comprised of knowledgeable individuals representative of the City; (2) 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 Hazard Mitigation Plan; (3) creating opportunities for the community as well as public agencies to review the Draft Mitigation Plan; (4) conducting a public meeting at the City Council where the public had an opportunity to express their views concerning the Draft Mitigation Plan.

Integrating public participation during the development of the Hazard 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.

Hazard Mitigation Planning Team

The preparation of the Hazard Mitigation Plan was the responsibility of the Hazard Mitigation Planning Team, which consisted of representatives from four City departments. The members have an understanding of how the City is organized and how the City, region, and environment might be affected by natural hazard events. The Planning Team 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.

Meetings

The following meetings were facilitated by City staff and/or Emergency Planning Consultants:

Meeting #1: Initial Meeting - June 30, 2004
City staff met to discuss the requirements for a Hazard Mitigation Plan. A Planning Team was identified.

Meeting #2: Joint Meeting with Redondo Beach – July 14, 2004
Planning Team met with City of Redondo Beach Mitigation Planning Team to discuss need for mitigation plan and desire to coordinate planning efforts.

Meeting #3: Planning Process – July 19, 2004
Planning Team met to review Disaster Mitigation Act (DMA) 2000 regulations and examples of Mitigation Plans for other jurisdictions. An outline was agreed on and assignments made within the Team to begin work on a draft plan.

Meeting #4: Mitigation Actions – August 26, 2005
Planning Team met to review the Draft Mitigation Plan and develop mitigation actions.

Meeting #5: Prioritization of Action Items – October 9, 2007
Planning Team met with consultant who facilitated the prioritization of mitigation action items utilizing the STAPLEE tool.

Meeting #6: Review of Final Draft – July 15, 2008
Planning Team met with consultant to discuss possibility of conducting a Community Workshop. Decision was made to invite CERT and Neighborhood Watch members. Consultant will present overview of hazard mitigation planning process and the mitigation actions. Input will be solicited from the audience and incorporated into the Plan as deemed appropriate by the Planning Team.

Community Workshop – September 8, 2008
A Community Workshop was held on September 8, 2008 at Fire Station #1 to introduce and seek input on the Draft Natural Hazards Mitigation Plan. An announcement of the workshop was posted on the City's Website as well as inviting Community Emergency Response Teams (CERT) and Neighborhood Watch members.

Public Meetings
City of Manhattan Beach conducted one public meeting concerning the Draft Natural Hazards Mitigation Plan. The City Council heard the item on November 5, 2008. *The Council was ___________________________ (supportive/opposed) of the overall goals established by the Hazard Mitigation Planning Team.* The planning process was discussed and public input was provided, satisfying the DMA 2000 requirements.

Public Meeting Invitation Process
The Planning Team identified possible public notice sources. A press release was drafted and distributed to weekly print media. In addition, the Executive Summary of the Plan was posted on the City website.

Public Meeting Results
The Planning Team began the presentation to the City Council by providing an overview of the project objectives. The Planning Team Chair Esteban Danna and Consultant presented the staff report on the Plan, including an overview of the Hazard Analysis, Mitigation Goals, and Mitigation Actions. The staff presentation included a summary of the input received during the public review of the document. The meeting participants were encouraged to present their views and make suggestions on possible mitigation actions. The Chair then fielded questions from the City Council. The meeting lasted approximately 1 hour and was televised live on local cable access and was available through video streaming on the City's website.

The City Council was ____________(unanimous/ vote) in its adoption of the City of Manhattan Beach Natural Hazards Mitigation Plan.

Appendix B – Attachment 1
List of Plan Reviewers

Appendix B – Attachment 2
Council Resolution

Appendix B – Attachment 3
Hazard Mitigation Planning Team
Sign-In Sheets

City of Manhattan Beach
Hazard Mitigation Workshop - STAPLEE
October 9, 2007

Name	Department
[illegible]	[illegible]
Rosie Lackow	CDD
DALE REISSIG	POLICE
RANDY LEAF	POLICE
Rod Uyeda	PD
RICHARD THOMPSON	CD
Lindy Coe-Juell	CM office
Bonnie Shrewsbury	PW
Carol Jacobson	CDD
DENNIS GROAT	FIRE
KEN Shuck	FIRE
Stephanie Katsouleas	Engineering

Emergency Planning Consultants

City of Manhattan Beach
Hazard Mitigation Community Workshop
September 8, 2008

Name	Organization
Robert Henriquez	Cert
Anita Henriquez	Cert
Gary Stabile	CERT
George Cohn	CERT
Ginny Thorkelson	Neigh. Watch
George Burns	CERT
Paul Curry	CERT
Frank Chiella	MB Fire Dept.
Richard Thompson	City MB.
Esteban Danna	City MB.
Bonnie Shrewsbury	CMB
Harry Andreas	citizen
David Lessick	CERT
Scott Ferguson	FIRE DEPT
Shereen Ansari	CERT
Barbara Heacox	CERT
Carol Curry	CERT

Emergency Planning Consultants

City of Manhattan Beach
Hazard Mitigation Community Workshop
September 8, 2008

Name	Organization
MARI SERRANO	CERT 310 283-5693 cell
WAYNE POWELL	CERT 310-545-2184

APPENDIX C: BENEFIT/COST ANALYSIS

Benefit/cost analysis is a key mechanism used by the state 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: The Interagency Hazards Mitigation Team, State Hazard Mitigation Plan, and 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 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

CUREe Kajima Project, Methodologies For Evaluating The Socio-Economic Consequences Of Large Earthquakes, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997.

Federal Emergency Management Agency, Benefit/Cost Analysis of Hazard Mitigation Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics Inc., 1996.

Federal Emergency Management Agency Report on Costs and Benefits of Natural Hazard Mitigation. Publication 331, 1996.

Goettel & Horner Inc., Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in The City of Portland, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., Benefit/Cost Analysis of Hazard Mitigation Projects Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, October 25, 1995.

Horner, Gerald, Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures, Robert Olson Associates, Prepared for Oregon State Police, Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, State Hazard Mitigation Plan, (Oregon State Police – Office of Emergency Management, 2000).

Risk Management Solutions, Inc., Development of a Standardized Earthquake Loss Estimation Methodology, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., A Benefit/Cost Model for the Seismic Rehabilitation of Buildings, Volumes 1 & 2, Federal Emergency Management Agency, FEMA, Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects, 1993.

VSP Associates, Inc., Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model, Volume 1, Federal Emergency Management Agency, FEMA, Publication Number 255, 1994.

ATTACHMENT 1 – STAPLEE PRIORITIZATION TOOL

STAPLEE Instructions

One method of assessing the costs and benefits associated with mitigation actions in FEMA's STAPLEE tool. STAPLEE (Social, Technical, Administrative, Political, Legal, Economic, and Environmental) is a systematic approach for weighing strengths and weaknesses of various mitigation actions. Each of the STAPLEE categories can be assessed in terms of opportunities and constraints. Following is a list of questions that will guide a jurisdiction through the STAPLEE process.
Note: An answer of "yes" is not always judged positively.

Social
Community Acceptance - Will the mitigation action be socially accepted within the community where it will be implemented?
Yes (+) or No (-)
Effect on Segment of Population - Will the mitigation action adversely impact one particular segment of the population (neighborhood, culture, religion, etc.)?
No (+) or Yes (-)

Technical
Technical Feasibility - Is the mitigation action technically feasible?
Yes (+) or No (-)
Long-Term Solution - Will the mitigation action help to reduce losses in the long term?
Yes (+) or No (-)
Secondary Impacts - Will there be any secondary effects which could nullify the action's benefits?
No (+) or Yes (-)

Administrative
Staffing - Does the jurisdiction have the staffing capability (own and outside resources) to implement the action, and can it be readily obtained?
Yes (+) or No (-)
Funding Allocated – Has the jurisdiction allocated or funded the action (i.e. annual budget, CIP, grants, etc.)?
Yes (+) or No (-)
Maintenance/Operations - Can the community provide the necessary maintenance work required to maintain the mitigation action?
Yes (+) or No (-)

Political
Political Support - Is there political support to implement and maintain the mitigation action?
Yes (+) or No (-)
Local Champion - Is there a local champion (political or public) willing to help see the action to completion?
Yes (+) or No (-)
Public Support - Is there enough public support to ensure the success of the mitigation action?
Yes (+) or No (-)

Legal
State Authority - Do State regulations exist that support the implementation of the mitigation action?
Yes (+) or No (-)
Existing Local Authority - Are the proper local laws, ordinances, and resolutions in place to implement the mitigation action?
Yes (+) or No (-)
Potential Legal Challenge - Is the mitigation action likely to be challenged by stakeholders who may be negatively affected?
No (+) or Yes (-)

Economic
Benefit of Action - Do the benefits of the mitigation action exceed the associated costs?
Yes (+) or No (-)
Cost of Action - Does the cost seem reasonable for the size of the problem and likely benefits?
Yes (+) or No (-)
Contributions to Economic Goals - Does the action contribute to other community economic goals, such as capital improvements or economic development?
Yes (+) or No (-)
Outside Funding Required - Will outside sources of funding be required?
No (+) or Yes (-)

Environmental
Effect on Land/Water - Will the mitigation action have a significant effect on the environment (including land, water, and air resources)?
No (+) or Yes (-)
Effect on Endangered Species - Will the mitigation action have a significant effect on endangered species?
No (+) or Yes (-)
Effect on HAZMAT/Waste Sites - Will the mitigation action have a significant effect HAZMAT or waste sites?
No (+) or Yes (-)
Consistent with Community Environmental Goals - Will the mitigation action comply with local, State, and Federal environmental laws and regulations?
Yes (+) or No (-)
Consistent with Federal Environmental Laws - Is the mitigation action consistent with the community's environmental values and goals?
Yes (+) or No (-)

Plan Maintenance - Attachment 1
STAPLEE Prioritization Tool
(Scoring: “+” = 1 point, “-” = -1 point, “n/a” = 0 point, “n/k” = not known)

		S Social		T Technical			A Administrative			P Political			L Legal			E Economic				E Environmental					
Mitigation Action	**$**	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-Term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Comm. Env. Goals	Consistent with Federal Env. Laws	Priority Total (net)
Multi-Hazard Mitigation Action Items																									
MH-1 Integrate goals and action items into General Plan, Municipal Code, Capital Improvement Plan and other regulatory or policy documents and programs, as appropriate.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-2 Identify and pursue funding opportunities to develop and implement local mitigation activities.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-3 Retrofit essential City buildings with automatic fire sprinkler systems to limit damage from fires caused by earthquakes and other natural disasters.																									
MH-4 Develop inventories of critical facilities and infrastructure; assess structural vulnerability to the identified hazards and prioritize mitigation projects.	n/k	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	-	n/a	n/a	n/a	+	+	16
MH-5 Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhancing public education on a regional scale.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-6 Develop, enhance, and implement education programs aimed at mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-7 Evaluate current hazard warning systems to ensure effectiveness and efficiently increase coordination between local jurisdictions and emergency service providers.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-8 Update policy for government to determine what reconstruction criteria should be applied to structures damaged during a disaster. Update building and reconstruction policies and requirement in the local government building code for post-disaster situations.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-9 Review priorities and publish for restoration of the community’s infrastructure and vital public facilities following a disaster.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18

Plan Maintenance - Attachment 1
STAPLEE Prioritization Tool
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Mitigation Action	**$**	Community Acceptance	Effect on Segment of Population	Technical Feasibility	Long-Term Solution	Secondary Impacts	Staffing	Funding Allocated	Maintenance/ Operations	Political Support	Local Champion	Public Support	State Authority	Existing Local Authority	Potential Legal Challenge	Benefit of Action	Cost of Action	Contributes to Economic Goals	Outside Funding Required	Effect on Land / Water	Effect on Endangered Species	Effect on HAZMAT/Waste Sites	Consistent with Comm. Env. Goals	Consistent with Federal Env. Laws	Priority Total (net)
MH-10 Provide information on Manhattan Beach website that includes information specific to residents, building codes, and information on damage prevention. Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, businesses, and government offices.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-11 Provide a program to minimize the impact on utilities based on all possible disasters (may require redundant or quick-replacement systems).	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-12 Inspect fire hydrants and conduct fire-flow tests on a regular basis.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-13 Incorporate the Los Angeles Regional Uniform Codes Program into the City's municipal code, making the Municipal Code building regulations more stringent than the current adopted state codes. To be implemented on an on-going basis.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-14 Continue participation in local mutual aid agreements for emergency response with other jurisdictions.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-15 Ensure availability/effective response of emergency and disaster relief services for the community after a major emergency.	n/k	+	+	+	+	+	-	-	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	15
MH-16 Implement and coordinate existing local, state and federal disaster preparedness resources and emergency mobilization/evacuation plans to assure their continued adequacy and effectiveness.	n/k	+	+	+	+	+	-	-	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	15
MH-17 Work with the Manhattan Beach Unified School District (MBUSD) in teaching children to respond appropriately in emergency and to threats to personal safety.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-18 Continue to operate the Community Alert Network (CAN) and Reverse 911 which provides immediate notification to residents when a disaster strikes.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18

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STAPLEE Prioritization Tool
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MH-19 Alert residents to dangers that household items can pose during a natural hazard/disaster. The following are measures homeowners can take: repair electrical wiring and leaky gas connections, secure shelving, move heavy/large objects to lower shelves, hang pictures and mirrors away from beds, brace overhead light fixtures, secure water heater, repair foundation/ceiling cracks, store weed-killers, pesticides, flammable products away from heat sources, place oily polishing rags or waste in covered metal cans, clean and repair chimneys, flue pipes, vent connections and gas vents.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
MH-20 Adopt effective land-use regulations and building codes and continue to discourage new construction or development in identified hazard areas without first implementing appropriate remedial measures.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
Earthquake Action Items																									
EQ-1 City reservoirs and the elevated water tank have been evaluated and seismically retrofitted.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
EQ-2 Un-reinforced masonry buildings have been inventoried and retrofitted in accordance with UBC standards.	n/k	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
EQ-3 Identify and require analysis and modification, as needed, of city owned structures that may fall into categories that are vulnerable to damage from earthquakes, such as pre-cast concrete, soft-story structures, and non-ductile concrete frame buildings.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	n/a	+	+	18
EQ-4 Encourage the adoption of building codes and design standards that incorporate the most recent seismic requirements.	n/k	+	+	+	+	+	+	-	+	+	+	n/a	+	+	n/a	+	+	+	+	+	+	+	+	+	19
EQ-5 Continually maintain, monitor, and update all relevant geologic and seismic related ordinances, regulations, and codes, to maximize awareness and planning for emergency response efforts.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	23
EQ-6 Inform the public about earthquake safety, hazards and risks which may include: City newsletters & website, cable TV, Reverse 911 or other communication methods that explain the City's Emergency Response Plan, Emergency Operations Center, and appropriate procedures and phone numbers to call if a disaster occurs.	n/k	+	+	+	+	+	+	+	n/a	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	22

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EQ-7 Promote the collection of relevant data on local groundwater levels and areas susceptible to liquefaction, as a basis for future refinements of liquefaction policies or procedures in the City.	n/k	+	+	+	+	+	-	-	+	+	n/a	+	+	n/a	+	n/a	n/a	-	-	+	+	+	+	+	11
EQ-8 Support the improved delineation of potential liquefaction zones and strengthen the justification for geotechnical site investigations.	n/k	+	-	+	+	n/a	-	-	+	+	n/a	+	+	+	n/a	n/a	n/a	n/a	-	+	+	+	+	+	9
EQ-9 Support the development of methods to quantify ground deformation associated with the occurrence of liquefaction.	n/k	+	-	+	+	n/a	-	-	-	+	n/a	+	+	+	-	n/a	n/a	n/a	-	+	+	+	n/a	+	5
Flood Action Items																									
FLD-1 Review proposed development and require detention basin, where necessary, to reduce flooding risks. Ensure critical facilities have proper storm water drainage to prevent local flooding.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	+	-	+	+	n/a	+	+	18
FLD-2 Continue working with Los Angeles County to increase storm drain capacity and efficiency.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	+	-	+	+	n/a	+	+	18
FLD-3 Continue to pursue all capital improvement projects related to improvement, maintenance for water related infrastructure.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	+	-	+	+	n/a	+	+	18
FLD-4 Prepare an inventory of major urban drainage problems, and identify causes and potential mitigation measures for urban drainage problem areas.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	+	-	+	+	n/a	+	+	18
FLD-5 Review proposed development and require retention basin, where necessary, to reduce flooding risks. Ensure critical facilities have proper storm water drainage to prevent local flooding.	n/k	+	+	+	+	+	+	+	+	+	+	+	+	+	+	n/a	n/a	+	-	+	+	n/a	+	+	18
FLD-6 Encourage green building practices to increase permeable surfaces.	n/k	+	+	+	+	+	+	+	+	+	+	+	n/a	+	+	+	+	n/a	+	+	+	+	+	+	21
Landslide Mitigation Actions Items																									
LND-1 Establish a method to inform and notify the public about tell-tale signs that a landslide is imminent so that personal safety measures may be taken.	n/k	+	-	+	+	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	n/a	+	+	+	14
LND-2 Install signs warning the public of landslide danger in the vicinity of Sand Dune Park.	n/k	+	-	+	+	-	-	-	+	+	+	+	+	+	-	+	+	+	+	+	n/a	-	+	+	10

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LND-3 Erosion control maintenance at Sand Dune Park.	n/k	+	+	+	+	+	+	+	+	+	n/k	+	n/a	+	+	+	+	n/a	+	+	+	+	+	+	20
Tsunami Action Items																									
TSU-1 Initiate a tsunami awareness program. Provide education to those specifically living or working within the areas of Manhattan Beach at risk of tsunami inundation. Publish tsunami information and post on the City's website for general dissemination.	n/k	+	-	+	+	-	-	-	+	+	+	+	+	+	-	+	+	+	+	+	n/a	n/a	+	+	11
TSU-2 Consider the installation of signage along the coast directing people away from the ocean to flee a tsunami.	n/k	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-	n/a	n/a	n/a	+	n/a	15
TSU-3 Investigate a local tsunami warning system that would utilize sirens from fire and police department's equipment.	n/k	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	+	+	-	n/a	n/a	n/a	+	n/a	13
TSU-4 Develop Tsunami Warning Plan to establish improved communications between local agencies and universities.	n/k	+	+	+	+	+	+	-	n/a	+	+	+	n/a	+	+	+	+	n/a	n/k	+	+	+	n/a	n/k	15
TSU-5 Study feasibility of a warning system for "local tsunami" caused by close-to-shore underwater landslides.	n/k	+	+	+	+	+	+	-	n/a	+	+	+	n/a	+	+	+	+	n/a	n/k	+	+	+	n/a	n/k	15