C I T Y O F S I G N A L H I L L

General Plan

SAFETY ELEMENT

2016

Prepared by the City of Signal Hill in collaboration with RGP Planning & Development Services (2010)
Geologic and hazards mapping provided by Earth Consultants International

ACRONYMS & ABBREVIATIONS

CAL FIRE	California Department of Forestry and Fire Protection
CERT	Community Emergency Response Team
CGC	California Government Code
CUPA	Certified Unified Program Agency
DMAC	Disaster Management Area Coordinator
DOGGR	Division of Oil, Gas, and Geothermal Resources
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
LACoFD	Los Angeles County Fire Department
LACOEM	Los Angeles County Office of Emergency Management
LBGO	Long Beach Oil & Gas Department
NIMS	National Incident Management System
SCAQMD	South Coast Air Quality Management District
SEMS	Standardized Emergency Management System
SHMC	Signal Hill Municipal Code
SHPD	Signal Hill Police Department
SHPI	Signal Hill Petroleum, Inc.
URM	Unreinforced Masonry

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I. INTRODUCTION

A. Purpose and Scope

The Safety Element is one of seven General Plan elements required by the State of California.[1] This document provides the City of Signal Hill with background information on hazards and public safety services, and establishes goals, policy direction, and implementation measures intended to limit the community's exposure to a range of hazards. This element is a comprehensive update of the 1986 Safety Element and incorporates the latest available information from local, state, and federal sources regarding public safety and hazards. This element includes:

- Existing conditions & background information on the City and existing police, fire, and medical services serving the City.
- A discussion of seismic and geologic hazards, including surface rupture and ground shaking resulting from earthquakes, liquefaction, landslides, and soil settlement and expansion.
- A discussion of oilfield hazards related to hazardous materials impacts, with a focus on identifying and minimizing risks associated with oil production, storage, and transportation activities.
- An evaluation of other hazards, including fires, flooding, tsunami, seiche, and dam failure, including evacuation routes.
- Goals, policies, and implementation measures that provide direction and guidance for the City of Signal Hill to minimize impacts resulting from hazards over the coming decades.

Like all General Plan elements, this Safety Element is intended to serve as a long-range planning document. The planning period for this document is through 2020. [2]

[1] California Government Code Section 65302.

[2] California Government Code Section 65302(g)(5) Upon each revision of the housing element, the planning agency shall review and, if necessary, revise the safety element to identify new information that was not available during the previous revision of the safety element.

B. Regulatory Framework

The State of California has mandated that each city and county prepare a Safety Element as part of its General Plan. Section 65302(g) of the California Government Code (CGC) requires that a Safety Element provide:

> [...] *for the protection of the community from any unreasonable risks associated with the effects of seismically-induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides; subsidence, liquefaction, and other seismic hazards identified pursuant to Chapter 7.8 (commencing with Section 2690) of Division 2 of the Public Resources Code, and other geologic hazards known to the legislative body; flooding; and wildland and urban fires. The safety element shall include mapping of known seismic and other geologic hazards. It shall also address evacuation routes, military installations, peakload water supply requirements, and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards.* [...]

Section 65302(g)(2) of the CGC establishes additional requirements for safety elements revised in 2009 or later. These requirements provide for the inclusion of additional information and analysis of flood hazards. Section 65302(g)(3) of the CGC establishes additional requirements for safety elements revised in 2014 or later to address the risk of fire for land classified as very high fire hazard severity zones.

This 2016 Safety Element meets all state requirements described in the CGC and summarized above. As there are no military installations within Signal Hill, that topic will not be further discussed in this document.

C. Relationship to Other Elements

General Plan elements provide important policy guidance to assist in decision-making. All of the elements of the General Plan are related and interdependent to some degree. However, the Safety Element is closely related to the Land Use, Housing, and Circulation Elements.

The objective of the Safety Element is to provide guidelines that minimize the impacts of potential hazards on humans and property. Where hazard areas are identified, the Land Use and Housing Elements provide guidelines and standards which establish appropriate development intensities and require enhanced analysis and mitigation of potential risks. Similarly, the Circulation Element's plans and policies take into account Safety Element recommendations to ensure fire department and other emergency access vehicles can access fire-prone areas.

D. Element Organization

This element is organized into seven sections:

Section I, Introduction – a discussion of the purpose and scope, regulatory framework, and organization of this document.

Section II, Background & Existing Conditions – a discussion of the City's oilfield and public safety services in the area.

Section III, Issues, and Constraints – a discussion of known hazards in the area.

Section IV, Goals and Policies – goals and policies which will serve to minimize hazards impacts.

Section V, Implementation Program – a list of specific, practical action steps that, when implemented, achieve the goals and policies identified in Section III.

Section VI, Resource Directory – a list of state, federal, and private agencies and organizations which provide valuable information or input related to the topics covered in this document.

Section VII, Mapping References – a list of the references used in the preparation of geotechnical and geological maps included in this document.

Appendix A – the City's adopted Hazards Mitigation Plan

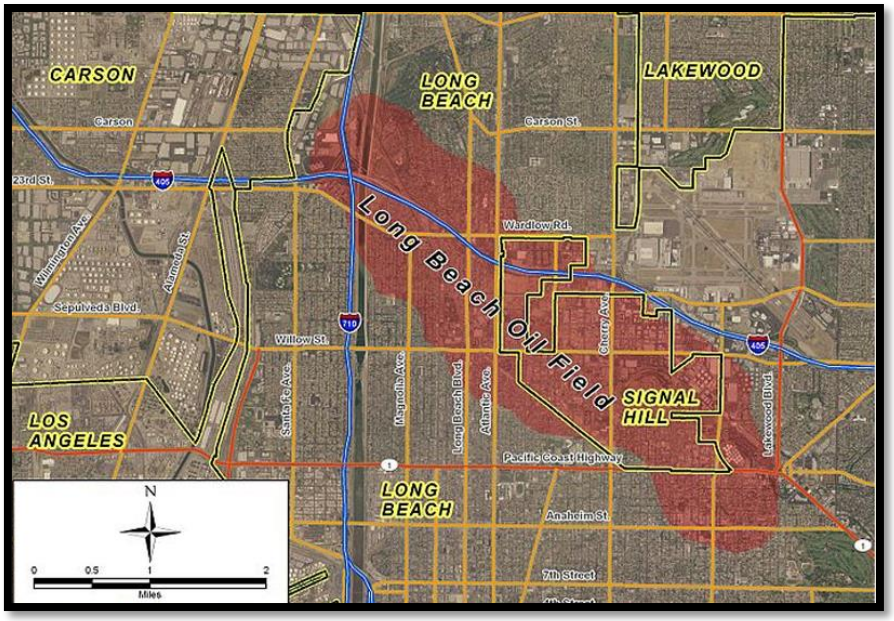
II. BACKGROUND & EXISTING CONDITIONS

A. City Profile

The City of Signal Hill ("City") is located centrally within the southwestern coastal area of Los Angeles County. It is the County's 41st city, encompassing 2.25 square miles. The City of Signal Hill was incorporated as a general law city in 1924 and became a charter city in 2000. Signal Hill is located four miles west of the 605 Freeway, three miles east of the 710 Freeway and the 405 Freeway runs through the northern portion of the City. Although still a producing oilfield, the City is transitioning into a diverse, modern community and has active oil wells co-existing adjacent to modern commercial and residential development. Signal Hill is a growing community with an inventory of vacant land available for development. The City's population has increased from 11,016 in 2010 to 11,673, according to 2016 State Department of Finance data. Housing data shows an increase in available housing from 4,389 to an estimated 4,531 between 2010 and 2016.

B. Oilfield

Oil operations are not common to every City, therefore a discussion of the history of the oilfield, as well as a summary of oil production processes is included to provide general information about the oilfield (related hazards are discussed in more detail in Section III). Signal Hill is within the Long Beach Oilfield. Oil was discovered in 1921 in the Long Beach Oilfield with the completion of "Alamitos No. 1" by Shell Oil Company, located at the corner of Temple Avenue and Hill Street in what is now Discovery Well Park, the oilfield was originally estimated to hold approximately three billion barrels of oil. Approximately 2,900 wells have been drilled in the Long Beach Oilfield of which approximately 2,618 are within the City of Signal Hill. Of the wells in Signal Hill thousands were abandoned, while hundreds remain active and the field continues to produce both oil and gas.



Source: SHPI.net

The Long Beach Oilfield reached a peak production of 68 million barrels just two years after it was discovered, but continued robust production to meet wartime needs during World War II. Between 1945 and 1958, the field gradually became depressurized and another occurrence during that time was subsidence. As a result of oil extraction and reduced pressure in the Wilmington Oilfield (just south of the Long Beach Oilfield), parts of the City of Long Beach and Long Beach Harbor, sank by as much as one to two feet per year. There was less subsidence in Signal Hill and the Long Beach Oilfield. In 1959, both the federal and state governments stepped in to address subsidence and stop the collapse. It was discovered that water injection could be used to re-pressurize oilfields, to arrest and ultimately correct subsidence. However, for water injection to succeed, each oil and gas reservoir in the field would have to be operated as a unit. In 1958, the Subsidence Control Act was passed to regulate water injection and to utilize unitization agreements as a method to share the resource. The objective of unitization is to provide unified development and operation of an oil and gas reservoir so that exploration, drilling and production can proceed in the most efficient and economical manner.

Since the 1970s water injection has been utilized as a secondary recovery method and the Long Beach Oilfield continues to produce 1 million barrels of oil and 365 cubic feet of natural gas per year. The secondary recovery method, minimizes the risk of future subsidence resulting from oil extraction in the city and allows the mature field to remain an active producer. Signal Hill Petroleum, Inc. (SHPI) has been

operating in the City since 1984 and is the primary oil operator in the City, SHPI is a privately owned California based energy company.

As of June 2014, approximately 2,196 wells have been abandoned and/or re-abandoned and approximately 422 active oil or gas wells remain within the City ("active" wells include injection wells, production wells, and idle wells). As of October 2016, these active wells, 375 (over 88 percent) are owned and operated by SHPI and the remaining 47 are owned and operated by a range of 18 independent operators. As the City has developed into a commercial and residential environment oil and gas production has shifted from industrial to urban operations.

Oil and gas wells are regulated by both the State and the City. The State Department of Conservation, Division of Oil Gas and Geothermal Resources (DOGGR) regulates resource capture, production and abandonment activities and the City of Signal Hill, Community Development Department regulates land use activities over and in close proximity to wells. DOGGR maintains listings, well logs and maps of all active and inactive wells in the State.[3] The wells in Signal Hill are concentrated in a broad swath of land stretching from the northwest to the southeast. Oilfield operations have changed over time and as a result regulations continue to change in response to technological advances, understanding of geology, and refinement of best practices to protect public health and safety.

Well Classifications

Active Wells

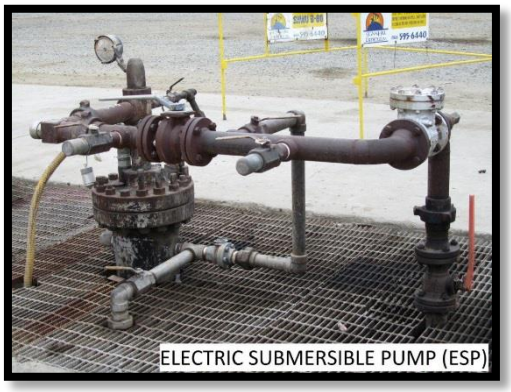
Active and idle wells and equipment can be below grade, at grade and above grade throughout the City. Wells are found in a wide range of land use districts, and sometimes share parcels with non-oil-related land uses including residential uses. The Signal Hill Municipal Code (SHMC) prohibits the drilling of new wells in residential districts. Currently, a new well could only be drilled within one of Signal Hill Petroleum's seven established Consolidated Drilling and Oil Production Sites under the conditions of their Conditional Use Permit. As of October 2016, of the 375 Signal Hill Petroleum wells, 69 are in drill sites (18%), while 306 are outside drill sites (82%). Redrilling and repair work is permitted for established wells and occurs regularly. Below are images of active wells that can be used in oil operations today.

[3] Available at www.conservation.ca.gov/dog


HYDRAULIC ROD PUMP (HRP)

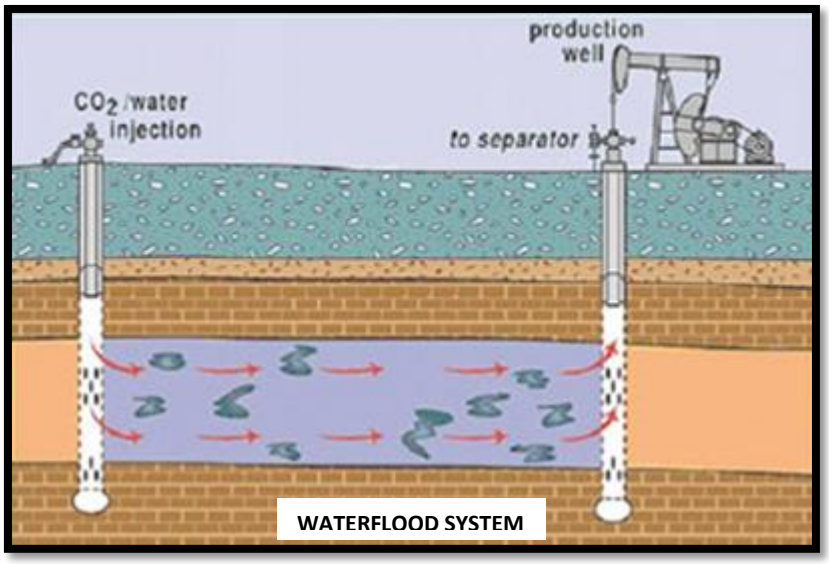
PROGRESSIVE CAVITY PUMP (PC)


CONVENTIONAL ROD PUMPING UNIT (RP)


ELECTRIC SUBMERSIBLE PUMP (ESP)

Injection Wells

Water injection involves pumping pressurized water into the oil reservoir by use of an injection well which moves the oil in place and recovery of the oil through the use of a production well which pulls both the oil and water to the surface. Water must be injected to increase oilfield pressure; a mix of water and oil (with a small amount of natural gas) is then pumped out of wells. Without active pumping, liquids stop moving and the well ceases operation. Water is injected in from 2,500 to 6,000 feet at a maximum pressure of 1,800 psi. Every injection well is monitored daily as to injection rate and pressure, the data is collected and reported to DOGGR monthly. Every injection well receives an annual inspection by DOGGR to review the conditions of well head and to confirm the certification of the test gauge.



Idle Wells

A well shall be deemed to be an idle well if, the well does not produce an average of two barrels of oil per day or one hundred cubic feet of gas per day for a continuous six months period during any consecutive five-year period prior to or after January 1, 1991, except that an active water injection well shall not be classified as an idle well. DOGGR requires operators of idle wells to test them periodically to ensure that no damage is occurring to oil and gas reservoirs or groundwater. An idle-well test for DOGGR may be as simple as a fluid-level survey or may be a more complicated well-casing mechanical integrity test. The City cannot require that an idle well be abandoned. Therefore, idle wells can be reactivated at any time.

Abandoned Wells

When a well is no longer needed, either because the oil or gas reservoir becomes depleted, or because no oil or gas was found (called a dry-hole), the well is plugged and abandoned. Abandonment of oil wells in the field began shortly after the field was discovered therefore, there are numerous abandoned oil wells throughout the City. Abandoned wells were typically backfilled, abandoned wells on vacant properties are typically unseen and require excavation to locate them and existing development in the City may be over or near an abandoned oil well that is below ground.

Abandonment of an active or idle oil well is governed by SHMC Chapter 16.23 (Abandonment of Wells) and state law.[4] DOGGR has established standards for the abandonment of wells and requires well operators to show that wells have been properly shut down. This includes submittal of wellbore schematic diagram with casing intervals and sizes, perforation locations, cement plug depths inside casing, and the location of the cement outside casing. DOGGR reviews and approves plugging requirements to minimize the potential for subsurface contamination (to oil and gas reservoirs or ground water supplies) and to minimize hazardous surface conditions. Prior to commencement of abandonment or re-abandonment, the permittee or other responsible party shall provide a copy of the DOGGR approval to abandon said well and obtain a City issued abandonment permit from the Oil Services Coordinator. The cost to abandoning or re-abandoning a well is very high, ranging from $25,000 - $100,000 and up.


ABANDONED WELL

Products and Processing

A mix of water and oil and small amount of natural gas is pumped out of wells. Approximately 97 percent of the liquid pumped from Signal Hill wells is salt water, with the remaining 3 percent mostly crude oil. Liquids pumped from oil wells are transported via pipeline to two processing facilities in Signal Hill. At these processing facilities, the water/oil mix is broken down into its constituent parts. Salt water is pressurized and sent to water injection wells, where it is re-injected into the oilfield. Crude oil is sent via pipeline to refineries throughout Southern California. Wells are also connect to a gas vacuum system pipeline and taken to a turbine or processing facility.

[4] Public Resources Code Section 3208.

Federal, State and Local Agency Oversight

Oil operations are under the oversight of several federal and state agencies for various aspects for example, pipelines, transportation, vehicles, emissions, materials handling, spills, well operations are managed by different agencies. A list of various agencies and areas of oversight for oil operators is provided in **Table 1** and more detailed information on Division of Oil, Gas and Geothermal Resource and City oversight provided below.

TABLE 1 **Agency's with Oil Operations Oversight**

Agency	Area of Oversight	Example of Area of Coverage
Department of Transportation Pipeline & Hazardous Materials	Oil and Natural Gas Facilities and Pipelines (OPA)	Facility Response Plans and Spill Equipment
U.S. Environmental Protection Agency	Environmental Activity, Oil Spills, Greenhouse Gas Emissions	Facility Response Plans and Spill Prevention; Containment and Countermeasure Plans; Facility Greenhouse Gas Emissions
California Environmental Protection Agency	Manage local California Unified Program Agencies (CUPA)	Los Angeles County Fire Department
Los Angeles County Fire Department (CUPA for Signal Hill)	Hazardous Materials Handler; Hazardous Waste Generator, Above Ground Storage Tanks Program, California Accidental Release Prevention Program, California Uniform Fire Code	Consolidated Contingency Plan; Hazardous Material Inventory Program; California Accidental Release Prevention Program
Department of Toxic Substance Control	Hazardous Waste	Hazardous Waste Accumulation, Storage and Disposal; Regular disposal of solvents, used oil, antifreeze, automotive batteries, universal and electronic waste
California Air Resource Board	Mobile Source Emissions, Criteria and Hazardous Air Pollutants, Greenhouse Gas Emissions	On-road and off-road vehicle emissions and portable vehicle emissions
South Coast Air Quality Management District	Stationary Air Emission Sources, Criteria and Hazardous Air Pollutants	Natural gas turbine emissions; minor combustion device emissions, internal combustion engines, process heater emissions, fugitive gas leaks from pipelines, compressors, valves, fittings, flanges
Division of Oil Gas and Geothermal Resources	Drilling, operation, maintenance, and plugging and abandonment of natural gas and geothermal wells; lease management and injection management	Annual oil/injection well equipment/signage/containment/area inspections; well work plan review and permit issuance; idle well inspection and testing; injection well 3rd party surveys/annual rate/pressure inspections and monthly reporting

City of Signal Hill	Drilling for production, processing, storage and transport by pipeline of petroleum and well abandonment	Well discovery permit; well leak test permit; methane site assessment permits; methane barrier plan check; well abandonment reports; annual active and idle well permits; annual inspections

Division of Oil, Gas and Geothermal Resources

The Division of Oil, Gas, and Geothermal Resources was formed in 1915 to address the needs of the state, local governments, and industry by regulating statewide oil and gas activities with uniform laws and regulations.

DOGGR is charged with implementing Section 3000 of the *Public Resources Code*. With oversight of the drilling, operation, maintenance, and abandonment of wells and the operation, maintenance, and removal or abandonment of tanks and facilities attendant to oil and gas production, including pipelines that are within an oil and gas field, so as to prevent, as far as possible, damage to life, health, property, and natural resources; damage to underground oil and gas deposits from infiltrating water and other causes; loss of oil, gas, or reservoir energy, and damage to underground and surface waters suitable for irrigation or domestic purposes by the infiltration of, or the addition of, detrimental substances.

Every oil, gas, or geothermal well drilled in California has information about that well such as the history of work done, permits issued, inspections made, and well logs run called a well record. The DOGGR District 1 office maintains well records for wells in Signal Hill. DOGGR well records are open to public inspection.

City Regulatory Oversight

In 1942, the first Signal Hill Oil Code was adopted and it was significantly revised in 1964. In 1990, the City convened an Oil Code Committee to initiate another comprehensive update to the 1964 Oil Code. The 1990 Oil Code regulated the following: drilling of new wells, re-drilling of existing wells and abandoning wells; waterflood injection; location of drill sites; noise standards; surface mitigation measure recommendations; methane gas venting; property maintenance; landscaping; development constraints; and, vehicular access for oilfield equipment.

The City's 1990 code required developers or property owners intending to develop, to first obtain written approval (i.e., certification letter and stamped site plans) from DOGGR documenting compliance with

the provisions of the Construction Site Plan Review Program (CSPRP) prior to issuance of a grading, building permit, or development permit whichever should occur first in the City's entitlement process. In 2010, DOGGR abruptly changed the CSPRP, and discontinued the process of providing a certification letter along with the option of an equivalent standard for well abandonments. In addition, DOGGR discontinued conducting the leak testing that had been the practice in District 1. Because of the City's Oil Code strict reliance upon the DOGGR certification process and the subsequent certification letter, the City was left with an obsolete Oil Code with respect to the determination to build over an abandoned well. This created an extreme hardship for the City in that no development permits could be issued for properties with abandoned wells until the Oil Code was amended.

In order to replace the previous DOGGR certification letter review process with safe and responsible City standards, the City conducted special technical studies on past and present oil operations, collected, collated and analyzed thousands of documents dating back nearly two decades. The contents of the studies and details of the current oil code are discussed above.

In 2015, the City's Oil Code was amended. One amendment was to the title. The new title is the Oil and Gas Code, which recognizes the additional gas resource in the field even though the prominent regulatory resource is oil and that it is also regulated by the SHMC. Additional updates reflected changes to the standards and procedures for well surveys, leak testing and venting, and establish regulations for development on properties with abandoned wells. Site restoration requirements for well abandonments were added and an equivalency standard related to the City's authority regarding development over and in close proximity to abandoned wells was established. In addition, all development projects in the city would be required to conduct a methane assessment and the results of each assessment would dictate the need for any methane mitigation systems. The sections of the old Oil Code related to drilling of new wells, re-drilling of existing wells and abandoning wells; waterflood injection; location of drill sites; noise standards; property maintenance; and landscaping remained in place.

Per the Oil and Gas Code, at least one time per year, the City Oil Services Coordinator inspects the wells and well sites for compliance with the provisions of the City Oil and Gas Code. In the event a violation is found, the inspector shall provide notice to the operator and the operator shall have thirty days from the date of the notice to correct the violation.

C. Public Safety Services

Fire Protection

Fire protection services in Signal Hill are provided by contract through the Los Angeles County Fire Department (LACoFD). Primary response to incidents within Signal Hill is provided by Fire Station No. 60, located at 2300 E. 27th Street. Station No. 60 houses: 1 paramedic engine and is manned by 4 firefighters at all times. These firefighters are trained to provide emergency medical attention. The estimated response time for this station is up to 3 to 4 minutes to any location in Signal Hill.[5] This station is part of Battalion 9, which includes a total of 9 fire stations serving the cities of Bellflower, Cerritos, Hawaiian Gardens, Lakewood, and Paramount, in addition to Signal Hill.

Fire stations in the area are listed in **Table 2** and mapped on **Figure 1**. LACoFD maintains mutual aid agreements with other regional fire agencies, including the Long Beach Fire Department, which has stations in the vicinity of Signal Hill.

TABLE 2 **Area Fire Stations**

Station No.	Location	Distance to Signal Hill*
LOS ANGELES COUNTY FIRE DEPARTMENT		
60	2300 E. 27th Street, Signal Hill	--
122	2600 Greenmeadow Road, Lakewood	1.2 miles
45	4020 E. Candlewood Street, Lakewood	2.9 miles
LONG BEACH FIRE DEPARTMENT		
7	2295 Elm Avenue, Long Beach	0.4 mile
9	3917 Long Beach Boulevard, Long Beach	0.8 mile
17	2241 Argonne Avenue, Long Beach	0.9 mile

**Distance from nearest Signal Hill boundary.*

Peakload Water Supply Requirements

The City Water Department provides water for domestic and fire-fighting purposes for the entire City. Currently, water supplies are via two City operated groundwater production wells (Well #7 and #8),

[5] Phone conversation with Captain Nagaoka, LACoFD, August 17, 2010.

located in the North Long Beach area. The City can also receive imported water from a connection with the Metropolitan Water District regional water transmission system. Water storage is provided from three storage reservoirs, with water delivery to higher pressure zones achieved from three booster pump stations.

The Gundry Reservoir and pumping facility was constructed in 1929 and has a storage capacity of 4.7 million gallons. This facility is located in the northern part of the City at Reservoir Park. Two hilltop reservoirs and pumping facilities (one below Hilltop Park and the other on Temple Avenue, south of Skyline Drive) were constructed in the late 1990s and have a combined storage capacity of 2.6 million gallons. In addition, the City can also receive up to 3,350 gallons per minute of imported water supply from a service connection (CENB-19) to the Metropolitan Water District. The existing reservoirs, pumping facilities, and imported water supply are adequate for the City's projected growth and no further expansion of the system is considered necessary to meet peakload demands.

LACoFD has reviewed and approved the fire storage and fire flow requirements for the various land use categories throughout the City. As part of the 2005 Water Master Plan, an analysis of both fire storage and fire flow was conducted. The results indicate that there is adequate fire storage within the City's water system to meet LACoFD requirements. The fire flow analysis results indicate that the water system as a whole is adequate to meet the required fire flow demands approved by LACoFD. The analysis did identify some specific locations where fire flow inadequacies may exist within the water system. These locations are identified in the 2005 Water Master Plan and are mostly related to the existence of dead-end water mains. The an update to Water Master Plan (2015) is currently being reviewed and will be adopted by the City Council in the near future. The 2015 plan provides a plan for the City's water system over the next 10 years.

To improve existing infrastructure and reliability the 2011/12 through 2015/16 Capital Improvement Plans included notable water projects such as:

- The dead-end water main at 20th Street and Alamitos Avenue was eliminated.
- An emergency interconnection with the Long Beach Water Department was constructed at Reservoir Park. The interconnection would provide an imported water supply to the Reservoir treatment plant, in the case of an emergency affecting water Wells #7 and #8 groundwater supply.
- In 2015, construction of water Well #9 project began. The Well is within the City and expected production capacity of 1.725 million gallons per day. The Well is equipped with nano-filtration

treatment to treat naturally occurring constituents in the groundwater. Well #9 is expected to be operation in December 2016 and will provide the needed water demand to service the City with imported water serving as an emergency back-up.

Police Protection

Police protection in Signal Hill is provided by the Signal Hill Police Department (SHPD). As of 2016, the SHPD has 34 sworn officers and 19 civilian staff (14 full-time and 5 part-time) operating from one station located at 2745 Walnut Avenue. The police station is 21,500-square-feet and includes a fully functional Emergency Operations Center (EOC). (See **Figure 1.)**

Mutual aid agreements are in place with the Long Beach Police Department, Los Angeles County Sheriff's Department, and other regional law enforcement agencies. These agreements allow for assistance from other agencies in the event of a major crime or natural disaster that could not effectively be handled with the resources available to the SHPD. Nearby police stations are listed in **Table 3**.

TABLE 3 **Area Police Stations**

Station Name	Location	Distance to Signal Hill*
SIGNAL HILL POLICE DEPARTMENT		
Existing Headquarters	2745 Walnut Avenue, Signal Hill	--
LONG BEACH POLICE DEPARTMENT		
East Patrol Division	3800 E. Willow Street, Long Beach	0.4 mile
North Patrol Division	4891 Atlantic Avenue, Long Beach	1.8 miles

**Distance from nearest Signal Hill boundary.*

Medical Services

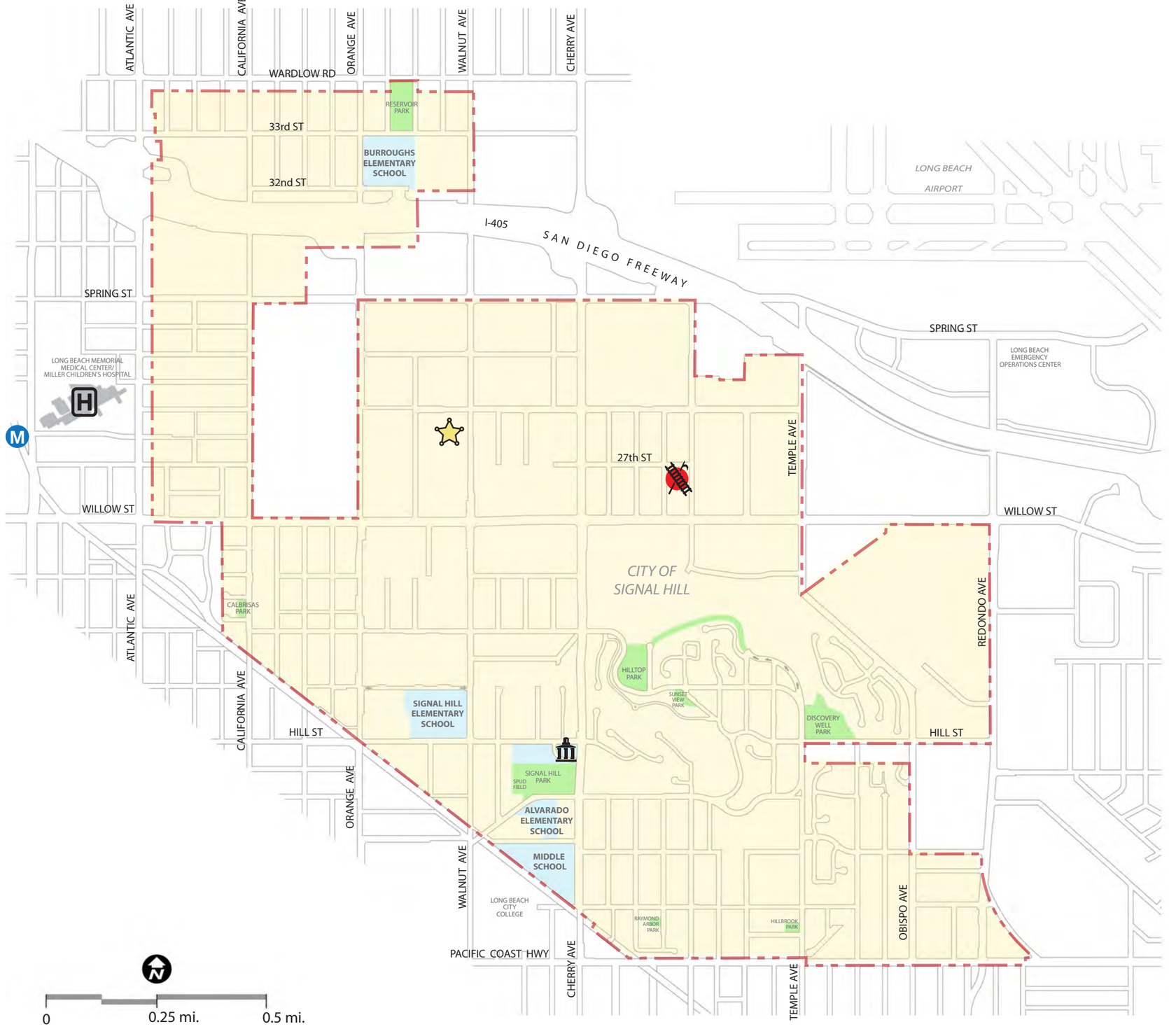
Signal Hill is close to a number of health care facilities, as listed in **Table 4**. Long Beach Memorial Medical Center and Miller Children's Hospital, which are co-located on a single site, are immediately west of Signal Hill on Atlantic Avenue. Collectively, almost 1,800 hospital beds are available within a 1.5-mile radius of the City. Signal Hill is also served by the 237-bed Veteran's Administration Medical Center in Long Beach, about 2 miles southeast of the City. The City of Signal Hill currently contracts with CARE Ambulance Service for emergency medical transport.

TABLE 4 **Local Hospitals**

Hospital	Location	No. of Beds	Distance to Signal Hill*
Long Beach Memorial Medical Center	2801 Atlantic Avenue, Long Beach	462	0.1 mile
Miller Children's Hospital Long Beach	2801 Atlantic Avenue, Long Beach	324	0.1 mile
Community Hospital of Long Beach	1720 Termino Avenue, Long Beach	416	0.2 mile
Pacific Hospital of Long Beach	2776 Pacific Avenue, Long Beach	184	0.5 mile
St. Mary Medical Center	1050 Linden Avenue, Long Beach	389	1.3 miles

**Distance from nearest Signal Hill boundary.*

City of Signal Hill
GENERAL PLAN
Safety Element



- City of Signal Hill Boundary
- Parks
- Schools
- Metro Rail Station
- Hospital
- Police Station & Emergency Operations Center
- Fire Station
- Civic Center

Figure 1
Public Service Facilities

Disaster Preparedness

The Signal Hill Emergency Operations Plan (EOP) provides detailed guidance to emergency service providers, City staff, and elected officials on actions required to maximize the City's preparedness for disaster, and to react effectively when disasters occur. The 2015 EOP updated the 2011 EOP document and was harmonized with the current California Emergency Management Agency template. The 2015 Signal Hill EOP is in full compliance with state requirements for content and scope. It has three goals:

- To provide effective life safety measures and reduce property loss.
- To provide for the rapid resumption of impacted businesses and community services.
- To provide accurate documentation and records required for cost recovery efforts.

The Chief of Police is responsible for the coordination of training events and exercises in support of the EOP, and for coordinating and disseminating annual reviews and updates to the document.

In addition, Signal Hill attempts to minimize the potential impacts of natural and man-made hazards through its Hazard Mitigation Plan (HMP), which is being updated concurrently with the 2016 Safety Element. The HMP has five goals: to protect life and property, enhance public awareness, preserve natural systems, encourage partnerships and implementation, and strengthen emergency services. To do this, the HMP analyzes hazards that occur within the City and establishes a mitigation plan including short- and long-term actions which should be implemented to reduce risk. A range of hazards are assessed in the plan, and four hazards considered most likely to impact the City were analyzed in greater detail: earthquakes, landslides, windstorms, and drought. The mitigation plan discusses potential funding sources and assigns responsibility for the accomplishment of each mitigation measure. The HMP remains a relevant and vital document through annual reviews and plan revisions every five years. The Hazard Mitigation Plan and all policies and programs contained therein, is incorporated in Appendix A. In addition, the HMP serves as one of implementation programs of the Safety Element

Both the HMP and EOP analyze risks to critical and essential facilities in the City. The HMP also includes mitigations which would reduce these risks. Critical facilities are defined as those necessary for government response and recovery activities, generally including 911 dispatch facilities, EOCs, schools hosting shelters, police and fire stations, public works facilities, local communications centers, hospitals, bridges and major roads, and shelters. In addition, the City of Signal Hill considers high-occupancy facilities such as shopping centers and high-risk facilities such as reservoirs and hazardous materials sites

to be critical facilities. Essential facilities are those facilities that are vital for the continued delivery of key city services or that may significantly impact the City's ability to recover from a disaster. These facilities generally include jails, public services buildings not considered critical facilities, and schools which do not house shelters. **Table 5** lists critical facilities (excluding roadways and bridges) identified by the EOP.

TABLE 5 **EOP Critical Facilities**

Facility	Address
GOVERNMENT AND COMMUNITY FACILITIES	
Alvarado School	1900 E. 21st Street
Burroughs School	1260 E. 33rd Street
City Yard	2175 E. 28th Street
Discovery Well Park	2200 Temple Avenue
Jessie Elwin Nelson Academy	1951 Cherry Avenue
Las Brisas Community Center	2397 California Avenue
Los Angeles County Records	1401 Willow Street
Los Angeles County Fire Station No. 60	2300 E. 27th Street
Signal Hill City Hall	2175 Cherry Avenue
Signal Hill Community Center	1780 Hill Street
Signal Hill Library (under construction in 2016/2017)	1770 E. Hill Street
Signal Hill /Long Beach Radio Towers	2321 Stanley Avenue
Signal Hill Police Department	2745 Walnut Avenue
Signal Hill School	2285 Walnut Avenue
Reservoir Park	3015 Gundry Avenue
UTILITIES	
Edison Substation	2999 Cherry Avenue
Gundry Reservoir	3315 Gundry Avenue
Hilltop Reservoir	Corner of Dawson Avenue/Skyline Drive
Sewer Lift Station 1	2000 Alamitos Avenue
Sewer Lift Station 4	2200 Spring Street
Sewer Lift Station 4a	2275 21st Street
Temple Reservoir	2207 Temple Avenue
Water Well No. 9	2175 E. 28th Street
MAJOR HAZARDOUS MATERIALS LOCATIONS	
Tesoro Hathaway Terminal (Tank Farm)	2350 Hathaway Avenue
Shell Terminal (Tank Farm)	2457 Redondo Avenue

TABLE 5 **EOP Critical Facilities**

Facility	Address
Signal Hill Petroleum	1215 E. 29th Street
Signal Hill Petroleum	2700 Combellack Drive
Signal Hill Petroleum	3365 E. Grant Street
HIGH-OCCUPANCY STRUCTURES	
Atlantic Medical	701 E. 28th Street
Best Buy	2701 Cherry Avenue
Boulevard Buick	2850 Cherry Avenue
Comfort Inn	3201 E. Pacific Coast Highway
Costco	2200 E. Willow Street
Courtyard Care	1880 Dawson Avenue
Food-4-Less Market	1600 Willow Street
Glenn Thomas Dodge	2100 Spring Street
Home Depot	751 E. Spring Street
Home Depot	2450 Cherry Avenue
Kaiser Permanente Medical Offices	845 Willow Street
Long Beach BMW	1600 E. Spring Street
Long Beach Mini	2998 Cherry Avenue
Long Beach Chrysler Jeep	2800 Cherry Avenue
Long Beach Honda	1500 E. Spring Street
Long Beach Mercedes-Benz	2300 Spring Street
Long Beach Nissan	1800 E. Spring Street
Office Depot Store	2301 E. Willow Street
Office Depot Warehouse & Office	3366 Willow Street
Petco	3065 California Avenue
PetsMart	2550 Cherry Avenue
Queen City Motel	3555 E. Pacific Coast Highway
Target Store	950 E. 33rd Street
Turner's Guns	2201 E. Willow Street
Universal Care Office	1600 Hill Street
U.S. Bank	2633 Cherry Avenue

Similar to the local HMP adopted by the City of Signal Hill, an All-Hazard Mitigation Plan (updated February 2014) has been adopted by the Los Angeles County Board of Supervisors. This plan analyzes risks and provides mitigations for unincorporated areas throughout the county, as well as for County-

provided services utilized by incorporated cities. As Signal Hill contracts for fire protection services with the County, risk analysis and mitigation for such services are covered by the County-adopted plan.

Emergency Operations

The EOP describes the City's emergency response and recovery operations. Emergency operations are managed in one of three modes, depending on the magnitude of the event:

- **Level One — Decentralized Coordination and Direction.** A minor to moderate incident wherein local resources are adequate and available. A local emergency may or may not be proclaimed. The EOC may or may not be activated. Off-duty personnel may be recalled.
- **Level Two — Centralized Coordination and Decentralized Direction.** A moderate to severe emergency wherein local resources are not adequate and mutual aid may be required. Key management level personnel from the principal involved agencies will co-locate in a central location to provide jurisdictional or multi-jurisdictional coordination. A local emergency will be proclaimed. The EOC should be activated. Off-duty personnel may be recalled.
- **Level Three — Centralized Coordination and Direction.** A major local or regional disaster wherein resources in or near the impacted area are overwhelmed and extensive state and/or federal resources are required. A local emergency will be proclaimed. All response and early recovery activities will be conducted from the EOC. All off-duty personnel will be recalled.

As discussed under Police Protection, above, the EOC component of the police department serves as a centralized location for emergency and disaster management.

Signal Hill Municipal Code (SHMC) Chapter 2.76 (Emergency Organization and Functions) creates a Disaster Council to develop emergency and mutual aid plans and agreements. The Disaster Council consists of the Mayor, Director of Emergency Services, Assistant Director of Emergency Services, and other members as determined by the City Council. It is responsible for the preparation of the EOP that provides for the mobilization of resources in emergency situations. The City Manager serves as Director of Emergency Services. The Director of Emergency Services is authorized to direct emergency organization within the City, request the proclamation of an emergency by the City Council or the Governor, and represent the City in dealings with public and private entities related to emergencies, among other powers.

Signal Hill's emergency management programs maintain compliance with the federally-mandated National Incident Management System (NIMS) and the state Standardized Emergency Management System (SEMS) through regular training and disaster preparedness exercises for employees and the community. SEMS (Title 19, Division 2 of the Code of California Regulations) requires local governments within each county be organized into a single operational area for the purposes of emergency management. Signal Hill is part of the Los Angeles County Operational Area, which is managed by the Los Angeles County Office of Emergency Management (LACOEM). This Operational Area is further divided into eight Disaster Management Areas. Signal Hill is part of Disaster Management Area F, which also includes the cities of Long Beach and Avalon. The Disaster Management Area Coordinator (DMAC) for Area F is the Long Beach Fire Department Disaster Management Bureau, which is based out of the City of Long Beach EOC (located 0.5 mile northeast of Signal Hill at 2990 Redondo Avenue). The DMAC represents the region at operational area, regional, and state meetings and events.

The Los Angeles County Operational Area Citizen Corps Council is a volunteer component of the LACOEM and operates with support from the Federal Emergency Management Agency (FEMA). Citizens Corps Councils help coordinate volunteer activities that make communities safer and better prepared to respond to emergency situations.

Community Organizations, Volunteer Groups, and Safety Programs

A range of community organizations, volunteer groups, and safety programs are in place to assist with public safety and emergency management in the City. Among these are:

- **Citizens' Police Academy.** The SHPD offers the Citizens' Police Academy, a program taught by police officers and staff members and which gives an inside look at law enforcement in the community. Attendees learn about patrol operations, criminal law, narcotics enforcement, investigative techniques, crime prevention, emergency dispatch procedures, the court system, and many other areas of law enforcement.
- **Explorer Post 806.** The Explorer Post is a youth-oriented program sponsored by the SHPD. Members of the Explorer Post receive basic instruction in all phases of law enforcement, including crime prevention, investigation, fingerprinting, drug and narcotics recognition, first aid, Vehicle Codes, Penal Codes, juvenile crimes, truancy, and other related fields. The basic program emphasizes good citizenship and high moral character.

- **Community Emergency Response Team (CERT).** CERT members assist citizens and police, fire, and medical professionals during major disasters. The SHPD, in conjunction with the LACoFD, offers CERT training to the public. Training is free of charge and provided in emergency preparedness, fire safety, light search and rescue operations, medical operations, disaster psychology, and disaster simulation.
- **Community Volunteer Program.** The SHPD recruits community volunteers to support police services. Volunteers receive classroom training, field training, and in-service training, and assist with functions such as parking enforcement, vacation watch, speed watch, clerical functions, bicycle registration, fingerprinting services, and newsletter creation.
- **Emergency Network of Los Angeles.** This network consists of Los Angeles County nonprofit community based organizations that provide assistance to individuals, families, and organizations following emergencies and disasters. Network organizations include the American Red Cross – Los Angeles Region, Los Angeles Regional Food Bank, the Salvation Army, and others.
- **Neighborhood Watch.** Neighborhood Watch programs are in effect in Signal Hill. These are crime prevention programs that stress education and community cooperation. Neighborhood Watch groups typically focus on observation and awareness as a means of preventing crime.

Evacuation Routes

The roadway grid in and around Signal Hill provides for multiple means of evacuation from natural, technological, or human-caused disasters. Arterial roadways and the I-405 freeway are major evacuation routes (see **Table 6** and **Figure 2**). Dead-end streets limit movement over the I-405 in the northern part of the City and the former Pacific Electric Railway right-of-way along the City's southwest boundary limit roadway connections in some areas. Nonetheless, the presence of numerous bridges across these barriers makes existing evacuation routes adequate to serve the City's population; no major improvements are considered necessary to maintain emergency access. Future development in the City would be required to meet minimum roadway widths and subdivision design requirements as established by SHMC Titles 15 (Building and Construction) and 18 (Subdivisions) and Los Angeles County Fire Department. These standards ensure that roadways are wide enough to allow emergency vehicle access during emergencies and permit the efficient movement of large numbers of people.

TABLE 6 **Major Evacuation Routes**

North-South Routes	East-West Routes
Atlantic Avenue	Pacific Coast Highway
California Avenue	Hill Street
Orange Avenue	Willow Street
Walnut Avenue	Spring Street
Cherry Avenue	Wardlow Road
Redondo Avenue	I-405 Freeway

City of Signal Hill
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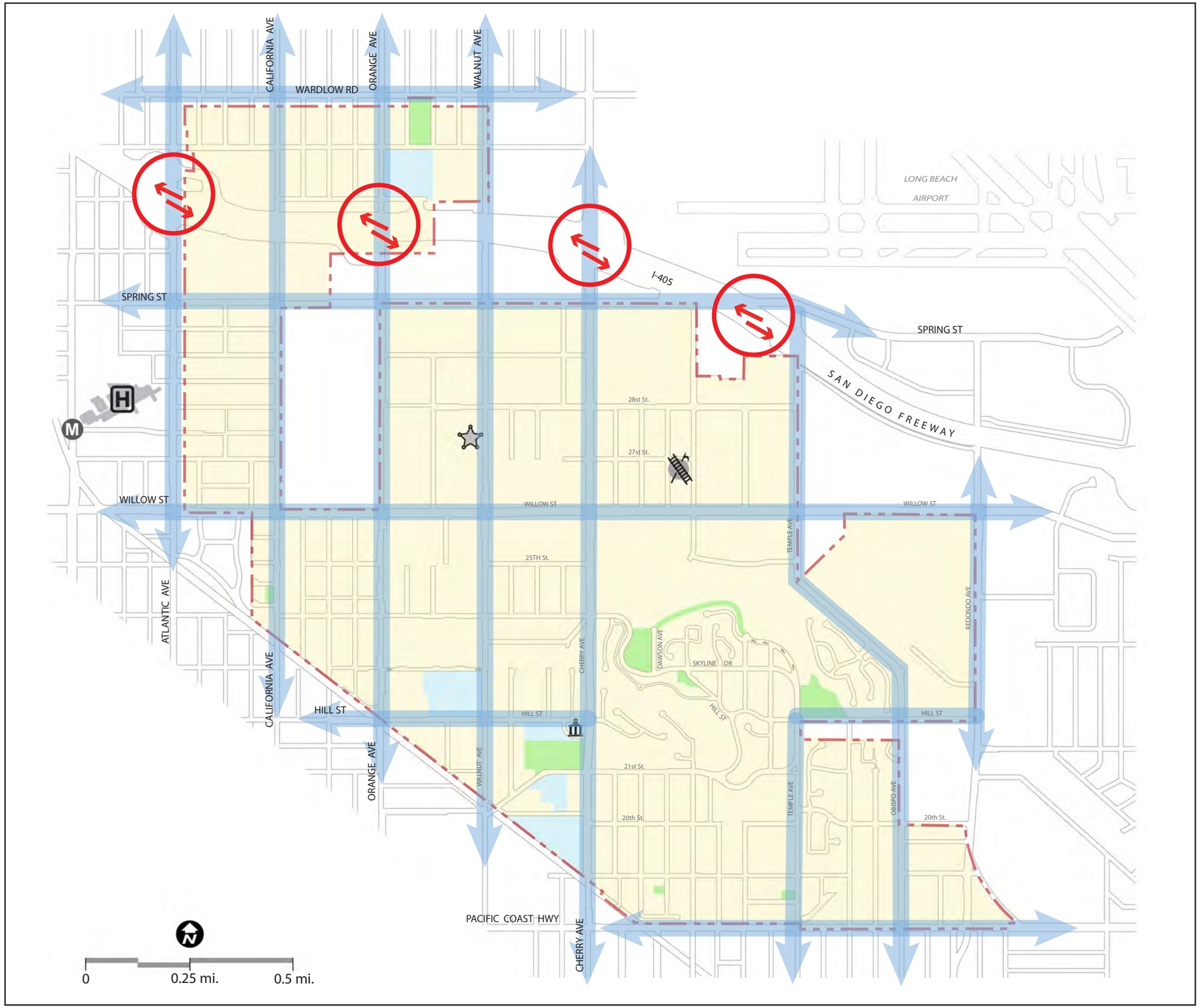

City of Signal Hill Boundary

Evacuation Route

Freeway Access Point

Figure 2
Evacuation Routes

III. ISSUES AND CONTRAINTS

A. Seismic and Geologic Hazards

Earthquakes

Signal Hill is located in a seismically active region, and major regional faults create the risk of substantial earth shaking and potential ground rupture in the area. Within Los Angeles County, there are over 50 active and potentially active fault segments, an undetermined number of buried faults, and at least 4 blind-thrust faults capable of producing damaging earthquakes.

Earthquakes present a multitude of potentially dangerous consequences that can include ground rupture, ground failure, and landslides. A catastrophic earthquake would severely strain the emergency response and recovery capabilities of federal, state, and local governments, and profoundly impact the regional and state economy.

Regional Faults

Major regional faults are displayed in **Figure 3**, along with the approximate epicenters of significant historical earthquakes.

The San Andreas Fault is the most significant regional fault, and is recognized as being capable of producing an earthquake of magnitude 8.0+ on the Richter scale. In 2007, the Working Group on California Earthquake Probabilities projected that the Southern California segment of the San Andreas Fault has a 59 percent chance of producing a magnitude 6.7 or greater earthquake within 30 years.[6] Despite this risk and because the San Andreas Fault is located over 40 miles from Signal Hill, smaller faults located closer to the City, including the Newport-Inglewood and Whittier Faults, are generally considered a greater risk to the area's residents and infrastructure.

Table 7 lists the most significant earthquakes to have impacted Signal Hill over the past century.

[6] The Working Group on California Earthquake Probabilities consists of the U.S. Geological Survey, California Geological Survey, and Southern California Earthquake Center. Their report is available at www.wgcep.org.

TABLE 7 **Major Historical Earthquakes**

Year	Magnitude	Name	Fault
1933	6.4	Long Beach	Newport-Inglewood Fault
1971	6.6	San Fernando (Sylmar)	San Fernando Fault
1987	5.9	Whittier Narrows	Whittier Fault
1994	6.7	Northridge	Northridge Thrust

Sources: California Geological Survey, Southern California Earthquake Center

0 2.5 5 10mi

City of Signal Hill
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Figure 3
Regional Earthquake Faults & Major Historical Earthquakes

Local Seismicity

Locally, the Newport-Inglewood Fault System cuts diagonally across Signal Hill (see **Figure 4**). This is the most significant seismic feature in the area and is considered seismically active. The 1933 Long Beach earthquake resulted from activity on this fault (see **Figure 3** for epicenter location). Within the Newport-Inglewood Fault System, five faults have been identified in and in the immediate vicinity of Signal Hill: the Cherry Hill Fault, Pickler Fault, Northeast Flank Fault, Reservoir Hill Fault, and Wardlow Fault. These faults are generally in a northwest-to-southeast alignment. The Wardlow Fault is a pre-quaternary fault that has not ruptured in at least 2 million years, and is therefore considered inactive. All other faults are considered active.

The Newport-Inglewood Fault System is a nearly linear alignment of faults extending 45 miles along the southwestern side of the Los Angeles basin. It can be traced as a series of topographic hills, ridges, and mesas from the Santa Monica Mountains to Newport Beach, where it trends offshore. Structures along the zone of deformation act as groundwater barriers and, at greater depths, as petroleum traps. Continuing seismic activity has been evidenced most prominently by the 1920 Inglewood and 1933 Long Beach earthquakes.

Alquist-Priolo Earthquake Fault Zones

The Alquist-Priolo Earthquake Fault Zoning Act[7] of 1972 was created to prohibit the location of most structures for human occupancy across the traces of active faults, thus lessening the hazard of fault rupture.

The three main provisions of the Act:

- require the California Geological Survey to produce maps of the surface traces of known active faults, including both the best known location where faults cut the surface and a buffer zone around the known trace(s);
- require property owners (or their real estate agents) to disclose that their properties lie within identified hazard zones; and,

[7] California Public Resources Code Section 2621 et seq.

- prohibit new construction of projects, as defined by the Alquist-Priolo Act, within these identified hazard zones until a comprehensive geological study has been completed.

The City of Signal Hill complies with the Act through SHMC Chapter 15.04 (Building Code). The SHMC requires an engineering geology report be prepared for all projects within Alquist-Priolo zones, as well as other areas when deemed necessary by the City Engineer. Before projects can be permitted, the geologic investigation must demonstrate that proposed buildings will not be constructed across active faults. Structures for human occupancy must be set back at least 50 feet from active faults. The evaluation and written report must be prepared by a registered geologist.

Since the Newport-Inglewood Fault System is active, it has been designated as an Alquist-Priolo zone. The Alquist-Priolo Earthquake Fault Zones within Signal Hill are depicted on **Figure 4**.

City of Signal Hill
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Source: Compiled from numerous sources by Earth Consultants International. See Safety Element Section VI for list of references.

- City of Signal Hill Boundary
- Active Faults
- Active and Potentially Active Fault Traces
- Pre-Quaternary Faults
- Alquist-Priolo Earthquake Fault Zones

Note:

All faults shown are part of the Newport-Inglewood Fault Zone.

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

Fault lines on the map are used solely to approximate the fault location. The width and location of the fults should not be used in lieu of site-specific investigations, evaluation, and design. Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. Not all faults may be shown. This map may be amended as new data become available and are validated.

Pre-quaternary faults are considered inactive and are not subject to the requirements of the Alquist-Priolo Earthquake Faults Zoning Act.

Figure 4
Local Fault Map & Alquist-Priolo Zones

Unreinforced Masonry Structures

The typical unreinforced masonry building has brick walls with no steel reinforcing bars embedded within them. The Unreinforced Masonry (URM) Law[8] requires cities and counties within Seismic Zone 4 (including Signal Hill) to identify hazardous unreinforced masonry buildings and consider local regulations to abate risks associated with such buildings through retrofitting and demolition. The URM Law does not apply to the following types of structures: warehouses and similar structures not used for human habitation, residential structures with five or fewer dwelling units, and historical properties. The City of Signal Hill has completed a building inventory and determined that there are no unreinforced masonry structures within the City that require action under the URM Law.

Liquefaction

Liquefaction is a geologic process that causes various types of ground failure. Liquefaction typically occurs when loose, saturated sediment of primarily sandy composition is subject to strong ground shaking. When liquefaction occurs, the sediments involved experience a total or substantial loss of shear strength and behave like a liquid substance. Depending on other conditions, such as density, ground slope, and stratification, the temporary loss of strength may result in foundation failures, landslides, and subsidence.

To have a potential for liquefaction, three simultaneous conditions are necessary: 1) generally cohesionless soils, 2) high groundwater, and 3) groundshaking. California's Seismic Hazards Mapping Act provides for statewide mapping of seismic hazards based in part on an examination of these conditions. Mapping for Signal Hill is provided on **Figure 5**. As shown on the figure, only two small portions of the City are considered at risk from liquefaction. One area consists of a strip of land adjacent to and under the Columbia Street right-of-way (part of which is currently used for oil production) between Atlantic and California Avenues. The second area is a narrow band along the southwestern border of the City, adjacent to the right-of-way of the former Pacific Electric Railway. Notably, this area of liquefaction risk includes a large portion of the site of a Long Beach Unified School District middle school, Jessie Elwin Nelson Academy, (1951 Cherry Avenue). As a school district project, development on this site is subject to review by and required to meet the standards of the Division of the State Architect rather than

[8] Government Code Section 8875 et seq.

the City of Signal Hill. The Division of the State Architect maintains regulations that appropriately mitigate liquefaction risks on development sites.

As required by the Seismic Hazards Mapping Act, areas at risk of liquefaction have been mapped where the historical occurrence of liquefaction and/or local geological, geotechnical, and groundwater conditions indicate a potential for future permanent, liquefaction-induced ground displacements such that mitigation would be required. Such mitigation would be intended to minimize seismic risks.

Landslides

Landslides can result from earthquake-related ground shaking or failure of steep slopes due to water saturation or unstable soil conditions. Landslides can overrun structures and other property, and cause human injury or death. They can sever utility lines and block roads, thereby hindering rescue operations following an earthquake. Signal Hill was most recently impacted in 1998 when a portion of steep and unstable natural slope below Panorama Drive eroded due to heavy El Niño rains. The Seismic Hazards Mapping Act requires identification of landslide zones in which the stability of hill slopes must be evaluated. **Figure 5** outlines the areas of the City that are susceptible to landslides. Areas that previously experienced landslide movement and/or local topographic, geological, geotechnical, and groundwater conditions may indicate the potential for future, permanent ground displacements. If confirmed during site geotechnical analyses, site mitigation would be required.

The areas found susceptible to landslides are found in the upper reaches of Signal Hill. Development, completed mostly over the past decade, is located both above and below areas at risk of landslides. Geotechnical analyses were prepared for these developments, and risks associated with landslides were mitigated to reduce their potential impacts. As shown on **Figure 5**, two areas remain with landslide potential in the City, located north of Panorama Promenade and southwest of Sunset View Park.

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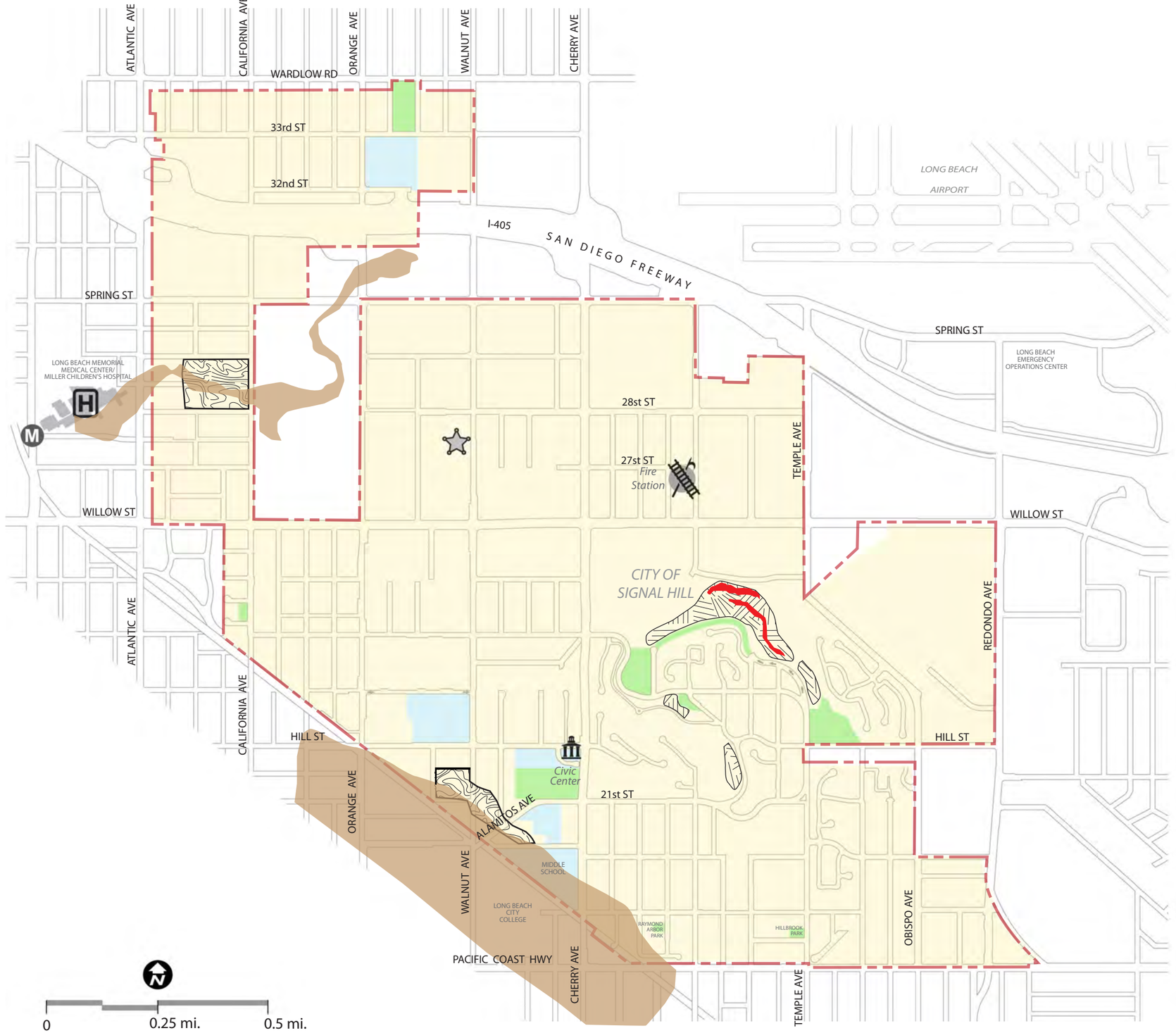

City of Signal Hill Boundary

Liquefaction Hazard

Undeveloped Land with Liquefaction Potential

Landslide Movement Hazard

Undeveloped Land with Landslide Potential

Source: Prepared by Earth Consultants International with data from the California Division of Mines and Geology.

Figure 5

Seismic Hazards

Soil Settlement and Expansion

The potential for seismic settlement to occur is based on the intensity and duration of ground shaking and the relative density of the subsurface soils. **Figure 6** shows the geologic units present in the Signal Hill. Information on the characteristics of these geologic units is provided in **Table 8.** As shown in the table, the Qop soil types which dominate Signal Hill have a limited expansion potential, with moderate expansion potential present only in clayey sections. The Qya and Qyfa which make up the remainder of the City have moderate to high expansion potential. In part because of the characteristics associated with the Qya and Qyfa geologic units, areas with these soils are considered to have a higher potential for liquefaction, as was previously shown on **Figure 5**. Development on these geologic units may be required to present geotechnical analysis before approval by the City.

TABLE 8 **Geologic Units**

Unit	Description
Qop	Old paralic deposits (late to middle Pleistocene; include the Lakewood Formation, terrace deposits, and Palos Verdes sand) – In the Signal Hill area, these are composed primarily of silt and sand with scattered gravel and fossiliferous lenses, capped locally with a reddish-brown weathered (soil) zone of clayey silt to clayey sand. These interfingered strandline, beach, estuarine, and colluvial deposits are mostly poorly sorted, moderately permeable, and medium dense to dense. The silt and sand sections, where exposed in slope faces, are susceptible to erosion and surficial slumping; the clayey sections may have a moderate expansion potential. May be corrosive to concrete.
Qya	Young alluvial floodplain deposits (Holocene and Late Pleistocene) – Composed mostly of soft clay, silt and loose to moderately dense sand and silty sand. These deposits are mostly poorly consolidated, poorly sorted, and permeable, and therefore potentially susceptible to liquefaction and differential settlement. Locally, these deposits may have a moderate to high expansion potential.
Qyfa	Young alluvial fan and valley deposits (Holocene and Late Pleistocene) – Composed of clay, sand, gravel and cobbles. These deposits are mostly poorly consolidated and poorly sorted, and are therefore compressible, potentially susceptible to collapse, liquefaction, and seismically-induced differential settlement. Locally, these deposits may have a moderate to high expansion potential.
-- ***(Not Mapped)***	Artificial fill (compacted and uncompacted) – deposits of various thicknesses are known to occur locally in the Signal Hill area but are not mapped here. These deposits are typically associated with petroleum exploration and drilling activities, grading, and construction. Fills impacted with petroleum hydrocarbons and heavy metals may be encountered in areas that were previously part of an oilfield. These deposits are mostly poorly consolidated, poorly sorted, potentially compressible, and may have a moderate to high expansion potential.

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City of Signal Hill Boundary

Faults

Qop

Qyfa

Qya

Please refer to Table 8 for a discussion of the characteristics of each geologic unit.

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

Fault lines on the map are used solely to approximate the fault location. The width and location of the fults should not be used in lieu of site-specific investigations, evaluation, and design. Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. All faults may not be shown. This map may be amended as new data becomes available and are validated.

Source: Earth Consultants International

Figure 6
Geologic Units

Subsidence

Subsidence is the sinking or gradual lowering of the earth's surface. Subsidence can result from either natural geologic and/or man-made causes. Natural geologic causes are basin-downwarp, fault movement, sediment compaction, and relaxation of deep earth stresses. Man-made causes include groundwater pumping, mining, oil and gas production, river channelization, and surface loading.

As mentioned in the background, from about 1940 to 1960, a significant amount of subsidence (up to 29 feet in some areas) occurred in the Port of Long Beach area due primarily to oil and gas extraction in the Wilmington Oilfield. In the 1960s, steps were taken that successfully prevented further subsidence in the Wilmington Field. The main action required was the injection of water into the areas where oil was removed. The Wilmington field is located much deeper underground, than the Long Beach Oilfield therefore, Signal Hill is not subject to the same subsidence concerns as the Port of Long Beach area. Nonetheless, Signal Hill Petroleum, Inc. (SHPI), which controls over 80 percent of the oil wells in Signal Hill and the units, uses the same strategy of injecting water into the oil formation. This minimizes the risk of future subsidence resulting from oil extraction in the City.

B. Fire Hazards

Fire hazards within Signal Hill may arise from three sources: open spaces with dry vegetation; urban development; and industry, particularly facilities associated with oil production, storage, and transportation. These fire hazards are discussed below.

Wildland Fire

With development over the past 15 years, much of the open space near the peak of Signal Hill has been developed with housing. However, some fire hazards remain in areas that have not been developed and are covered with natural vegetation. Vegetation in these areas generally consists of grasses which become dry and highly flammable during the fire season in the summer and fall.

The California Department of Forestry and Fire Protection (CAL FIRE) has mapped fire hazard severity zones throughout the state.[9] Designations include Unzoned (the lowest wildland fire risk), Moderate, High, and Very High. These designations take into account five major factors in wildland fire risk:

- **Vegetation:** Vegetation is "fuel" for a wildfire, but it varies over time. Fire hazard mapping considers the potential vegetation over a 50-year horizon.
- **Topography:** Fires burn faster on steep slopes.
- **Weather:** Fires burn faster and with more intensity where air temperatures tend to be high, relative humidity low, and winds strong.
- **Crown fire potential:** Under extreme conditions, fires burn up into trees and tall brush.
- **Ember production and movement:** Fire brands are blown ahead of the main fire, where they may enter buildings and ignite. This factor measures the likelihood of an area burning over a 30-to-50-year time period.

Fire hazard mapping for Signal Hill is provided in **Figure 7**. The City is unzoned, indicating a low potential for wildland fire; there are no Moderate, High or Very High fire hazard zones in Signal Hill.

Urban Fire

Residential development covers approximately 35 percent of Signal Hill, ranging from single-story single-family homes to multi-story apartment and condominium structures. According to the California Department of Finance, as of January 1, 2010, Signal Hill housed 1,950 single-family homes and 2,494 units in multi-family developments.[10] A significant number of single-family homes are over 60 years old, and are in varying states of maintenance and repair. Fire is a particular risk for these older residences; however, the Fire Department is generally prohibited by legal restrictions from conducting inspections of these homes. Multi-family development is generally newer, with few such projects over 40 years old.

Residential development is subject to the requirements of the Signal Hill Fire Code (SHMC Chapter 15.08), which adopts by reference the California Fire Code. The California Fire Code is updated periodically with new regulations intended to minimize potential fire hazards. Effective January 1, 2011,

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[9] Available at www.fire.ca.gov.

[10] California Department of Finance. *E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2010, with 2000 Benchmark*. Available at www.dof.ca.gov.

sprinklers are mandated for all new single-family homes. This requirement is intended to reduce the frequency and severity of house fires. It is estimated that the presence of sprinklers reduces deaths from fires by 83 percent.[11]

[11] National Fire Protection Association. *U.S. Experience with Sprinklers and Other Automatic Fire Extinguishing Equipment.* Available at http://www.nfpa.org/assets/files/PDF/OSsprinklers.pdf.

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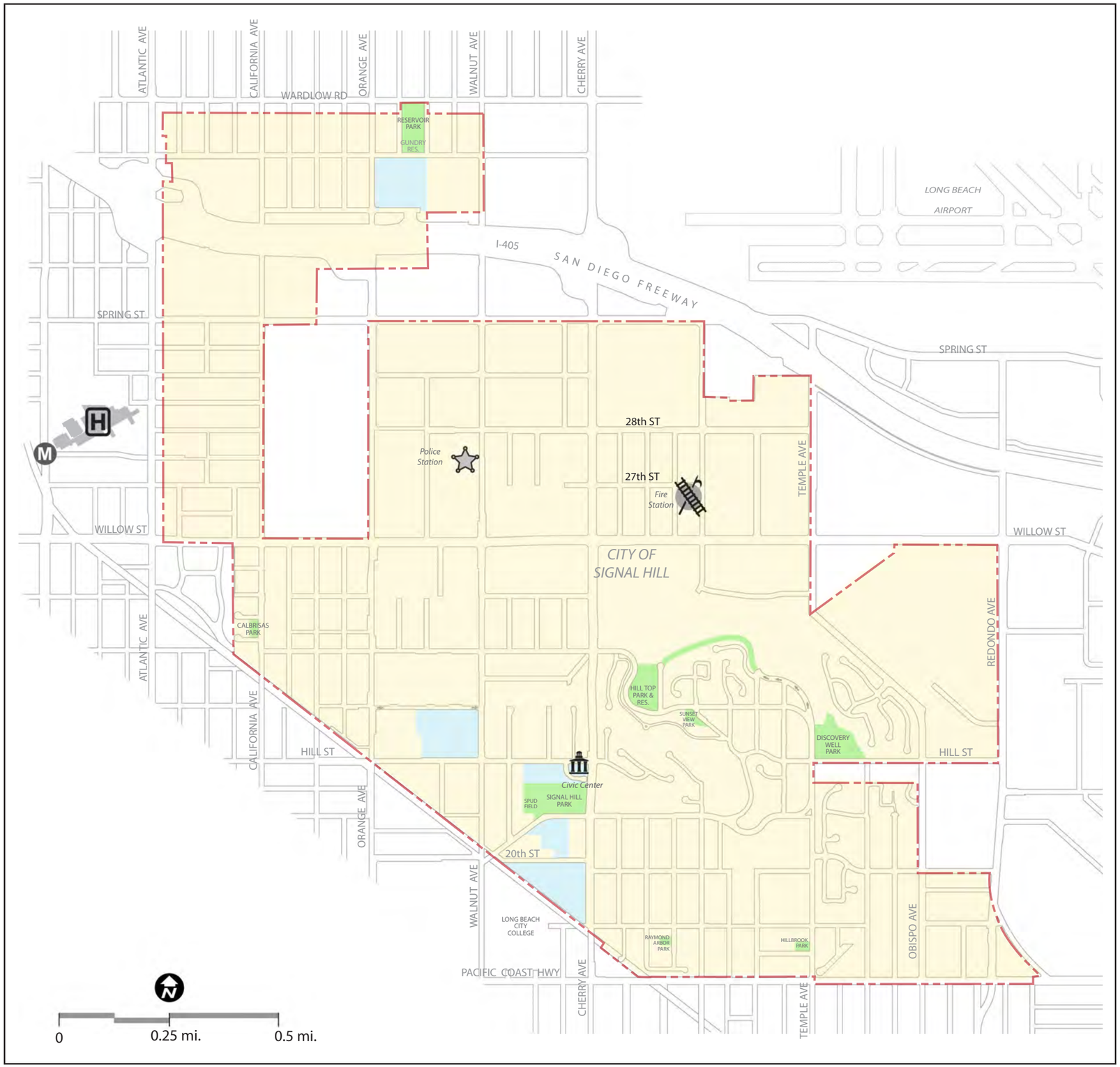

City of Signal Hill Boundary

Wildland Fire Hazard Severity Zones

Very High Risk *(None Shown)*

High Risk *(None Shown)*

Moderate Risk *(None Shown)*

Unzoned *(Lowest Risk)*

Source: Adapted from CAL FIRE Fire and Resource Assessment Program May 2012

Figure 7

Fire Hazard Mapping

Oil Fire Hazards

Potential fire hazard associated with the oilfield is explosion or fire resulting from the ignition of accumulated methane gas, overheating of pumps due to mechanical failures can cause oil well fires; however, existing active wells pose only minor fire hazards. The liquid extracted from wells is a mixture of salt water and oil (with water typically composing 97 percent of the mix). This mix is substantially less combustible than pure oil. The water-heavy mixture, combined with required blowout prevention equipment, significantly reduces potential hazards from oil well fires. Some of the independent well operators store pumped liquids in fuel tanks on the well site. These tanks are subject to regulation and inspection by the state and LACoFD.

Oil facilities are subject to the requirements of the SHMC Fire Code; in addition, to minimize fire hazards associated with such infrastructure, the SHMC Oil and Gas Code restricts the drilling of new wells in residential districts and establishes minimum building setbacks for such facilities. Other City policies require proper landscape maintenance and refuse removal to limit fire hazards. To further reduce potential fire impacts to these and other surrounding land uses, storage facilities maintain onsite fire suppression equipment to allow for rapid response to emergencies. Employees are trained to use suppression equipment until Fire Department equipment arrives. In addition, safety is ensured through routine inspection by local, state, and federal authorities, including the City of Signal Hill; Los Angeles County Fire Department; DOGGR; the federal Pipeline and Hazardous Materials Safety Administration; and others. SHPI, which operates over 80 percent of the wells in Signal Hill, monitors oil well activity 24 hours per day, and wells are subject to daily physical inspection. SHPI staff and firefighters conduct periodic drills and walkthroughs of oil facilities.

The 2013 Los Angeles County Fire Code section 5706.3 requires building not necessary to the operation of the well shall not be constructed within 100 feet of the oil well and 300 feet if the building is used as a place of assembly, institution or school. The Fire Code allows the Chief to approve the use of alternative materials and methods, provided that he finds that the proposed design meets the intent of the code and is at least equivalent to that which is prescribed by the Code. Due to the uniqueness of the oilfield and pumping operations in the City of Signal Hill, there are several alternate methods of protection approved. Mitigation may be provided at the well or at the structure to allow specific buildings to be constructed 35 feet from an oil well.

C. Flood Hazards

In general, Signal Hill is not subject to flood hazards. Only a small area along the City's southwestern boundary is designated as Zone X on the FEMA's Flood Insurance Rate Map, indicating no major flood risk (see **Figure 8**). The remainder of the City is unzoned. Accordingly, there are no special flood hazard areas in the City. However, due to topography, infrequent but intense rainfall can present minimal flooding problems in parts of the City. The areas with the greatest potential for rainfall-related flooding are in localized areas to the south, southeast, and southwest of the Hilltop area. Although some flood control facilities are maintained by the City of Signal Hill, the majority are controlled by the Los Angeles County Flood Control District. New drainage facilities will be considered during the review process for development projects.

There is a remote possibility that one of the City-operated water reservoirs (as described under Peakload Water Requirements, above) could rupture and leak, resulting in localized flooding in some areas of the City if stored water is released rapidly. The risk of damage is minimized because the reservoirs are partially or completely buried, limiting the amount of water that could be released. In addition, all reservoir facilities in the City are regularly inspected.

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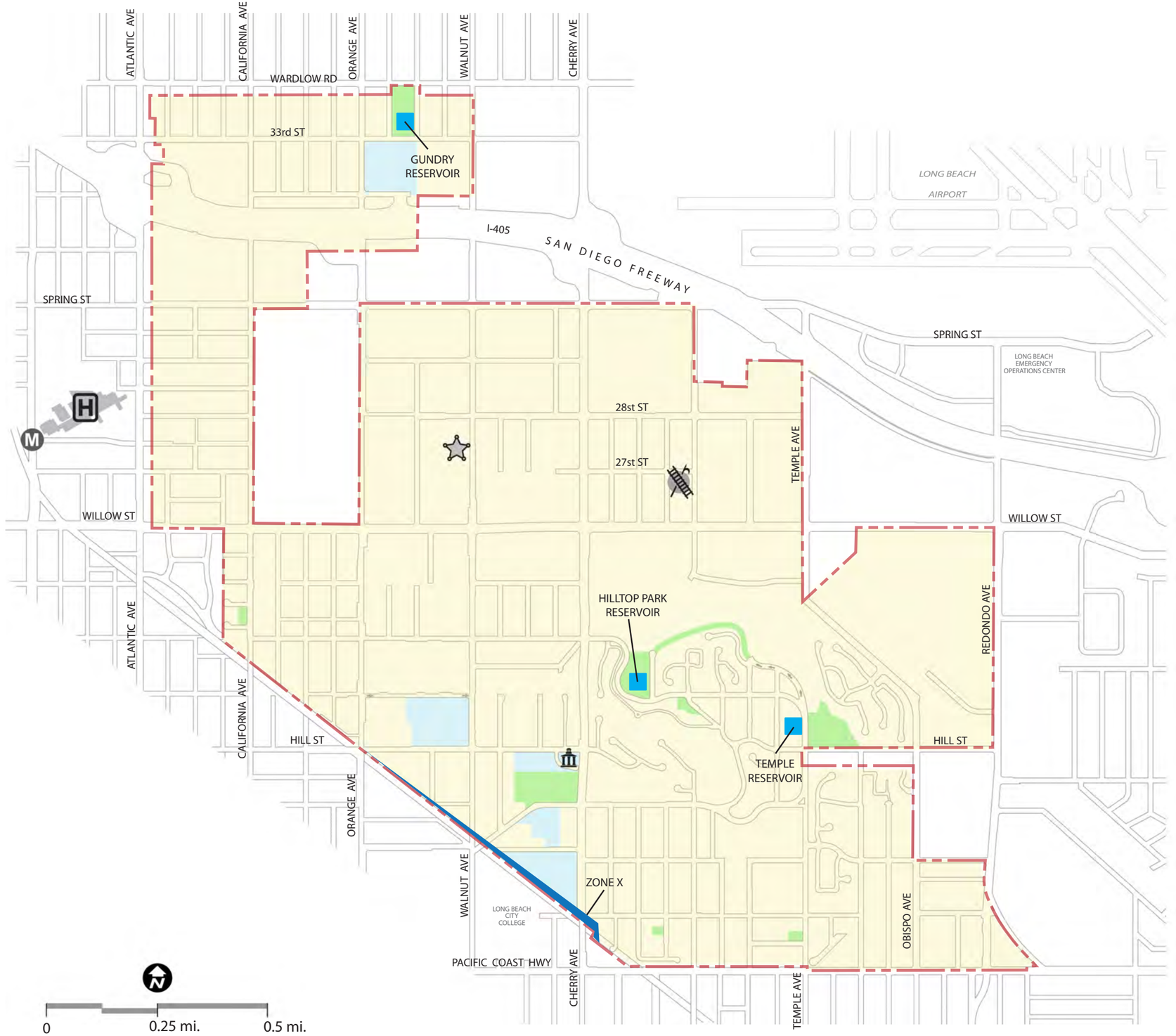


Legend

- City of Signal Hill Boundary
- Reservoir Location
- Zone X Flood Risk

Note: All areas outside of Zone X are unzoned. There are no special flood hazard areas within Signal Hill.

Figure 8
Flood Hazards

D. Oilfield Hazards

Oil Leaks

The risk of a significant oil leak in Signal Hill is low. This is in part because upward pressure in the Signal Hill oilfield is too low to rise to the surface through wells on its own. Water must be injected to increase oilfield pressure; without active pumping, liquids stop moving and the well ceases operation. In cases where a well is located near development, a "float switch" may be required to be placed at each well to shut off the flow of liquid if deemed necessary by the city inspector. In addition, in the event of a major incident such as an earthquake, a single switch can shut down all SHPI pumping operations in the area. The approximate locations of active wells are mapped on **Figure 9**.

Pipelines

Three types of pipelines service the oil industry in Signal Hill: one type carries a combination of water and oil, the second type carries natural gas and the third type carries refined fuel products to and from oil refineries in the region (for example, Carson, Wilmington, Torrance) to the two tank farms in the City and the Long Beach Airport (these pipelines are shown on **Figure 9** as "Hazardous Liquid Pipelines").

SHPI has pipelines that run underneath the streets, throughout the City. The pipelines are used to transport water, crude oil, and produced natural gas from the wells to a central processing facility. Wells operated by SHPI are connected to two pipelines: one carries a combination of water and oil and the second carries the relatively small amount of natural gas that is extracted with the water/oil mix from wells. Some natural gas is consumed by gas turbine electric generators operated by SHPI which supports their operations. The additional gas is sold to Long Beach Gas & Oil Department (LBGO).

The pipelines used to transport produced natural gas from oil and gas operations are operated at negative pressure at low flow rates. The produced natural gas contains a small amount of crude oil which builds up in the pipeline. There are "clean outs" (piping that connects back to the surface) with lids and valves at strategic locations on the natural gas pipeline (typically in streets). A special truck called a "vacuum truck" regularly goes to the clean outs and uses vacuum pressure to suck the residual crude oil out of the produced natural gas pipeline. This routine maintenance procedure is part of on-going work done. SHPI

also conducts mechanical integrity tests on all of its pipelines on a regularly scheduled basis to ensure their strength and safety.

The pipelines used to transport oil from oil and gas operations are required to comply with the provisions of federal and state law.[12] These regulations establish minimum requirements in the following areas of concern: 1) annual, accident, and safety-related condition reporting; 2) design requirements; 3) construction; 4) pressure testing; 5) operations and maintenance; 6) qualification of pipeline personnel; and 7) corrosion control. Inspection, testing, and investigation of pipelines are conducted by the Office of the State Fire Marshal's Pipeline Safety Division.

Oil and gas pipelines from oilfield operations are not the direct responsibility of the City of Signal Hill. Prior to the construction of public works projects or private development, maps are reviewed to determine if pipelines may be located under the project site. Pipeline locations may also be determined by contacting Underground Service Alert, which will send out staff to mark pipeline locations before excavations occur.

Processing Facilities

There are two processing facilities in Signal Hill (see **Figure 9**) liquids pumped from oil wells are transported via pipeline and collected at these facilities. At these facilities, the water/oil mix is broken down into its constituent parts. Approximately 97 percent of the liquid pumped from Signal Hill wells is salt water, with the remaining 3 percent mostly crude oil. The salt water is pressurized and sent to water injection wells, where it is reinjected into the oilfield. The crude oil is sent via pipeline from the processing facility to refineries throughout Southern California. There are no refineries in the City of Signal Hill. The risk of fire at the central processing facilities is very low due to the low concentration of oil in the liquid mix.

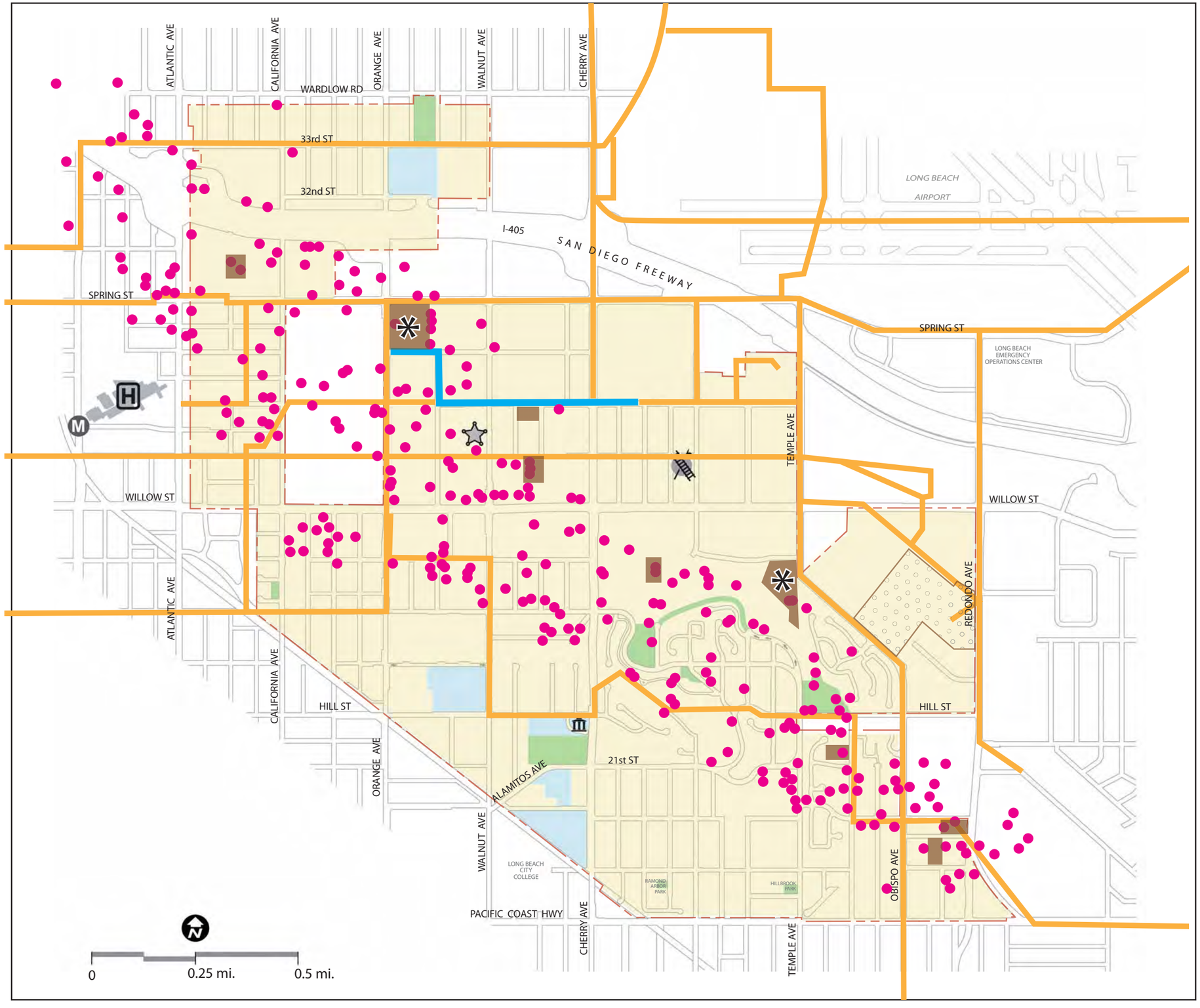
Refined Petroleum Tank Farms

Two tank farms (also sometimes called an oil depot or terminal) for refined petroleum product remain in operation within Signal Hill, as shown on **Figure 9**. The tank farms store petroleum products (after

[12] Part 195 (Transportation of Hazardous Liquids by Pipeline) of Title 49 of the Code of Federal Regulations and Section 31010 et seq. of the California Government Code (California Pipeline Safety Act).

they have been refined at refineries outside of the city) until they are transported to end users or another storage facility. There is no processing or other transformation on-site, however minor blending, addition of additives and distribution can be conducted at the sites as it is not considered major manufacturing. The tank farms are adjacent to each other and located near the City's eastern boundary. The larger of the two tank farms is the Tesoro Refining and Marketing Company, at 2350 Obispo which consists of 19 storage tanks with a total maximum design capacity of 1,119,500 barrels. Seven of the tanks were installed in 1958, and the remaining 12 in 1980. The smaller Shell Oil Products tank farm is supplied by direct pipeline from the companies Carson terminal, the tank farm is located east of the Tesoro facility at 2457 Redondo and includes tanks with a total capacity of 61,000 barrels. Employees at these facilities conduct daily visual inspections of storage tanks and other site facilities. Internal inspections of tanks are conducted periodically, when tanks are empty and open. Facility inspections are also carried out by the local Certified Unified Program Agency (CUPA), an entity which must be approved by the California Environmental Protection Agency. The CUPA for Signal Hill is the LACoFD Health Hazardous Materials Division.

City of Signal Hill
GENERAL PLAN
Safety Element



City of Signal Hill Boundary

Active Oil and Gas Wells
As of August 2010.

Refined Petroleum Tank Farms

Consolidated Drill Sites

Processing Facilities

Hazardous Liquid Pipelines

Gas Transmission Pipelines

Sources:
California Department of Conservation,
Division of Oil, Gas, and Geothermal Resources *and*
National Pipeline Mapping System

Figure 9
Active Oil & Gas Facilities

Groundwater Quality

Groudwater quality can be affected by various activities including oilfield operations, spills from commercial and industrial facilities and leaks from underground storage tanks if they are not managed properly. The City's water quality consultant, Flow Science, Inc., conducted a groundwater quality analysis to evaluate the potential impacts of oilfield operations on groundwater quality in the Signal Hill-Long Beach area. Flow Science reviewed information on subsurface geology, including the locations of drinking water aquifers and hydrocarbon production zones. The report found that in the Signal Hill area, drinking water aquifers typically occur well above hydrocarbon zones and the aquifers are generally separated by layers of low permeability. In addition, oil/gas wells are constructed with solid casings that extend through drinking water aquifers; oil/gas wells are not screened or perforated in drinking water zones.

In addition, a cursory analysis of the oil/gas recovery technique used in the Signal Hill area called waterflood was also conducted. DOGGR establishes limits and monitoring requirements for waterflood operations throughout California. DOGGR requires that injection pressures in waterflood operations be maintained below the fracture pressure of the formation and DOGGR requires pressure levels be confirmed in the field.

The report concludes that subsurface oilfield operations within the Signal Hill-Long Beach area to date have had no widespread significant impact on the water quality within overlying drinking water aquifers in spite of the fact that many abandoned wells within the Long Beach oil and gas field (the Field) lack an adequate plug at the base of fresh water. A copy of the February 24, 2014 Impacts of Oilfield Operations on Groundwater Quality in Signal Hill-Long Beach Area study is on file with the Community Development Department.

Soil Contamination

Petroleum hydrocarbons are the principal components of crude oil, therefore the soils around an active, idle or abandoned oil well or previous industrial sites including oilfield processing and manufacturing facilities may have hydrocarbons in the soil.

If DOGGR or City inspectors determine that contaminated soil is likely to be present on the project site, a soils investigation by a qualified soils engineer is required. In addition, a Human Health Risk

Assessment (HHRA) may be required as a condition of approval for a development project. A HHRA must follow the guidance in the Department of Toxic Substances Control (DTSC) ***Preliminary Endangerment Assessment*** guidance manual, along with the guidance of other manuals as needed. Human Health Risk Assessments are submitted to the State Office of Environmental Health Hazard Assessment for scientific validity.

For construction purposes, the property owners should submit a soils management plan to provide guidance to building contractors in the event that discolored or odiferous soils are discovered during onsite excavation and grading activities.

Methane

Methane is a colorless, odorless gas, is lighter than air and consequently travels in the subsurface along the path of least resistance until released into the atmosphere. Methane is generated from oil production and from microbial degradation of waste in municipal landfills and animal waste/sewage. Methane is a known asphyxiate and is explosive when three conditions are met: (1) it has accumulated in a confined space, (2) it is under pressure in the confined space, and (3) an ignition source is present.

The City has no record of methane or fluids leaking from abandoned or re-abandoned wells. However, all properties in the City, whether or not they contain abandoned wells, shall be tested for methane gas prior to issuance of construction or development permits unless otherwise approved by the Oil Services Coordinator. Methane Assessments are conducted per City of LADBS "Site Testing Standards for Methane" (P/BC 2002-101, November 30, 2004) using field instruments to measure methane, pressure and other fixed gases. The concentrations of methane detected and the measured pressure in the subsurface dictate the type of mitigation system warranted.

Methane Mitigation systems range from Vapor Barrier, Hardscape and Landscape Treatments, Passive Methane Mitigation System, and Modified Active Methane System. These may include, for example, venting systems, impervious foundation membranes, perforated pipe collection systems, and gas detection systems. Methane systems are then plan checked and installed during construction.

Development of Properties of Abandoned Oil Wells

DOGGR states the following significant and potentially dangerous issues related to development near abandoned oil wells:

"The property owner, developer, and local permitting agency should be aware of, and fully understand, the following significant and potentially dangerous issues associated with development near oil or gas wells:

1) The property owner is always responsible for providing access to any well located on the property, if re-abandonment becomes necessary. This means the property owner is responsible for removing any structure or obstacle that prevents or impedes access to a well. This includes, but is not limited to, buildings, housing, fencing, landscaping, trees, pools, patios, sidewalks, and decking. The DOGGR is also not responsible for the rebuilding or replacing of any structure or obstacle that needs to be removed to gain access to a well. According to Section 3255 of the Public Resources Code, the DOGGR may order the re-abandonment of any well that poses a danger to life, health, or natural resources.
2) There is no guarantees that wells properly abandoned to current DOGGR standards will not start leaking oil, gas, and/or water after abandonment. It always remains a possibility that any well may start to leak oil, gas, and/or water after abandonment, no matter how thorough the well was plugged and abandoned. DOGGR acknowledges wells that are abandoned to current standards have a lower probability of leaking oil, gas, and/or water after abandonment, but makes no guarantees about the abandonment."

When a proposal for development (new construction or addition) is presented to the Community Development Department, City staff review DOGGR maps to determine if any active, idle or abandoned oil wells are located within or adjacent to the subject property. If abandoned oil wells appear to be in the area of development, the property is subject to SHMC Chapter 16.24 Development Standards for Properties Containing Abandoned Wells. The steps needed prior to development are outlined below:

- **Step 1- Well Discovery.** First, the precise location of the well must be determined through on-site excavation, prior to excavation a well discovery permit is issued by the City to ensure the site is monitored and secured.

- **Step 2- Leak Test.** Once the well is located, it is uncovered and examined for gas and oil leakage. A leak testing permit shall be issued by the Oil Services Coordinator, a leak test shall be completed utilizing a "GT-43" gas detection meter, or one of comparable quality approved in advance by the Oil Services Coordinator, and shall be conducted by a state licensed geotechnical or civil engineer or state registered environmental assessor, class II, or other as determined necessary by the Oil Services Coordinator. The methane gas leak test is conducted around the perimeter of the interior and exterior surface plugs and across the face of the visible surface plugs of the visible well casing(s). A leak test report shall be prepared by a state licensed geotechnical or civil engineer or state registered environmental assessor, class II, and shall be submitted to the city for review and approval by the Oil Services Coordinator. The greatest detected measured concentrations of methane for the interior and exterior of each visible well casing shall be included in the report.

    - A well shall be considered leaking if the leak test report indicates the meter read is greater than 500 parts per million. If a well is found to be leaking they shall be abandoned pursuant to Sections 16.23.010 and 16.23.020.

    - A well shall not be considered leaking if the leak test report indicated the meter read is less than 500 parts per million. If a well is not leaking, vent risers and vent cones shall be installed to provide a subsurface path of least resistance for methane until released into the atmosphere. Cone and riser materials, design and installation shall be observed and inspected and approved by the Oil Services Coordinator and shall be in compliance with the recommendations contained in the leak test report.

    Following all testing and inspection, the test area shall be returned to its previous state and fencing may be required around the area, or the entire site, to the satisfaction of the Oil Services Coordinator. In addition, a licensed survey must be submitted to show the location of the well on the property to ascertain the location and document the depth of the well surface plate from the existing grade, or in the case of pending new development, the proposed depth. This is to provide more complete information about the well on the property.

- **Step 3-Well Access Exhibit.** Once the wells are located and a survey is created the developer shall create a well access exhibit that shows the locations of the abandoned oil well with a fully dimensioned site plan overlaid on top of the survey. The developer is responsible for the site

plan design and choosing whether to maintain rig access to the well, by not building over, or in close proximity to the well or building over or within close proximity of the well. Each abandoned well shall be marked on the exhibit as one of the following: 1. "Access provided" for wells meeting the close proximity standard, or not proposed to be built over. 2. "No access & methane mitigation required" for wells with improvements proposed over, or in close proximity to the well.

- **Step 4- Well Abandonment Report.** A well abandonment report shall be required for all abandoned wells marked as "no access & methane mitigation required" on the well access exhibit and shall be submitted to the Oil Services Coordinator for review. The report is to compile all of the information that is known for the well in one place, for example the well survey, leak test, DOGGR well bore data. The most important part of the report is the equivalency standard assessment report prepared by the applicant's registered petroleum engineer, registered petroleum geologist, or a professional with the equivalent of these registrations for review by the city's Petroleum Engineer. The assessment shall state whether the well meets, or does not meet, the City's equivalency standard pursuant to Section 16.24.070. The written narrative and wellbore diagram should therefore contain all relative facts (and assumptions) about the plugs to allow the developer and the City to reach conclusions on the adequacy of the plugs. The city's consulting petroleum engineer / geologist will determine if these conditions have been met (the abandonment is adequate to prevent hydrocarbons from reaching the surface via said well).

- **Step 5- Well Evaluation.** The primary focus of the Equivalency Standard (ES) is on the cement plugs set in the well during the course of the abandonment operations. The standard was developed by the City's Petroleum Engineer, Tom Walker of Evans & Walker, following extensive analysis of drilling and historic well abandonments and re-abandonments in the Field. The purpose of the standard is to establish a basis for the City's determination to allow development over and in close proximity to abandoned wells. The overarching goal of the standard is to insure that the integrity of the abandonment is sufficient to protect the public health, safety and welfare by preventing hydrocarbons from reaching the surface. In summary, the Equivalency Standard requires three cement plugs at three levels:

    - Last hydrocarbon producing zone
    - Base of fresh water zone

- Surface Plug

A copy of the October 7, 2014 Well Abandonment Equivalency Standard study is on file with the Community Development Department.

- **Step 6- Covenants, Conditions and Restrictions (CC&Rs).** Prior to issuance of any certificate of occupancy for developments constructed over abandoned wells, or for abandoned wells marked "no access," the property owner shall record a declaration of covenants, conditions and restrictions (CC&Rs), in a form subject to the review and approval of the City Attorney. This is to ensure that present and future property owners are aware of 1) the wells located on the property, and 2) significant and potentially dangerous issues associated with development near oil or gas wells. The CC&Rs are recorded to the property to put future owners and occupants on notice of the following: the existence of abandoned wells on the site; that the wells within the area of development have been leak tested and found not to leak; description of any methane mitigation measures employed; disclosure that access to these wells has been provided to address the fact that they may leak in the future causing potential harm; acknowledgment that the state may order the re-abandonment of any well should it leak in the future; acknowledgment that the state does not recommend building over wells; and releasing and indemnifying the city for issuing project permits.

E. Other Hazards

Hazardous Material Generators

Various industrial uses in Signal Hill use or produce materials which may be deemed hazardous by the state and federal governments. Regulation of hazardous wastes is provided on the federal, state and local levels.

The U.S. Environmental Protection Agency (EPA) and the California Department of Toxic Substances Control have developed and continue to update lists of hazardous waste subject to regulation. The South Coast Air Quality Management District (SCAQMD) works with the California Air Resources Board (CARB) and is responsible for developing and implementing rules and regulations regarding air toxins on a local level. The SCAQMD establishes permitting requirements, inspects emission sources, and enforces measures through educational programs and/or fines.

Hazardous waste management plans are implemented by jurisdictions across California. These plans assure adequate treatment and disposal capacity is available to manage the hazardous wastes generated within each jurisdiction. In 1988, Los Angeles County adopted the Los Angeles County Hazardous Waste Management Plan, which was subsequently approved by the State Department of Health Services. The Los Angeles County Hazardous Waste Management Plan provides policy direction and action programs to address current and future hazardous waste management issues that require local responsibility and involvement in Los Angeles County. In addition, the Plan discusses hazardous waste issues, and analyzes current and future waste generation within the region.

Senate Bill 1082 (1993) established the Unified Hazardous Waste and Hazardous Materials Management Regulatory Program (Unified Program). The Unified Program consolidates, coordinates, and makes consistent six hazardous materials and hazardous waste program elements. The Unified Program is implemented by the local CUPA. The LACoFD provides inspections and emergency response for facilities handling hazardous materials. They also evaluate Risk Management Plans prepared to minimize the risk of accidental releases.

Underground storage tanks, such as those commonly located below gas stations, are regulated by the Los Angeles County Department of Public Works, Environmental Programs Division. The Environmental Programs Division maintains the Underground Storage Tank Program, which has the goal of protecting the public, the environment, and storage tank owners/operators by ensuring that tank facilities are permitted, designed, installed, operated and eventually closed in compliance with local, state, and federal requirements.

Natural Gas Utility Pipelines

Natural gas pipelines service residential, commercial, and industrial uses throughout the city. Signal Hill is served by Long Beach Gas & Oil (LBGO), a municipal gas utility owned and operated by the City of Long Beach. LBGO services over 500,000 residents and businesses in Long Beach and Signal Hill, and maintains over 900 miles of natural gas main pipelines. No major natural gas explosions have occurred in Long Beach since LBGO's founding in 1924. In order to maintain safe service, approximately $8 million is expended annually to implement a long-range pipeline replacement plan. In the first eight months of 2010, LBGO replaced about 70,000 feet of pipeline, including 52,000 feet of pipelines constructed before 1950. Most gas pipelines in Signal Hill are small distribution lines, which provide

natural gas directly to individual homes and businesses. However, there is one larger gas transmission line within the city, running mostly below 28th Street (see **Figure 9**).

As required by federal regulations, LBGO continually monitors its pipelines for leakage, with personnel conducting walking surveys along the full length of the pipeline system with sensitive gas detection equipment. Leak surveys are conducted annually in business districts and every five years in residential areas. Depending on the magnitude of identified leaks, the damaged pipe is repaired or the pipeline section is completely replaced. The federal Department of Transportation's Office of Pipeline Safety conducts periodic audits of LBGO's pipeline operation and maintenance practices. LBGO has met all standards for leak survey, repairing all leaks according to federal safety standards and procedures. LBGO also maintains emergency service contact numbers and work crews on call 24 hours per day to investigate potential leaks.

Tsunami, Seiche, and Dam Failure

Tsunamis are unusually large sea waves produced by submarine earth movements or volcanic eruptions. They have the potential to impact coastlines and low-lying areas inland from the coast. Tsunami inundation mapping for California's coastal counties, including Los Angeles, was prepared in 2009 through a collaboration of the California Emergency Management Agency, the California Geological Survey, and the University of Southern California.[13] Mapping for the Long Beach Quadrangle shows that tsunamis are not expected to impact the City of Signal Hill. Much of the coast of Long Beach is protected by a high bluff which prevents tsunami impacts beyond the beach. The area nearest Signal Hill that could be impacted by a tsunami is the Colorado Lagoon area in Long Beach, located south of 7th Street and east of Ximeno Avenue, 1.5 miles southeast of Signal Hill's boundary.

Similar to a tsunami, seiche is the sudden oscillation of waters in an enclosed water body, such as a lake, rather than on the sea. There are no such enclosed water bodies in the vicinity of Signal Hill, and there is therefore no risk from seiche.

Dam failure can result in large-scale flooding of downstream areas. There are no dams in the Signal Hill area which could cause flooding in the City.

[13] Available at www.consrv.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/Statewide_Maps.aspx

IV. GOALS AND POLICIES

The goals and policies of this Safety Element fall into three major categories: prevention, preparation, and recovery. Goal 1 provides for *prevention*, which includes actions that should be taken to avert to the greatest degree feasible potential disasters. Where prevention is not feasible, Goal 2 provides for *preparation*, which involves taking steps to minimize impacts from disasters that are cannot be prevented. Finally, Goal 3 provides for *recovery*, or the rapid and effective restoration of services, infrastructure, and normal citywide operations following a major event.

Goal 1: PREVENTION: Strive to prevent man-made disasters and minimize the potential for natural disasters to impact the community.

Policy 1.a: Maintain a high level of interjurisdictional cooperation and communication on emergency planning and management.

Policy 1.b: Design future development located near water storage facilities and below the slope of the Hill to minimize the possibility of damage from flooding or a water storage facility leak or rupture.

Policy 1.c: Regulate the location, use, storage, and transportation of hazardous and toxic materials and protect the public from these hazards.

Policy 1.d: Maintain, revise, and enforce appropriate standards and codes to minimize seismic and geologic risks.

Policy 1.e: Encourage the maintenance or improvement of buildings' structural integrity to protect residents and preserve communities.

Policy 1.f: Locate, staff, and equip fire stations to meet established response times. Response time objectives are to be based on national standards.

Policy 1.g: Regulate the amount and type of new development in areas susceptible to fire hazards.

Policy 1.h: As development and population growth occurs, review service levels and adjust service accordingly to meet the demands of continued growth and development, tourism, and other factors which could change fire-rescue service needs.

Policy 1.i: Maintain communications with the Los Angeles County Fire Department to ensure that the department is continually equipped and trained to respond to fires and other emergencies.

Policy 1.j: Undertake preventive measures both for catastrophic events and for more frequent incidents such as structural fires and localized flooding.

Policy 1.k: Regulate development in Alquist-Priolo Earthquake Fault Zones consistent with levels of acceptable risk. Require the submission of geologic and seismic reports, as well as soils engineering reports, in relation to applications for land development permits whenever seismic or geologic problems are suspected.

Policy 1.l: Recognize the need for greater protection and safety of critical use facilities through careful site selection and comprehensive geotechnical evaluation that considers seismic and other geotechnical hazards.

Policy 1.m: Update the local Hazard Mitigation Plan every five years and evaluate the mitigation plan annually to determine the effectiveness of programs and to reflect changes in land development or programs that may affect mitigation priorities.

Goal 2: PREPARATION: Take necessary steps to allow for effective responses to disasters.

Policy 2.a: Maintain an effective Emergency Operations Plan and other emergency preparedness plans and programs, as necessary.

Policy 2.b: Ensure operational readiness of the City's EOC.

Policy 2.c: Adopt, monitor, and maintain service delivery objectives based on time standards for all fire, rescue and emergency response services.

Policy 2.d: Coordinate with healthcare providers so that the expansion or construction of new healthcare facilities addresses General Plan and community plan goals.

Policy 2.e: Coordinate with other area jurisdictions and local community groups and businesses to execute a variety of exercises to test operational and emergency plans and identify potential deficiencies in services that would occur during a disaster.

Policy 2.f: Address any deficiencies identified during emergency operations testing exercises by amending the City's Emergency Operations Plan accordingly.

Goal 3: RECOVERY: Plan for efficient and rapid recovery from disasters.

Policy 3.a: To the maximum extent possible, assist in the orderly and efficient reconstruction of Signal Hill following a major disaster.

Policy 3.b: Ensure that disaster recovery efforts involving the disposal of materials adhere to federal, state and City regulations when feasible.

Policy 3.c: To the extent possible, ensure that appropriate and effective action is taken to safeguard life and property during and immediately after emergencies, and assist in returning their lives and businesses to normal following a major event.

V. IMPLEMENTATION PROGRAM

This section provides a coordinated set of action plans and programs that serve to implement the goals and policies described in Section IV.

TABLE 9 **Implementation Program**

	Action Plans/Policies	Corresponding Goal/Policy
1	Continue to adopt the most-recent California Building, Electrical, Fire, Mechanical, Plumbing, and Residential Codes, as they are updated.	1.d / 1.e / 1.k / 1.l
2	Conduct annual reviews and updates, as necessary, of the Emergency Operations Plan.	1.a / 1.j / 2.f
3	Require geologic engineering and/or soils site investigations on all potential development sites located within Alquist-Priolo Earthquake Fault Zones. Such investigations are to be completed prior to issuance of a building permit.	1.d / 1.k / 1.l
4	Increase public awareness by developing an education program for residents and businesses on emergency preparedness.	1.j / 2.e / 3.c
5	Maintain the City's agreement with the Los Angeles County Fire Department for fire protection services and periodically review the adequacy of fire protection services.	1.a / 1.f / 1.i / 1.j
6	Continue to require Fire Department approval prior to project plan approval and completion.	1.a / 1.f / 1.g / 1.i / 1.j
7	With the assistance of the Fire Department, encourage employers to establish training programs regarding fire prevention, control, and evacuation.	1.a / 1.f / 1.j / 2.e
8	Coordinate with the Fire Department in their review of minimum fire flows and availability and distribution requirements for water in new developments.	1.a / 1.f / 1.g / 1.h /1.i / 2.a
9	Establish procedures for prioritizing services and assistance provided by mutual aid organizations, including the Long Beach Police and Fire Departments, the Los Angeles County Sheriff's Department, and the California Highway Patrol.	1.a / 1.f / 1.h / 1.i / 2.a / 2.b / 2.e / 3.c
10	Increase community awareness of potential crime hazards through public education programs conducted by qualified law enforcement personnel for all members of the community.	1.j / 2.c / 2.e / 3.c
11	Encourage City residents to become active in their community by continuing the support programs such as the Neighborhood Watch program.	1.j / 2.c / 2.e
12	Periodically review and update, as necessary, all law enforcement procedures and services to ensure the protection of public safety and welfare within Signal Hill.	1.h / 1.j / 2.c
13	Perform regular inspections of all water storage facilities located within the City and, if necessary, implement new procedures to ensure the safety of these facilities.	1.b / 1.e
14	Periodically review and update all municipal and building codes regulating the development and maintenance of facilities that extract, process, transport, and store petroleum, natural gas, chemical acid materials, and other potentially hazardous or toxic material.	1.c / 1.g

15	Continue to conduct safety inspections of hazardous and toxic materials facilities and implement, as necessary, any new requirements for the regulation of safety in these facilities.	1.c / 1.j
16	Collaborate with appropriate agencies and industries to define responsibility and cost allocation for repair and cleanup of hazardous, dangerous, toxic, and other spilled materials.	1.c
17	Require the annual updating of the City's inventory of all facilities, pipelines, and transport routes involved with hazard and toxic material activities.	1.c
18	Periodically update local standards, and support strengthening of state and federal standards concerning the transportation of hazardous and toxic materials within Signal Hill.	1.c
19	Specify those roadways that are designated as transportation routes for hazardous and toxic materials within Signal Hill.	1.c
20	Develop educational programs for public safety, public works, and inspection personnel identifying the types of hazardous materials located within the City and/or proper handling procedures in the event of a hazardous or toxic material emergency.	1.c / 1.j / 2.e / 3.b / 3.c
21	Maintain a capability for dealing with hazardous or toxic materials emergencies, and seek funding for such a capability.	1.c / 3.b
22	Maintain and revise, as necessary, the City's Emergency Operations Plan, to ensure the optimal safety and welfare of Signal Hill residents.	1.j / 2.a / 2.e / 2.f / 3.c
23	Continue regular exercises of Emergency Operations Plan procedures by City personnel in a simulated setting.	1.j / 2.a / 2.b / 2.f / 3.c
24	Develop an agreement with appropriate emergency medical service providers to serve Signal Hill's residents and workers in the event of a disaster.	1.j / 2.b / 2.d
25	Maintain an evacuation plan providing routes and procedures. Update the plan as necessary to account for changes in the roadway network, new development, and new hazards.	1.j / 2.a / 3.c
26	Develop an educational program aimed at informing the public of proper emergency response procedures.	1.j / 2.e / 3.c
27	Periodically review the coordinated efforts of all emergency response agencies to ensure the availability of services and efficiency of communications.	1.a / 1.j / 3.c
28	Prepare a recovery plan for reconstruction of essential services and facilities in the event of an emergency; develop resources and available sources of funding.	1.j / 2.a / 2.d / 3.a / 3.b / 3.c
29	Maintain an emergency operations center in accordance with the City's Emergency Operations Plan.	1.j / 2.a / 2.b / 3.c
30	Continue to train City employees in emergency response and management skills.	1.j / 2.a / 2.b / 2.e / 3.c
31	Update the local Hazard Mitigation Plan every five years and evaluate the mitigation plan annually to determine the effectiveness of programs and to reflect changes in land development or programs that may affect mitigation priorities.	1.m

VI. RESOURCE DIRECTORY

California Department of Forestry and Fire Protection (CAL FIRE)
www.fire.ca.gov
Applicable Activities: Wildland fire hazard mapping

California Department of Conservation
California Geological Survey (CGS)
www.conservation.ca.gov/cgs
Applicable Activities: Seismic hazards mapping

Division of Oil, Gas, and Geothermal Resources (DOGGR)
www.conservation.ca.gov/dog
Applicable Activities: Oil and gas well permitting, testing, safety inspections, and abandonment

California Office of Emergency Services (Cal OES)
www.oes.ca.gov
Applicable Activities: Emergency preparedness and response, tsunami inundation mapping

Long Beach Gas & Oil Department (LBGO)
www.longbeach.gov/lbgo
Applicable Activities: Natural gas pipelines and services

Los Angeles County Fire Department (LACoFD)
www.fire.lacounty.gov
Applicable Activities: Fire protection, building permit review

Los Angeles County Office of Emergency Management
www.lacoa.org
Applicable Activities: Countywide emergency organization and preparedness

U.S. Geological Survey (USGS)
www.usgs.gov
Applicable Activities: Earthquake records and statistics

U.S. Department of Transportation
Office of Pipeline Safety
www.phmsa.dot.gov/pipeline
Applicable Activities: Inspection of federally-regulated pipelines

VII. MAPPING REFERENCES

The following references were reviewed by Earth Consultants International, Inc. in August 2010 during preparation of **Figures 3, 4, 5** and **6** used in this Safety Element update.

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APPENDIX A- HAZARD MITIGATION PLAN

October 3, 2016 | # Hazard Mitigation Plan

emergency planning consultants

CITY OF SIGNAL HILL CALIFORNIA

Appendix A

Credits

Special Thanks

Hazard Mitigation Planning Team:

Agency	Name	Department	Position
City of Signal Hill	Richard Johnson, Chair	Police	Emergency Operations Coordinator
	Selena Alanis	Community Development	Associate Planner
	Travis Brooks	Public Works	Management Analyst
	Scott Charney	Community Development	Community Development Director
	Charlie Honeycutt	Administration	City Manager
	Michael Langston	Police	Chief of Police
	Aly Mancini	Community Services	Community Services Director
	Terri Marsh	Finance	Finance Director
	Steve Myrter	Public Works	Director
Emergency Planning Consultants	Carolyn J. Harshman	Consultant	President

Acknowledgements

City of Signal Hill

- ✓ Lori Y. Woods, Mayor
- ✓ Tina L. Hansen, Vice Mayor
- ✓ Larry Forester, Council Member
- ✓ Michael J. Noll, Council Member
- ✓ Edward H.J. Wilson, Council Member

Point of Contact

To request information or provide comments regarding this mitigation plan, please contact:

Name & Position Title	Richard Johnson, Emergency Operations Coordinator
Email	rjohnson@signalhillpd.org
Mailing Address	2745 Walnut Avenue, Signal Hill, CA 90755
Telephone Number	(562) 985-7239

Consulting Services

Emergency Planning Consultants

- ✓ Project Manager: Carolyn J. Harshman, CEM, President
- ✓ Lead Research Assistant: Alex L. Fritzler
- ✓ HAZUS/GIS: Michael McDaniel

3665 Ethan Allen Avenue
San Diego, California 92117
Phone: 858-483-4626
epc@pacbell.net
www.carolynharshman.com

Mapping

The maps in this plan were provided by the City of Signal Hill, County of Los Angeles, Federal Emergency Management Agency (FEMA), 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 Signal Hill 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.

Mandated Content

In an effort to assist the readers and reviewers of this document, the jurisdiction has inserted "markers" emphasizing mandated content as identified in the Disaster Mitigation Act of 2000 (Public Law – 390). Following is a sample marker:

EXAMPLE

Q&A | ELEMENT A: PLANNING PROCESS | A1

Q A1: Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))

A:

Table of Contents

Part I: PLANNING PROCESS

Introduction

The Hazard Mitigation Plan (Mitigation Plan) was prepared in response to Disaster Mitigation Act of 2000 (DMA 2000). DMA 2000 (also known as Public Law 106-390) requires state and local governments to prepare mitigation plans to document their mitigation planning process, and identify hazards, potential losses, mitigation needs, goals, and strategies. This type of planning supplements the City's comprehensive land use planning and emergency management planning programs. This document is a federally mandated update to the City of Signal Hill 2012 Hazard Mitigation Plan and ensures continuing eligibility for Hazard Mitigation Grant Program (HMGP) funding.

DMA 2000 was designed to establish a national program for pre-disaster mitigation, streamline disaster relief at the federal and state levels, and control federal disaster assistance costs. Congress believed these requirements would produce the following benefits:

- ✓ Reduce loss of life and property, human suffering, economic disruption, and disaster costs.
- ✓ Prioritize hazard mitigation at the local level with increased emphasis on planning and public involvement, assessing risks, implementing loss reduction measures, and ensuring critical facilities/services survive a disaster.
- ✓ Promote education and economic incentives to form community-based partnerships and leverage non-federal resources to commit to and implement long-term hazard mitigation activities.

The following FEMA definitions are used throughout this plan (Source: FEMA, 2002, *Getting Started, Building Support for Mitigation Planning*, FEMA 386-1):

Hazard Mitigation – "Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards".

Planning – "The act or process of making or carrying out plans; specifically, the establishment of goals, policies, and procedures for a social or economic unit."

Planning Approach

The four-step planning approach outlined in the FEMA publication, *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies* (FEMA 386-3) was used to develop this plan:

- ✓ **Develop mitigation goals and objectives -** The risk assessment (hazard characteristics, inventory, and findings), along with municipal policy documents, were utilized to develop mitigation goals and objectives.
- ✓ **Identify and prioritize mitigation actions -** Based on the risk assessment, goals and objectives, existing literature/resources, and input from participating entities, mitigation activities were identified for each hazard. Activities were 1) qualitatively evaluated against

the goals and objectives, and other criteria; 2) identified as high, medium, or low priority; and 3) presented in a series of hazard-specific tables.

- ✓ **Prepare implementation strategy -** Generally, high priority activities are recommended for implementation first. However, based on community needs and goals, project costs, and available funding, some medium or low priority activities may be implemented before some high priority items.
- ✓ **Document mitigation planning process -** The mitigation planning process is documented throughout this 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 (also known as Comprehensive Plans) and the implementing ordinances that are required to comply with the statewide land use 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. Such an analysis is found in this hazard mitigation plan.

State and Federal Partners in 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 hazards and hazard mitigation.

Some of the key agencies include:

- ✓ California Office of Emergency Services (Cal OES) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;
- ✓ Southern California Earthquake Center (SCEC) gathers information about earthquakes, integrates information on earthquake phenomena, and communicates this to end-users and the general public to increase earthquake awareness, reduce economic losses, and save lives.
- ✓ California Department of Forestry and Fire Protection (CAL FIRE) is responsible for all aspects of wildland fire protection on private and state properties, and administers forest practices regulations, including landslide mitigation, on non-federal lands.
- ✓ California Division of Mines and Geology (DMG) is responsible for geologic hazard characterization, public education, and the development of partnerships aimed at reducing risk.

- ✓ California Division of Water Resources (DWR) plans, designs, constructs, operates, and maintains the State Water Project; regulates dams; provides flood protection and assists in emergency management. It also educates the public, serves local water needs by providing technical assistance
- ✓ FEMA provides hazard mitigation guidance, resource materials, and educational materials to support implementation of the capitalized DMA 2000.
- ✓ United States Census Bureau (USCB) provides demographic data on the populations affected by natural disasters.
- ✓ United States Department of Agriculture (USDA) provides data on matters pertaining to land management.

Q&A | ELEMENT A: PLANNING PROCESS | A3

Q: A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

A: See **Planning Phases Timeline** below.

Stakeholders

A Hazard Mitigation Planning Team (Planning Team) consisting of department representatives from City of Signal Hill staff worked with Emergency Planning Consultants to create the updated Plan. **The Planning Team served as the primary stakeholders throughout the planning process.**

As required by DMA 2000, the Planning Team informed the general public and external agencies (including special districts and adjoining jurisdictions) of the planning process and provided opportunities for input during both the plan writing and review phases. **The general public and external agencies served as secondary stakeholders in the planning process.**

Hazard Mitigation Legislation

Hazard Mitigation Grant Program

In 1974, Congress enacted the Robert T. Stafford Disaster Relief and Emergency Act, commonly referred to as the Stafford Act. In 1988, Congress established the Hazard Mitigation Grant Program (HMGP) via Section 404 of the Stafford Act. Regulations regarding HMGP implementation based on the DMA 2000 were initially changed by an Interim Final Rule (44 CFR Part 206, Subpart N) published in the Federal Register on February 26, 2002. A second Interim Final Rule was issued on October 1, 2002.

The HMGP helps states and local governments implement long-term hazard mitigation measures for natural hazards by providing federal funding following a federal disaster declaration. Eligible applicants include state and local agencies, Indian tribes or other tribal organizations, and certain nonprofit organizations.

In California, the HMGP is administered by Cal OES. Examples of typical HMGP projects include:

- ✓ Property acquisition and relocation projects

- ✓ Structural retrofitting to minimize damages from earthquake, flood, high wind, wildfire, or other natural hazards
- ✓ Elevation of flood-prone structures
- ✓ Vegetative management programs, such as:
  - Brush control and maintenance
  - Fuel break lines in shrubbery
  - Fire-resistant vegetation in potential wildland fire areas

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation Program (PDM) was authorized by §203 of the Stafford Act, 42 United States Code, as amended by §102 of the DMA 2000. Funding is provided through the National Pre-Disaster Mitigation Fund to help state and local governments (including tribal governments) implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program.

In Fiscal Year 2009, two types of grants (planning and competitive) were offered under the PDM Program. Planning grants allocate funds to each state for Mitigation Plan development. Competitive grants distribute funds to states, local governments, and federally recognized Indian tribal governments via a competitive application process. FEMA reviews and ranks the submittals based on pre-determined criteria. The minimum eligibility requirements for competitive grants include participation in good standing in the National Flood Insurance Program (NFIP) and a FEMA-approved Mitigation Plan.
(Source: http://www.fema.gov/fima/pdm.shtm)

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) Program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 (42 U.S.C. 4101). Financial support is provided through the National Flood Insurance Fund to help states and communities implement measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP.

"Floods and hurricanes happen. The hazard itself is not the disaster – it's our habits, it's how we build and live in those areas…that's the disaster."

Craig Fugate,
FEMA Director

Three types of grants are available under FMA: planning, project, and technical assistance. Planning grants are available to states and communities to prepare Flood Mitigation Plans. NFIP-participating communities with approved Flood Mitigation Plans can apply for project grants to implement measures to reduce flood losses. Technical assistance grants in the amount of 10 percent of the project grant are available to the state for program administration. Communities that receive planning and/or project grants must participate in the NFIP. Examples of eligible projects include elevation, acquisition, and relocation of NFIP-insured structures. (Source: http://www.fema.gov/fima/fma.shtm)

Q&A | ELEMENT C. MITIGATION STRATEGY | C2

Q: C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))

A: See **NFIP Participation** below.

National Flood Insurance Program

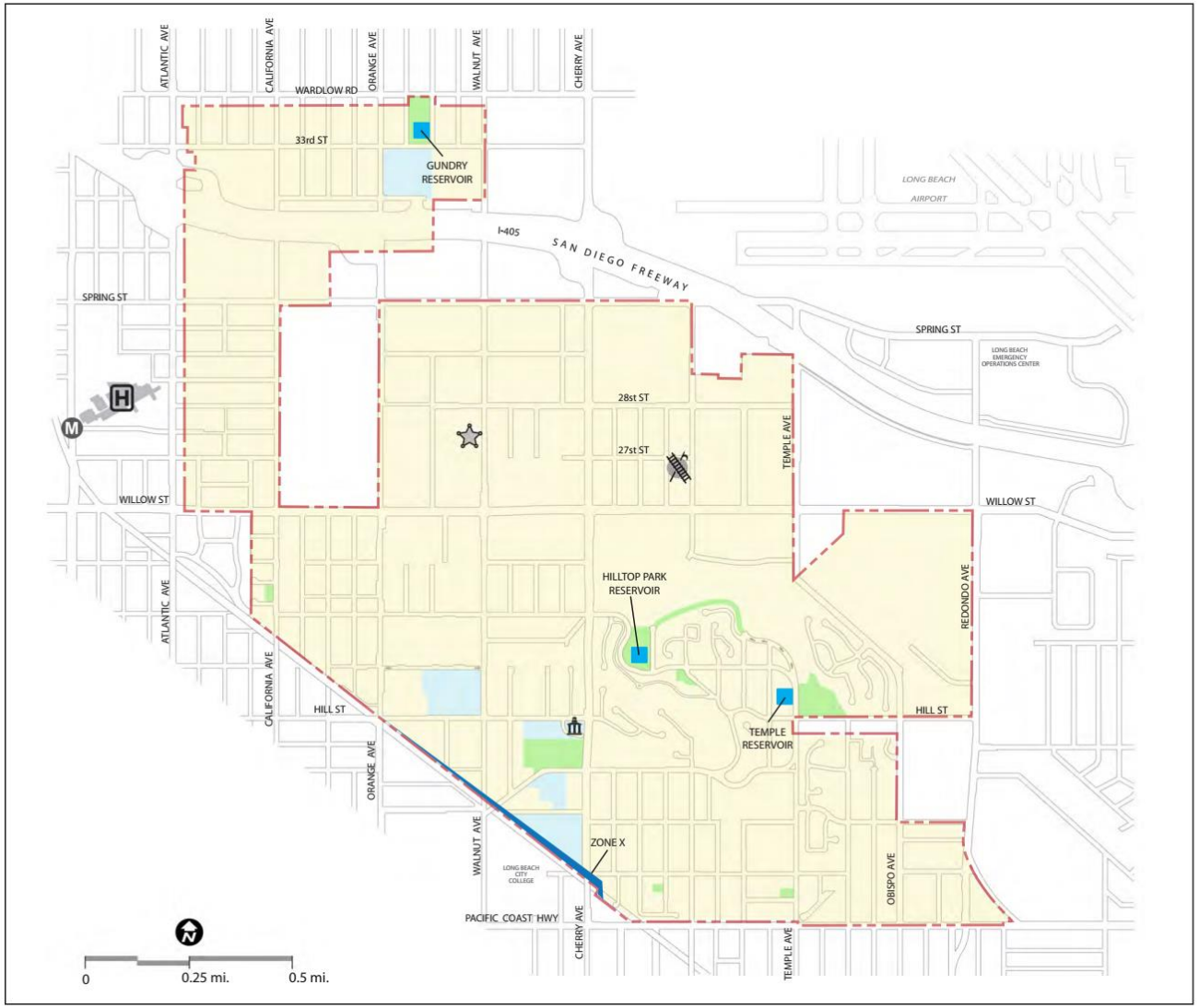
Established in 1968, the NFIP provides federally-backed flood insurance to homeowners, renters, and businesses in communities that adopt and enforce floodplain management ordinances to reduce future flood damage.

NFIP Participation

The City of Signal Hill participates in NFIP and the FEMA FIRM maps for the City of Signal Hill were last updated September 26, 2008. Unfortunately, FEMA flood maps are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed the studies, and does not incorporate planning for floodplain changes in the future due to new development. Although FEMA is considering changing that policy, it is optional for local communities.

According to FEMA, the City of Signal Hill is designated a No Special Flood Hazard Area (NSFHA). A Non-Special Flood Hazard Area (NSFHA) is an area that is in a moderate- to low-risk flood zone (Zones B, C, X Pre- and Post-FIRM). An NSFHA is not in any immediate danger from flooding caused by overflowing rivers or hard rains. According to the City's 2016 General Plan Safety Element, Signal Hill is not subject to flood hazards. Only a small area along the city's southwestern boundary is designated as Zone X on the Federal Emergency Management Agency's Flood Insurance Rate Map, indicating no major flood risk. The remainder of the City is unzoned. Accordingly, it is concluded that there are no special flood hazard areas in the City as shown on **Map: Flood Hazards**.

Map: Flood Hazards
(Source: City of Signal Hill General Plan – Safety Element 2016)



City of Signal Hill
GENERAL PLAN

Safety Element
October 2010

DRAFT

Legend

- City of Signal Hill Boundary
- Reservoir Location
- Zone X Flood Risk

Note: All areas outside of Zone X are unzoned. There are no special flood hazard areas within Signal Hill.

Figure 7
Flood Hazards

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B4

Q: B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))

A: See **Repetitive Loss Properties** below.

Repetitive Loss Properties

Repetitive Loss Properties (RLPs) are most susceptible to flood damages; therefore, they have been the focus of flood hazard mitigation programs. Unlike a Countywide program, the Floodplain Management Plan (FMP) for repetitive loss properties involves highly diversified property profiles, drainage issues, and property owner's interest. It also requires public involvement processes unique to each RLP area. The objective of an FMP is to provide specific potential mitigation measures and activities to best address the problems and needs of communities with repetitive loss properties. A repetitive loss property is one for which two or more claims of $1,000 or more have been paid by the National Flood Insurance Program (NFIP) within any given ten-year period. According to FEMA resources, there are no Repetitive Loss Properties within the City of Signal Hill.

State and Federal Guidance in Hazard Mitigation

While local jurisdictions have primary responsibility for developing and implementing hazard mitigation strategies, they are not alone. Various state and federal partners and resources can help local agencies with mitigation planning.

The Mitigation Plan was prepared in accordance with the following regulations and guidance documents:

- ✓ DMA 2000 (Public Law 106-390, October 10, 2000)
- ✓ 44 CFR Parts 201 and 206, Mitigation Planning and Hazard Mitigation Grant Program, Interim Final Rule, October 1, 2002
- ✓ 44 CFR Parts 201 and 206, Mitigation Planning and Hazard Mitigation Grant Program, Interim Final Rule, February 26, 2002
- ✓ How-To Guide for Using HAZUS-MH for Risk Assessment, (FEMA 433), February 2004
- ✓ Mitigation Planning "How-to" Series (FEMA 386-1 through 9 available at: http://www.fema.gov/fima/planhowto.shtm)
- ✓ Getting Started: Building Support For Mitigation Planning (FEMA 386-1)
- ✓ Understanding Your Risks: Identifying Hazards and Estimating Losses (FEMA 386-2)
- ✓ Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies (FEMA 386-3)
- ✓ Bringing the Plan to Life: Implementing the Mitigation Plan (FEMA 386-4)
- ✓ Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5)
- ✓ Integrating Historic Property and Cultural Resource Considerations into Mitigation Planning (FEMA 386-6)
- ✓ Integrating Manmade Hazards Into Mitigation Planning (FEMA 386-7)
- ✓ Multi-Jurisdictional Mitigation Planning (FEMA 386-8)

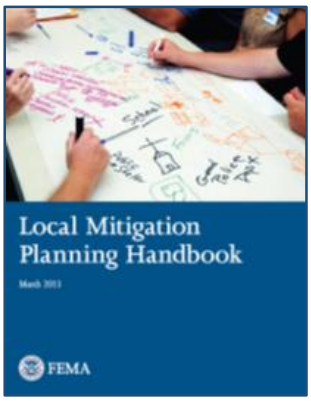
- ✓ Using the Mitigation Plan to Prepare Successful Mitigation Projects (FEMA 386-9)
- ✓ State and Local Plan Interim Criteria Under the DMA 2000, July 11, 2002, FEMA
- ✓ Mitigation Planning Workshop For Local Governments-Instructor Guide, July 2002, FEMA
- ✓ Report on Costs and Benefits of Natural Hazard Mitigation, Document #294, FEMA
- ✓ LHMP Development Guide – Appendix A - Resource, Document, and Tool List for Local Mitigation Planning, December 2, 2003, Cal OES
- ✓ Local Mitigation Plan Review Guide (FEMA 2011)
- ✓ Local Mitigation Planning Handbook (FEMA 2013)

How is the Plan Organized?

The structure of the plan enables the reader to use a section of interest to them and allows the City to review and update sections when new data is available. The ease of incorporating new data into the plan will result in a Mitigation Plan that remains current and relevant.

Following is a description of each section of the plan:

Part I: Planning Process



Introduction

Describes the background and purpose of developing a mitigation plan.

Planning Process

Describes the mitigation planning process including: stakeholders and integration of existing data and plans.

Part II: Risk Assessment

Community Profile

Summarizes the history, geography, demographics, and socioeconomics of the City.

Risk Assessment

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

City-Specific Hazard Analysis

Describes the natural hazards posing a significant threat to the City including:

Earthquake | Landslide | Windstorm | Drought

Each City-Specific Hazard Analysis includes information on previous occurrences, local conditions, hazard assessment, and local impacts.

Part III: Mitigation Strategies

Mitigation Strategies

Documents the goals, community capabilities, and priority setting methods supporting the Plan. Also highlights the Mitigation Actions Matrix: 1) goals met; 2) identification,

assignment, timing, and funding of mitigation activities; 3) benefit/cost/priorities; 4) plan implementation method; and 5) activity status.

Plan Maintenance

Establishes tools and guidelines for maintaining and implementing the Mitigation Plan.

Part IV: Appendix

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

General Hazard Overviews

Generalized subject matter information discussing the science and background associated with the identified hazards.

Attachments

FEMA Letter of Approval
City Council Staff Report
City Council Resolution
Planning Team sign-in sheets
Web postings and notices
References

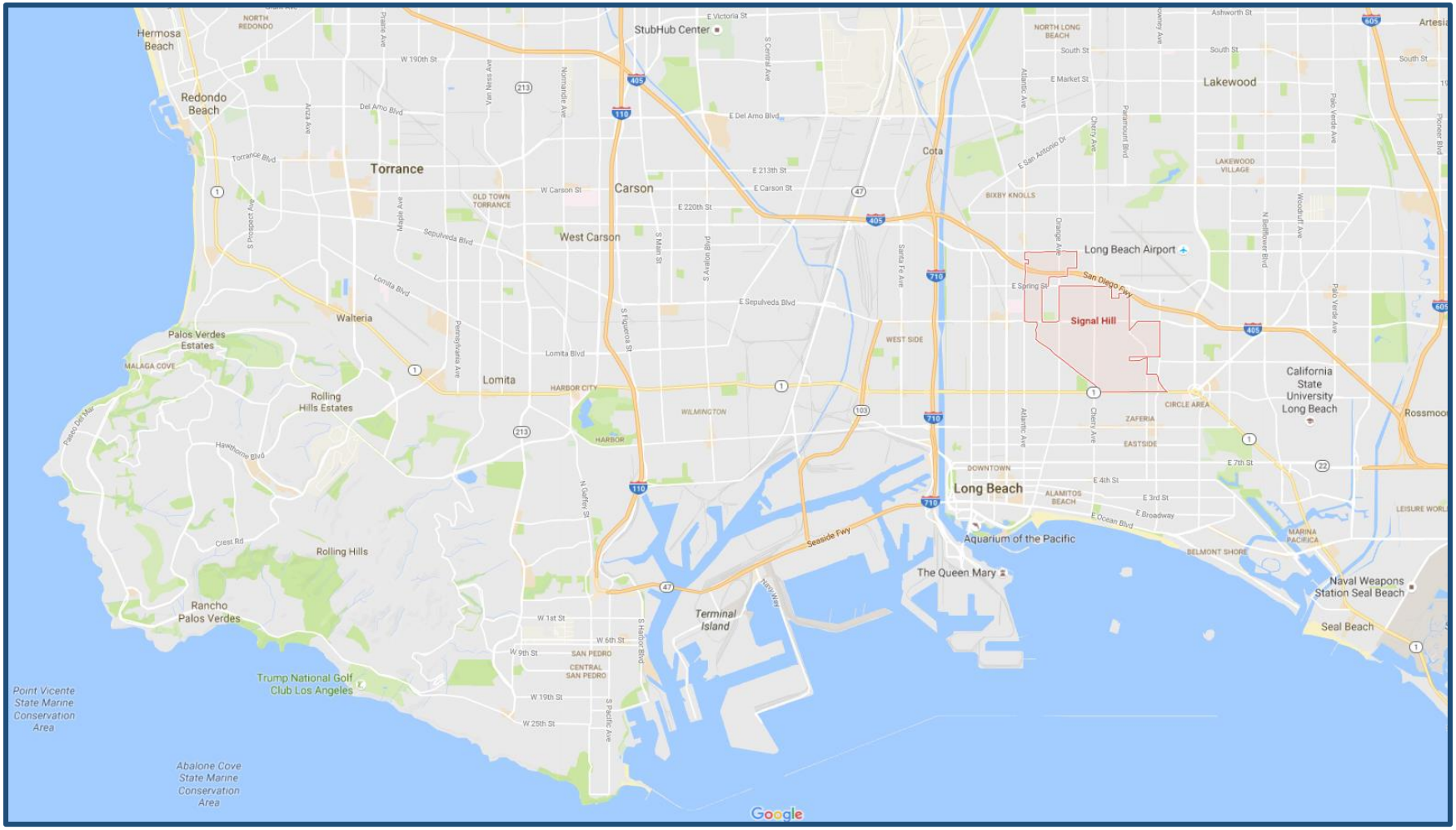
Plan Adoption and Approval

As per DMA 2000 and supporting Federal regulations, the Mitigation Plan is required to be adopted by the City Council and approved by FEMA. See the **Planning Process Section** for details.

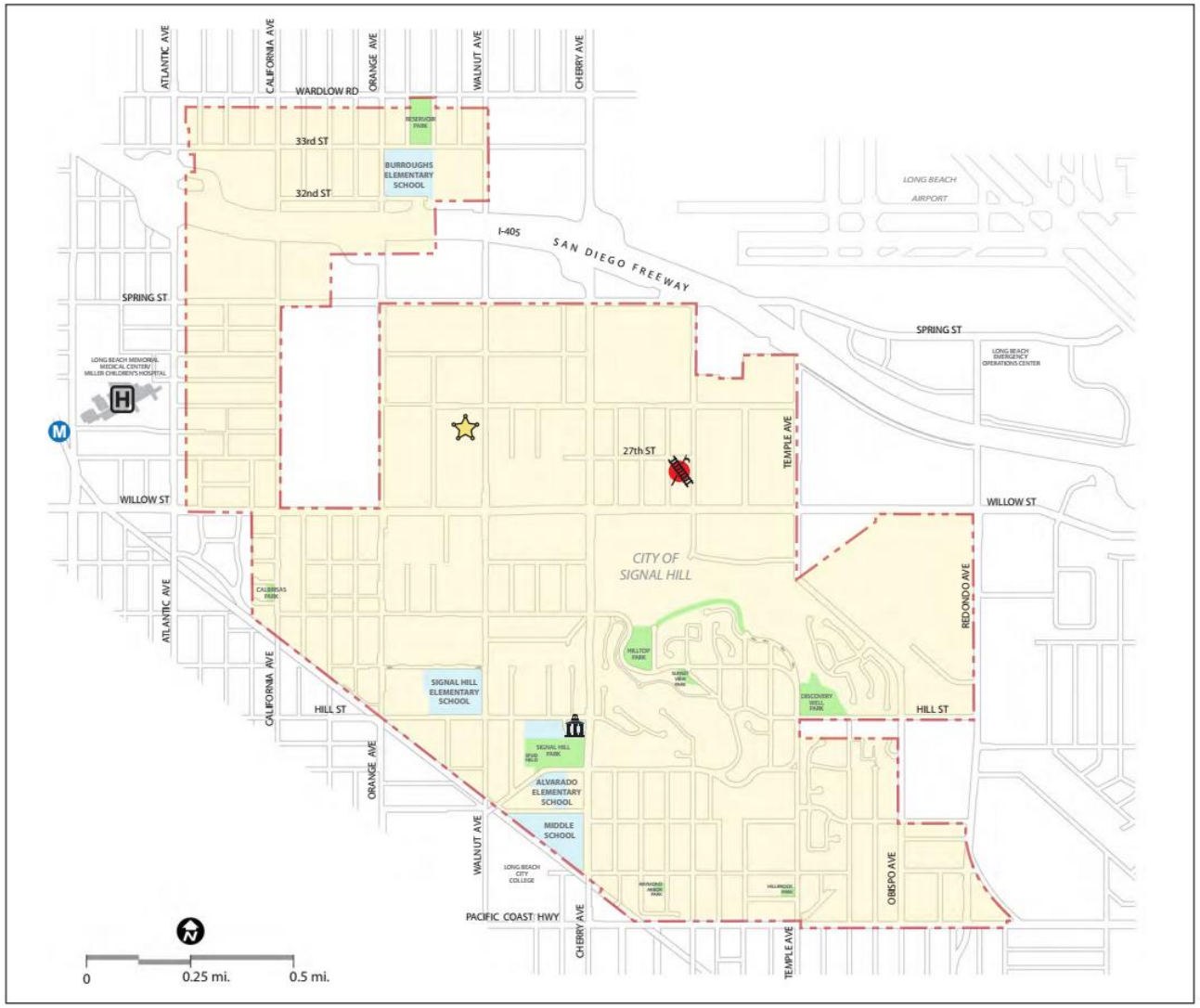
Who Does the Mitigation Plan Affect?

This plan provides a framework for planning for natural hazards. The resources and background information in the plan are applicable City-wide and to City-owned facilities outside of the City boundaries, and the goals and recommendations provide groundwork for local mitigation plans and partnerships. **Map: City of Signal Hill** shows the regional proximity of the City to its adjoining communities.

Map: City of Signal Hill - Regional
(Source: Google Maps)



Map: City of Signal Hill - Local
(Source: City of Signal Hill General Plan – Safety Element 2016)



City of Signal Hill
GENERAL PLAN

Safety Element
October 2010

- City of Signal Hill Boundary
- Parks
- Schools
- Metro Rail Station
- Hospital
- Police Station & Emergency Operations Center
- Fire Station
- Civic Center

Planning Process

Throughout the project, the City followed its traditional approach to developing policy documents which included preparation of a First Draft Plan for review by the City's Hazard Mitigation Planning Team who served as the primary stakeholders. Next, following necessary updates, a Second Draft Plan was shared with the general public and external agencies (special districts and adjoining jurisdictions) during the plan writing phase. The general public and external agencies served as the secondary stakeholders. Next, the comments gathered from the secondary stakeholders were incorporated into a Third Draft Plan which was submitted to Cal OES and FEMA along with a request for a conditional approval.

Next, the Planning Team completed amendments to the Plan to reflect mandated input by Cal OES and FEMA. The Fourth Draft Plan was then posted for an additional opportunity for input from the secondary stakeholders. Following the review period, comments gathered were incorporated into a City Council Staff Report and a public notice was placed on the City's website announcing the City Council's public meeting. Following adoption by the City Council, the Final Draft Plan was re-submitted to FEMA with a request for final approval. The planning process described above is portrayed below in a timeline:

Q&A | ELEMENT A: PLANNING PROCESS | A1

Q: A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))

A: See **Planning Phases Timeline** below.

Q&A | ELEMENT A: PLANNING PROCESS | A2

Q: A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))

A: See **Planning Phases Timeline** below.

Q&A | ELEMENT A: PLANNING PROCESS | A3

Q: A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

A: See **Planning Phases Timeline** below.

Q&A | ELEMENT E: PLAN ADOPTION | E1

Q: E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))

A: See **Planning Phases Timeline** below.

Figure: Planning Phases Timeline

PLANNING PHASES TIMELINE				
Plan Writing Phase (First & Second Draft Plan)	**Plan Review Phase (Third & Fourth Draft Plan)**	**Plan Adoption Phase (Fourth Draft Plan)**	**Plan Approval Phase (Final Draft & Final Plan)**	**Plan Implementation Phase**
• Planning Team input – research, meetings, writing, review of First Draft Plan • Incorporate input from the Planning Team into Second Draft Plan • Invite general public and external agencies to review, comment, and contribute to the Second Draft Plan. • Incorporate input into the Third Draft Plan	• Third Draft Plan sent to Cal OES and FEMA for conditional approval • Address any mandated revisions identified by Cal OES and FEMA into Fourth Draft Plan • Invite general public and external agencies to review, comment, and contribute to the Fourth Draft Plan	• Incorporate input into the City Council staff report. • Post public notice of City Council meeting • Fourth Draft Plan distributed to City Council in advance of meeting • Present Fourth Draft Plan to the City Council • City Council adopts Plan • Incorporate input from City Council meeting into Final Draft Plan	• Submit Final Draft Plan to FEMA with request for final approval • Receive FEMA approval • Incorporate FEMA approval into the Final Plan	• Conduct quarterly Planning Team meetings • Integrate mitigation action items into budget, CIP and other funding and strategic documents

Plan Methodology

The Planning Team discussed knowledge of natural hazards and past historical events, as well as planning and zoning codes, ordinances, and recent planning decisions.

The rest of this section describes the mitigation planning process including 1) Planning Team involvement, 2) extended Planning Team support (department heads), 3) public and external agency involvement; and 4) integration of existing data and plans.

Q&A | ELEMENT A: PLANNING PROCESS | A1

Q: A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))

A: See **Table: Planning Team Involvement and Level of Participation** below.

Planning Team Involvement

The Planning Team consisted of representatives from City of Signal Hill departments related to hazard mitigation processes. The Planning Team served as the primary stakeholders throughout the planning process. Citizens and businesses (general public) along with external agencies (special districts and adjoining jurisdictions) served as secondary stakeholders in the planning process. The Planning Team was responsible for the following tasks:

- ✓ Confirming planning goals
- ✓ Prepare timeline for plan update
- ✓ Ensure plan meets DMA 2000 requirements
- ✓ Organize and solicit involvement of public and external agencies
- ✓ Analyze existing data and reports
- ✓ Update hazard information
- ✓ Review HAZUS loss projection estimates
- ✓ Update status of Mitigation Action Items
- ✓ Develop new Mitigation Action Items
- ✓ Participate in Planning Team meetings and City Council public meeting

The Planning Team, with assistance from Emergency Planning Consultants, identified and profiled hazards; determined hazard rankings; estimated potential exposure or losses; evaluated development trends and specific risks; and developed mitigation goals and action items.

Table: Planning Team Level of Participation

Name	Research and Writing of Plan	Planning Team Meeting 8/10/16	Planning Team Meeting 8/31/2016	Planning Team Meeting 9/7/2016	Planning Team Review and Comment on First Draft Plan	Share Second Draft with General Public and External Agencies	Submit Third Draft Plan to Cal OES/FEMA for Conditional Approval	Post Fourth Draft Plan for Review by General Public and External Agencies	Present Fifth Draft Plan to City Council at Public Meeting	Submit Final Draft Plan to FEMA for Final Approval
City of Signal Hill										
Selena Alanis			X		X					
Travis Brooks		X			X					
Scott Charney		X	X		X					
Charlie Honeycutt		X	X		X				X	
Richard Johnson, Chair		X	X		X	X	X	X	X	X
Michael Langston		X	X		X					
Aly Mancini		X	X		X					
Terri Marsh		X	X		X					
Steve Myrter			X		X					
Emergency Planning Consultants										
Carolyn J. Harshman	X	X								

Table: Planning Team Timeline

	April 2016	May	June	July	August	September	October	November	December	January 2017
Research and Writing of First Draft Plan	X	X	X	X	X					
Planning Team Meetings					X	X				
Planning Team Comment on First Draft Plan						X				
Share Second Draft Plan with General Public and External Agencies							X			
Submit Third Draft Plan to Cal OES/FEMA for Conditional Approval								X		
Incorporate mandated amendments into Fourth Draft Plan										
Post Fourth Draft Plan for Review by General Public and External Agencies along with posting of City Council meeting.										
Present Fourth Draft Plan to City Council										
Submit Final Draft Plan to FEMA for Final Approval										
Incorporate FEMA Approval into Final Plan										

Q&A | ELEMENT A: PLANNING PROCESS | A2

Q: A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))

A: See **General Public and External Agency Involvement** below.

Q&A | ELEMENT A: PLANNING PROCESS | A3

Q: A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

A: See **General Public and External Agency Involvement** below.

General Public and External Agency Involvement

The Planning Team provided data and expertise during plan writing phase. This effort was supplemented through the assistance of the general public and external agencies (special districts and adjoining jurisdictions). The City posted public notices announcing the availability of the Second Draft Plan on its website and other customary posting locations. Copies of the postings are located in the **Appendix**. The postings directed the general public to the City's website where the Second Draft Plan was available for download along with a request to submit input directly to the Chair of the Planning Team.

External agencies listed below were invited via email and provided with an electronic link to the City's website. Following is the email distributed along with the invitation to comments:

Figure: External Agencies Email Invite

INSERT EMAIL

Feedback received from the general public and external agencies included _____ which was incorporated into the Third Draft Plan prior to submission to Cal OES and FEMA.

In advance of the City Council public meeting, the general public (via public noticing) and external agencies (via email invitation) were informed of the Fourth Draft Plan and encouraged to provide input and attend the public meeting. Gathered comments from the public and external agencies were noted in the City Council Staff Report and added to the Final Draft Plan.

Table: External Agencies

External Agencies		
Agency	**Name**	**Job Title**

Q&A | ELEMENT C. MITIGATION STRATEGY | C1

Q: C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))

A: See **Capability Assessment – Existing Processes and Programs** below.

Capability Assessment – Existing Processes and Programs

The City will incorporate mitigation planning as an integral component of daily operations. This will be accomplished by the Planning Team working with their respective departments to integrate mitigation strategies into the planning documents and operational guidelines within the City. In addition to the Capability Assessment below, the Planning Team will strive to identify additional policies, programs, practices, and procedures that could be created or modified to address mitigation activities.

Table: Capability Assessment - Existing Processes and Programs

Process	Action	Implementation of Plan
Administrative	Departmental or organizational work plans, policies, and procedural changes	✓ *City Administration* ✓ *Community Development Department* ✓ *Public Works Department* ✓ *Other departments as appropriate*
Administrative	Other plans	✓ *Reference plan in Emergency Operations Plan* ✓ *Address plan findings and incorporate mitigation activities in General Plan*
Budgetary	Capital and operational budgets	✓ *Include line item mitigation measures in budget as appropriate*
Regulatory	Executive orders, ordinances, and other directives	✓ *Building Code* ✓ *Capital Improvement Plan (Require hazard mitigation in design of new construction)* ✓ *General Plan (Institutionalize hazard mitigation in land use, new construction and major renovations)* ✓ *National Flood Insurance Program* ✓ *Storm Water Management Plan* ✓ *Zoning Ordinance* ✓ *Strategic Plan 2015-2019*
Funding	Traditional and nontraditional sources	✓ *Once plan is approved, seek authority to use bonds, fees, loans, and taxes to finance projects* ✓ *Seek assistance from federal and state government, foundation, nonprofit, and private sources, such as Hazard Mitigation Grant Program* ✓ *Research and grant opportunities through U.S. Department of Housing and Urban Development, Community Development Block Grant*
Partnerships	Creative funding and initiatives	✓ *Community volunteers* ✓ *In-kind resources* ✓ *Public-private partnerships* ✓ *State support*
Partnerships	Advisory bodies and committees	✓ *Disaster Council* ✓ *Disaster Management Area Coordinator* ✓ *Safety Committee*

Q&A | ELEMENT A: PLANNING PROCESS | A4

Q: A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))

A: See **Use of Existing Data** below.

Use of Existing Data

The Planning Team gathered and reviewed existing data and plans during plan writing and specifically noted as "sources". Numerous electronic and hard copy documents were used to support the planning process:

- ✓ City of Signal Hill General Plan and Elements
- ✓ City of Long Beach Hazard Mitigation Plan (Draft 2016)
- ✓ County of Los Angeles All-Hazards Mitigation Plan (2014)
- ✓ California State Hazard Mitigation Plan (2013)
- ✓ HAZUS maps and reports
- ✓ Census data
- ✓ FEMA "How To" Mitigation Series (386-1 to 386-9)
- ✓ National Oceanic and Atmospheric Administration statistics
- ✓ Historic GIS maps and local inventory data
- ✓ Local Flood Insurance Rate Maps

Q&A | ELEMENT E: PLAN ADOPTION | E1

Q: E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))

A: See **Plan Adoption Process** below.

Plan Adoption Process

Adoption of the plan by the local governing body demonstrates the City's commitment to meeting mitigation goals and objectives. Governing body approval legitimizes the plan and authorizes responsible agencies to execute their responsibilities.

The City Council must adopt the Mitigation Plan before the Plan can be approved by FEMA.

In preparation for the public meeting with the City Council, the Planning Team prepared a Staff Report including an overview of the Planning Process, Risk Assessment, Mitigation Goals, and Mitigation Actions. The staff presentation concluded with 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 City Council heard the item on _____. The City Council voted _____ to adopt the updated Mitigation Plan. The Resolution of adoption by the City Council is in the **Appendix**.

Plan Approval

FEMA approved the Plan on _____. A copy of the FEMA Letter of Approval is in the **Appendix**.

Part II: RISK ASSESSMENT

Community Profile

Geography and the Environment

The City of Signal Hill is located approximately two miles north of the Pacific Ocean in southern Los Angeles County. Signal Hill consists of 2.2 square miles completely surrounded by the City of Long Beach. Regional access to the City is provided by freeways, especially Interstate 405 (I-405); arterial roadways; bus routes; a light rail line; two major seaports; and Long Beach Airport, which is located immediately northeast of Signal Hill.

According to the City's General Plan, the panoramic view from the crest of Signal Hill is truly one of the most beautiful in all of Southern California. Most spectacular is the view of the Pacific Ocean framed by the Palos Verdes Peninsula and the Sheep Hills at Newport Beach. This ocean view features rolling breakers at Huntington Beach, the Queen Mary and the Long Beach skyline arguably equally spectacular at night. To the northwest, Signal Hill vistas include the skyscrapers in downtown Los Angeles, the Hollywood sign and the Getty Museum of Art perched upon the Santa Monica Mountains. To the east the view is remarkably grand including the Long Beach Airport and the Pyramid at the California State University at Long Beach.

Most famous for the discovery of oil in 1921, and commonly known as an "oil town," the City is now a diverse community with an "oil history" and a bright future. By the turn of the 20th Century, stately mansions dotted the hilltop, as the value of the panoramic view became evident. However, by 1917 the prospect of striking oil on the hilltop surpassed the value of the view and the Union Oil Company drilled the first oil well in the area. The well failed to produce any oil and it was abandoned. Further exploration was suspended until the Royal Dutch Shell Oil Company resumed exploration and hit pay dirt on June 23, 1921. That first "gusher," at Alamitos Well #1, marked a turning point in Signal Hill's history and put the city on the map.

Ultimately one of the richest oil fields in the world, it produced over 1 billion barrels of oil by 1984. The field is still active and produced over 1.6 million barrels of oil in 1994 alone. Oil production continued to be Signal Hill's mainstay until declining oil prices reduced production in the 1970's. Today, Signal Hill is a well-balanced, financially sound and economically diverse community of over 11,673 people.

Climate

According to the City of Signal Hill's General Plan – Environmental Resources Element (1989), is located within a moderate climate of the South Coast Air Basin. The annual average temperature in the City ranges from the mid 50°F in winter to the mid 70°F in the summer. Freezing conditions and temperatures over 100°F occur infrequently.

The prevailing wind pattern is a daytime sea breeze, flowing toward the east and northeast with little seasonal variability. Nighttime winds are light, and although variable, often have an offshore character that flows toward the south/southwest. During the fall and early winter, Santa Ana wind conditions sometimes occur. These relatively strong winds flow from the mountains in the east toward the southwest in the vicinity of Signal Hill and generally increase local temperatures.

Annual precipitation varies, with long-term average of about 15.4 inches per year. Annual average relative humidity in January ranges from 50 to 75 percent daily, whereas in July it varies from 60 to 85 percent. As the State of California and the Los Angeles region has undergone a several-year drought, rainfall has been much lower in the City.

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. In short rainfall in Southern California might be characterized as feast or famine within a single year.

Population and Demographics

According to the City's General Plan, in 1980, the City's population was approximately 5,734 residents. According to the California Department of Finance (2016), the population has grown to 11,673 as of 2016. From 2000 to 2016, the City has experienced an average growth rate of 1.4 percent annually. Similarly, the population of Los Angeles County experienced a growth rate of 0.4 percent per year.

According to the California Department of Finance (2014), the demographic makeup of the City is as follows:

Table: City of Signal Hill Demographics
(Source: California Department of Finance, E-5, 2014)

Racial/Ethnic Group	2000	2014	Change	Change %
White	2,828	3,184	356	13%
Black	1,213	1,483	270	22%
American Indian Eskimo	19	23	4	21%
Asian or Pacific Islander	1,876	2,510	634	34%
Other	457	468	11	2%
Total	9,333	11,411	2,078	22%
Hispanic	2,940	3,743	803	27%

Housing and Community Development

Table: City of Signal Hill Housing
(Source: California Department of Finance, E-5, 2016)

2014	Number	Percent %
Housing Type:		
1-unit, detached	1,423	31.7%
1-unit, attached	618	13.8%
2-4 Units	638	14%
5+ Units	1,852	40.5%
Mobile homes/Other	0	0 %
Housing Statistics:		
Total Available Housing Units	4,531	100 %
Owner-Occupied Housing	2,340	51.6 %
Renter-Occupied	2,191	48.4 %
Average Household Size:	2.7 persons	
Median Home Price:	$440,000	

Employment and Industry

According to the City's General Plan, Signal Hill has a large and growing retail and commercial services employment base. The major employers within the City include Office Depot, Costco, and the Oil Well Service Company.

Table: City of Signal Hill Industry
(Source: American Community Survey - 2014)

Industry	2014	
	Number	Percent %
Agriculture, forestry, fishing and hunting, and mining	33	0.6%
Construction	445	8.0%
Manufacturing	506	9.1%
Wholesale Trade	154	2.8%
Retail Trade	478	8.6%
Transportation and Warehousing, and Utilities	386	6.9%
Information	154	2.8%
Finance and insurance, and real estate and rental and leasing	339	6.1%
Professional, scientific, and management, and administrative and waste management services	908	16.2%
Educational services, and health care and social assistance	1,145	20.5%
Arts, entertainment, and recreation, and accommodation and food services	559	10.0%
Other services, except public administration	275	4.9%
Public administration	206	3.7%

Table: City of Signal Hill Occupation
(Source: American Community Survey - 2014)

Occupation	2014	
	Number	Percent
Civilian employed population (16 years and over)	5,588	38.5%
Management, business, science, and arts occupations	2,152	19.2%
Service occupations	1,074	26.9%
Sales and office occupations	1,503	6.4%
Natural resources, construction, and maintenance occupations	359	8.9%
Production, transportation, and material moving	500	38.5%

Transportation and Commuting Patterns

According to the City of Signal Hill's General Plan – Circulation Element (2009), Signal Hill is completely surrounded by the city of Long Beach, and its transportation network is intertwined with that of its neighbor. Regional access to the City as shown on **Map: Regional Access**, is provided by freeways, especially Interstate 405 (I-405); arterial roadways; bus routes; a light rail line; two major seaports; and Long Beach Airport, which is located immediately northeast of Signal Hill.

The existing Signal Hill transportation system consists of roads of varying sizes and capacities; public transportation systems, including bus, light rail, and paratransit service; airports, and seaports as shown on **Map: Roadway Classifications**. The network created by these systems serves two distinct and equally important functions: 1) to provide access to adjacent land uses, and 2) to facilitate the movement of persons and goods to, from, within, and through the City.

Interstate

The San Diego Freeway (Interstate 405 or I-405) crosses the northern portion of Signal Hill. The highway is owned and maintained by Caltrans. In the Signal Hill area, the I-405 currently consists of ten travel lanes, including eight mixed-flow and two carpool lanes.

Interstate 405 is one of the major access routes to Signal Hill but is also a major traffic generator that affects traffic flow within the City. The freeway interchanges with the Long Beach Freeway (I-710) approximately three miles northwest of Cherry Avenue, with the San Gabriel Freeway (I-605) approximately five miles southeast of Cherry Avenue, and with the Garden Grove Freeway (State Route 22 or SR-22) approximately 7.5 miles southeast of Cherry Avenue. Full freeway access is provided at Atlantic, Cherry, and Orange Avenues. Northbound I-405 access to the City for traffic oriented south on Cherry Avenue is provided at Temple Avenue. This circuitous access to Cherry Avenue increases traffic levels on Temple Avenue and Spring Street and is confusing to motorists.

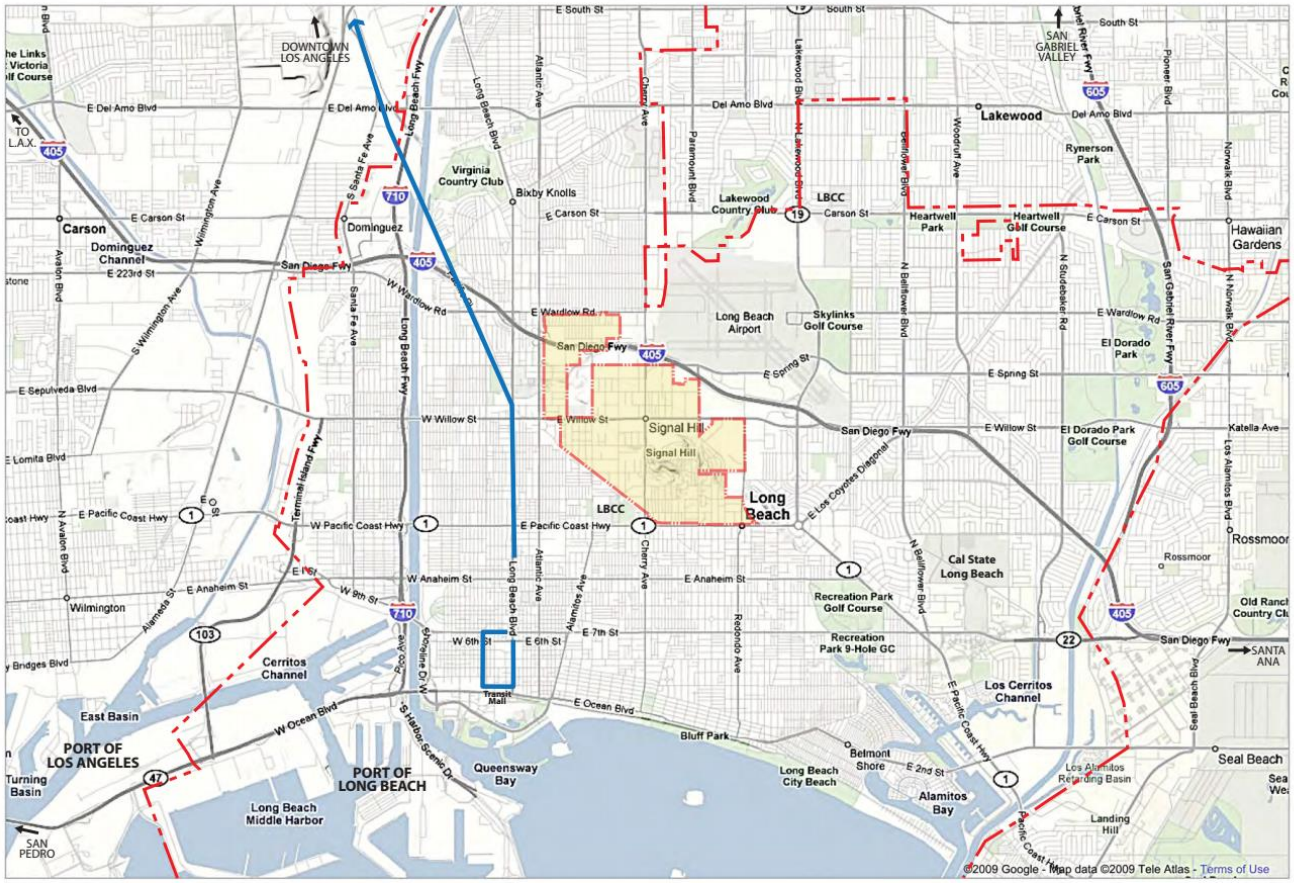
The 2003 Short-Range Transportation Plan (SRTP), prepared by the Metropolitan Transportation Authority (Metro), recognizes the I-405 as a "congested corridor" in the Signal Hill area, and identifies the Cherry and Atlantic Avenue ramps as "hot spots" with recurring heavy traffic congestion. These designations make this freeway corridor a higher priority for future improvements; however, no major improvements are currently funded.

Bus Service

Signal Hill is well-served by bus systems. Services provided by Long Beach Transit and Metro operate within or in the vicinity of the City; additional bus lines are accessible through the nearby Long Beach Transit Mall.

Long Beach Transit is the primary public transportation provider to Signal Hill. It is a municipal transit agency operated on behalf of the City of Long Beach by a nonprofit corporation, the Long Beach Public Transportation Company. In 2007, Long Beach Transit operated a total of 249 buses on 38 bus routes, providing over 26.6 million passenger trips. Service is provided from approximately 4:30 am to 1:30 am, seven days per week.

Map: Regional Access
(Source: City of Signal Hill General Plan – Circulation Element 2009)

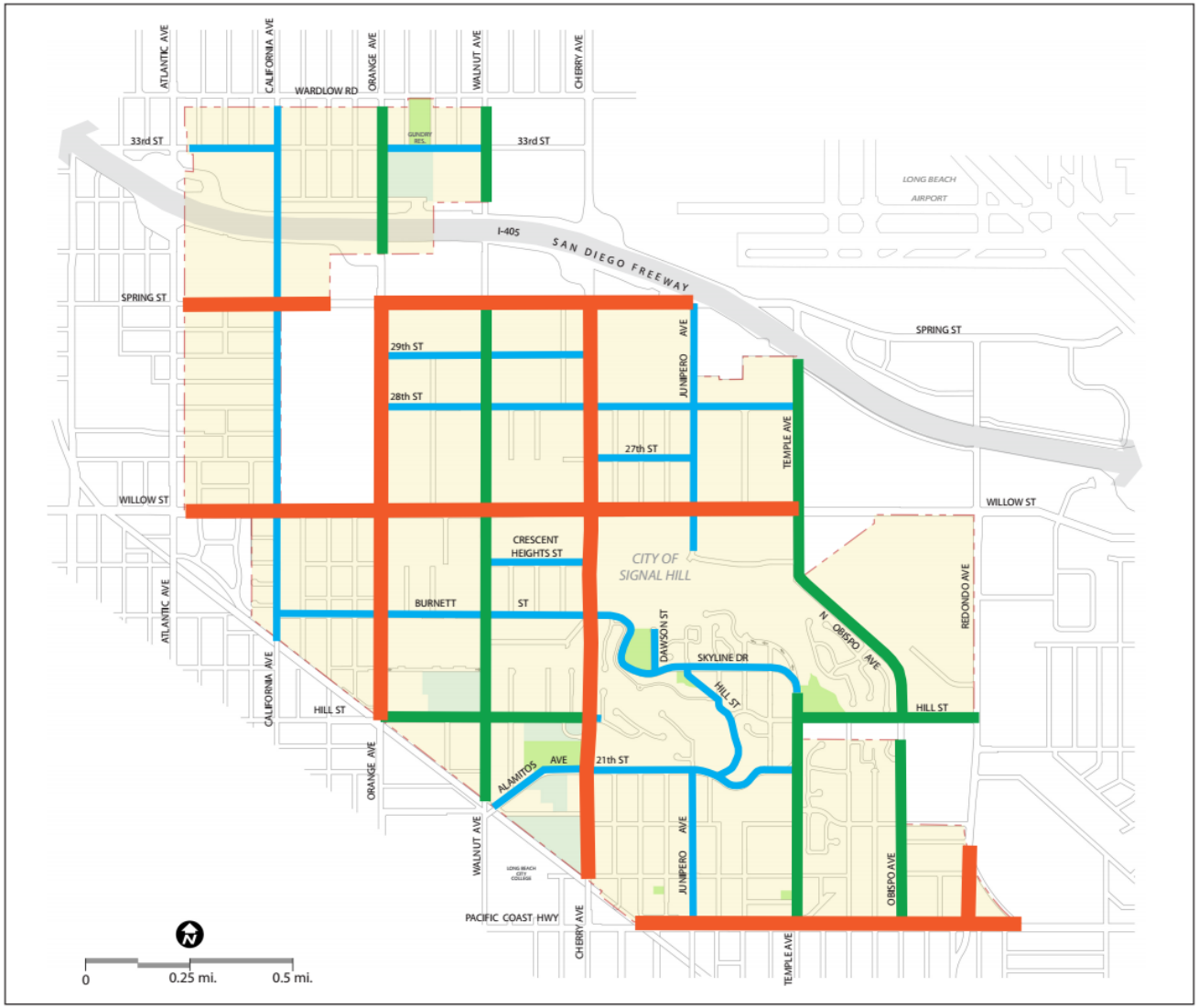


City of Signal Hill
GENERAL PLAN

Circulation Element
December 2009

City of Signal Hill Boundary
City of Long Beach Boundary
Metro Blue Line

Map: Roadway Classifications
(Source: City of Signal Hill General Plan – Circulation Element 2009)



City of Signal Hill
GENERAL PLAN

Circulation Element
December 2009

- Freeway
- Principal Arterial
- Minor Arterial
- Collector
- City of Signal Hill Boundary

Risk Assessment

What is a Risk Assessment?

Conducting a risk assessment can provide information regarding: 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*
2. *Profiling Hazard Events*
3. *Vulnerability Assessment/Inventory of Existing Assets*
4. *Risk Analysis*
5. *Assessing Vulnerability/Analyzing Development Trends*

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B1

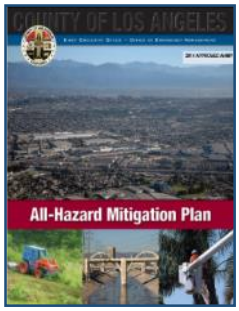
Q: B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))

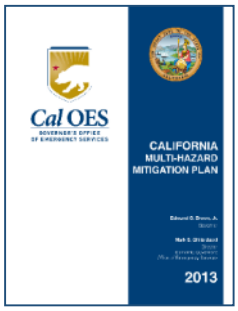
A: See **Hazard Identification** below.

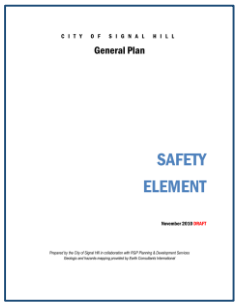
1) Hazard Identification

This section is the description of the geographic extent, potential intensity, and the probability of occurrence of a given hazard. Maps are used in this plan to display hazard identification data. ***The City of Signal Hill utilized the categorization of hazards as identified in California's State Hazard Mitigation Plan, including: Earthquakes, Floods, Levee failures, Wildfires, Landslides and earth movements, Tsunami, Climate-related hazards, Volcanoes, and Other hazards***.

Next, the Planning Team reviewed existing documents to determine which of these hazards posed the most significant threat to the City. In other words, which hazard would likely result in a local declaration of emergency.







The geographic extent of each of the identified hazards was identified by the Planning Team utilizing maps and data contained in the City's General Plan and City's Emergency Operations Plan. In addition, numerous internet resources and the County of Los Angeles All-Hazards Mitigation Plan served as valuable resources. Utilizing the Calculated Priority Risk Index (CPRI)

ranking technique, the Planning Team concluded the following hazards posed a significant threat against the City:

Earthquake | Landslide | Windstorm | Drought

The hazard ranking system is described in **Table: Calculated Priority Risk Index**, while the actual ranking is shown in **Table: Calculated Priority Risk Index Ranking for City of Signal Hill**.

Table: Calculated Priority Risk Index
(Source: Federal Emergency Management Agency)

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Level ID	Description	Index Value	
Probability	Unlikely	Extremely rare with no documented history of occurrences or events. Annual probability of less than 1 in 1,000 years.	1	45%
	Possibly	Rare occurrences. Annual probability of between 1 in 100 years and 1 in 1,000 years.	2	
	Likely	Occasional occurrences with at least 2 or more documented historic events. Annual probability of between 1 in 10 years and 1 in 100 years.	3	
	Highly Likely	Frequent events with a well-documented history of occurrence. Annual probability of greater than 1 every year.	4	
Magnitude/ Severity	Negligible	Negligible property damages (less than 5% of critical and non-critical facilities and infrastructure. Injuries or illnesses are treatable with first aid and there are no deaths. Negligible loss of quality of life. Shut down of critical public facilities for less than 24 hours.	1	30%
	Limited	Slight property damage (greater than 5% and less than 25% of critical and non-critical facilities and infrastructure). Injuries or illnesses do not result in permanent disability, and there are no deaths. Moderate loss of quality of life. Shut down of critical public facilities for more than 1 day and less than 1 week.	2	
	Critical	Moderate property damage (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). Injuries or illnesses result in permanent disability and at least 1 death. Shut down of critical public facilities for more than 1 week and less than 1 month.	3	
	Catastrophic	Severe property damage (greater than 50% of critical and non-critical facilities and infrastructure). Injuries and illnesses result in permanent disability and multiple deaths. Shut down of critical public facilities for more than 1 month.	4	
Warning Time	> 24 hours	Population will receive greater than 24 hours of warning.	1	15%
	12–24 hours	Population will receive between 12-24 hours of warning.	2	
	6-12 hours	Population will receive between 6-12 hours of warning.	3	
	< 6 hours	Population will receive less than 6 hours of warning.	4	
Duration	< 6 hours	Disaster event will last less than 6 hours	1	10%
	< 24 hours	Disaster event will last less than 6-24 hours	2	
	< 1 week	Disaster event will last between 24 hours and 1 week.	3	
	> 1 week	Disaster event will last more than 1 week	4	

Table: Calculated Priority Risk Index Ranking for City of Signal Hill

Hazard	Probability	Weighted 45% (x.45)	Magnitude Severity	Weighted 30% (x.3)	Warning Time	Weighted 15% (x.15)	Duration	Weighted 10% (x.1)	CPRI Ranking
Earthquake – San Andreas M7.8	3	1.35	3	0.9	4	0.6	1	0.1	**2.95**
Earthquake – Newport-Inglewood M6.9	3	1.35	3	0.9	4	0.6	1	0.1	**2.95**
Earthquake – Puente Hills M7.1	3	1.35	3	0.9	4	0.6	1	0.1	**2.95**
Landslide	2	.90	2	0.6	4	0.6	1	0.1	**2.20**
Windstorm	4	1.80	2	0.6	1	0.15	2	0.2	**2.75**
Drought	4	1.80	1	0.3	1	0.15	4	0.4	**2.65**

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 the City-Specific Hazard Analysis. **Table: Vulnerability: Location, Extent, and Probability for City of Signal Hill** indicates a generalized perspective of the community's vulnerability of the various hazards according to extent (or degree), location, and probability.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B1

Q: B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))

A: See **Table: Vulnerability: Location, Extent, and Probability for City of Signal Hill** below.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B2

Q: B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))

A: See **Table: Vulnerability: Location, Extent, and Probability for City of Signal Hill** below.

Table: Vulnerability: Location, Extent, and Probability for City of Signal Hill

Hazard	Location (Where)	Extent (How Big an Event)	Probability (How Often) *	Previous Occurrences
Earthquake	Entire Project Area	The Southern California Earthquake Center (SCEC) in 2007 concluded that there is a 99.7 % probability that an earthquake of M6.7 or greater will hit California within 30 years.[1]	Moderate	1994 – Northridge Earthquake
Landslide	Hillside areas surrounding Hilltop Park Undeveloped land areas on West side of City	Earthquake-induced and rain-induced landslide events possibly impacting dozens of structures.	Moderate	1995
Windstorm	Entire Project Area	30 miles per hour or greater.	High	Annual
Drought	Entire Project Area	Droughts in urban areas vary considerably in scope and intensity. Likely emergency water shortage regulations would restrict such activities as watering of landscape, washing of cars, and other non-safety related activities.	Moderate	Mild Drought Now
* Probability is defined as: Low = 1:1,000 years, Moderate = 1:100 years, High = 1:10 years				
[1] Uniform California Earthquake Rupture Forecast				

3) Vulnerability Assessment/Inventory of Existing Assets

A Vulnerability Assessment in its simplest form is a simultaneous look at the geographical location of hazards and an inventory of the underlying land uses (populations, structures, etc.). Facilities that provide critical and essential services following a major emergency are of particular concern because these locations house staff and equipment necessary to provide important public safety, emergency response, and/or disaster recovery functions.

Critical and Essential Facilities

Facilities critical to government response activities (i.e., life safety and property and environmental protection) include: local government 9-1-1 dispatch centers, local government emergency operations centers, local police and fire stations, local public works facilities, local communications centers, schools (shelters), and hospitals. Also, facilities that, if damaged, could cause serious secondary impacts are also 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 include but are not limited to: schools (hosting shelters); buildings such as the jail, law enforcement center, public services building, community corrections center, the courthouse, and juvenile services building and other public facilities.

Table: Critical and Essential Facilities Vulnerable to Hazards illustrates the critical and essential facilities within City of Signal Hill and the vulnerability of those facilities to the identified hazards.

Table: Critical and Essential Facilities Vulnerable to Hazards

Name of Facility	Earthquake	Landslide	Windstorm	Drought
City Hall 2175 Cherry Avenue	X		X	X
Los Angeles County Fire - Signal Hill Station 2300 E. 27th Street	X		X	X
Police Department / Emergency Operations Center 2745 Walnut Avenue	X		X	X
City Corporate Yard (Public Works) 2175 E. 28th Street	X		X	X
Community Center 1780 E. Hill Street	X		X	X
Hilltop Park 2351 Dawson Ave	X	X	X	X
Discovery Well Park 2200 Temple Ave	X	X	X	X
Signal Hill Elementary 2285 Walnut Avenue	X		X	X
Alvarado Elementary School 990 East 21st Street	X		X	X
Jessie E. Nelson Academy 1260 E. 33rd Street	X		X	X
Library 1770 East Hill Street (under construction in 2016/2017)	X		X	X

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 for all of the identified hazards. The **Mitigation Actions Matrix** 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 Mitigation Plan provides comprehensive description of the character of the City of Signal Hill in the **Community Profile Section**. 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 Signal Hill 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, state, or federal 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 in the **Mitigation Strategies Section**. 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.

Land and Development

The City of Signal Hill General Plan provides the framework for the growth and development of the City. 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.

According to the City's General Plan - Land Use Element (2001), Signal Hill's land use pattern is well established and it is not anticipated to change materially over time. New development will occur within the vacant oil field areas and to a lesser extent in-fill development is anticipated in established neighborhoods. Significant constraints to development of the "oil patch" will continue to limit the availability of development sites and the rate of development. These constraints include: ongoing oil field operations, steep slopes, unsuitable soils, environmental contamination, lack of existing utility systems or the need to upgrade existing systems, small lot sizes, complex

property ownership patterns, and a reluctance by traditional lending institutions to finance development of environmentally impacted properties.

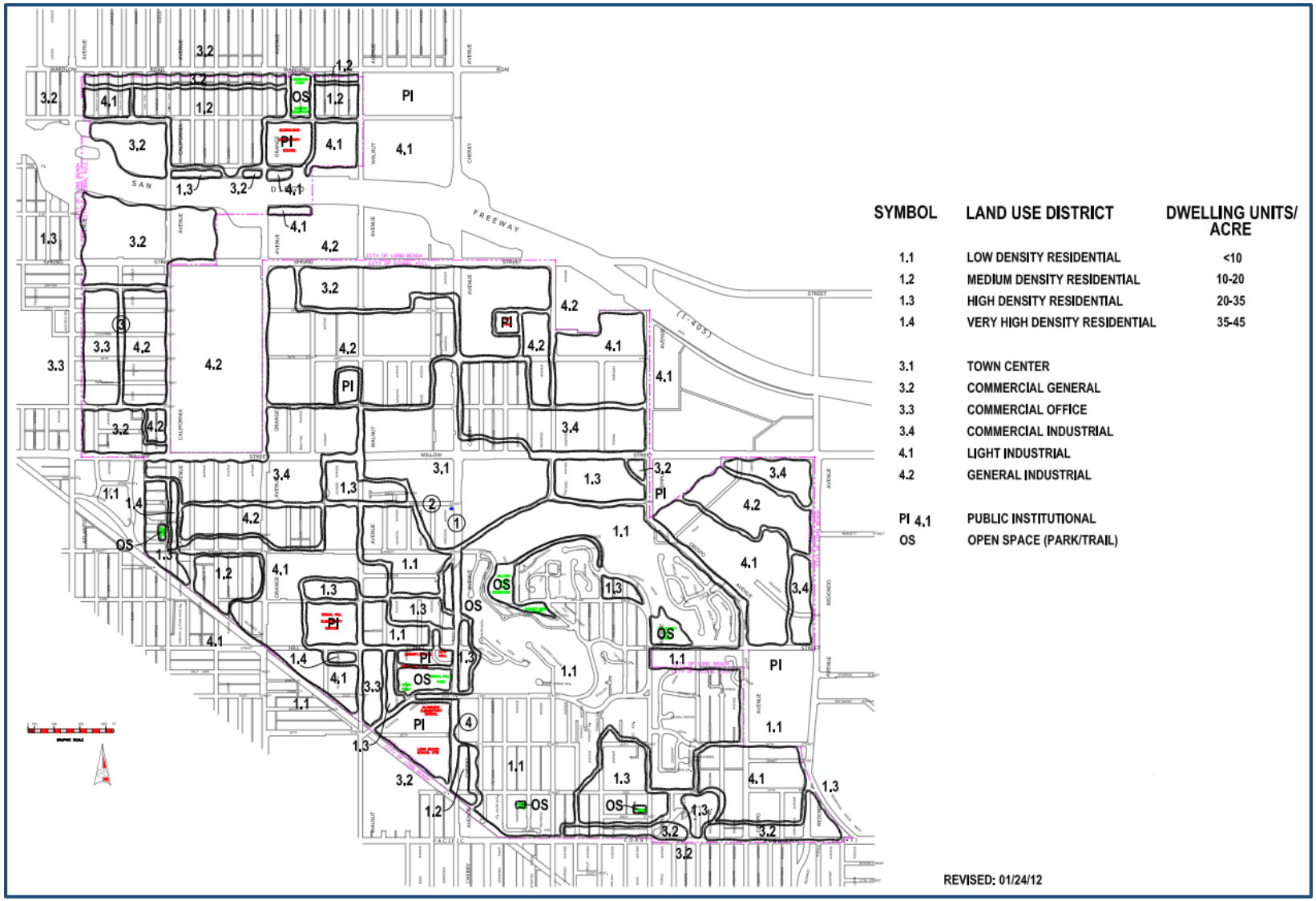
Impacts to Types of Land Uses

City of Signal Hill's General Plan identifies primarily residential land uses with other land uses consisting of commercial, industrial, public institutional, and open space.

Table: Impacts to Existing and Future Land Uses in the City of Signal Hill
(Source: EPC analysis based on City of Signal Hill General Plan – Land Use Element 2001)

Category of Land Use Designation	Acres (%)	Earthquake	Landslide	Windstorm	Drought
Low Density Residential	350 (24%)	X	X	X	X
Medium Density Residential	68 (5%)	X		X	X
High Density Residential	84 (6%)	X	X	X	X
Town Center	87 (6%)	X		X	X
Commercial General	179 (13%)	X		X	X
Commercial Office	25 (2%)	X	X	X	X
Commercial Industrial	151 11%)	X		X	X
Light Industrial	195 (14%)	X	X	X	X
General Industrial	192 (14%)	X	X	X	X
Public Institutional	35 (3%)	X	X	X	X
Open Space	24 (2%)	X	X	X	X

Map: Land Use Map
(Source: City of Signal Hill General Plan – Land Use Element, 2001



Earthquake Hazards

Previous Occurrences of Earthquakes in the City of Signal Hill

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B2

Q: B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))

A: See **Previous Occurrences of Earthquakes in the City of Signal Hill** below.

The following earthquake events significantly impacted the region surrounding the City of Signal Hill.

In January 1994, the magnitude 6.7 Northridge Earthquake (thrust fault) which produced severe ground motion, caused 57 deaths, 9,253 injuries and left over 20,000 displaced. Scientists have stated that such devastating shaking should be considered the norm near any large thrust earthquake. Recent reports from scientists of the U.S. Geological Survey and the Southern California Earthquake Center say that the Los Angeles Area could expect one earthquake every year of magnitude 5.0 or more for the foreseeable future.

Since the writing of the 2012 Mitigation Plan, there have been no significant earthquake events in the City of Signal Hill.

Previous Occurrences of Earthquakes in Los Angeles County

Southern California has a history of powerful and relatively frequent earthquakes, dating back to the powerful magnitude 8.0+ 1857 San Andreas Earthquake which did substantial damage to the relatively few buildings that existed at the time.

Paleoseismological research indicates that large magnitude (8.0+) earthquakes occur on the San Andreas Fault at intervals between 45 and 332 years with an average interval of 140 years. Other lesser faults have also caused very damaging earthquakes since 1857. Notable earthquakes include the 1933 Long Beach Earthquake, the 1971 San Fernando Earthquake, the 1987 Whittier Earthquake and the 1994 Northridge Earthquake.

Local Conditions

According to the City of Signal Hill General Plan - Safety Element (2016), Signal Hill is located in a seismically active region, and major regional faults create the risk of substantial earth shaking and potential ground rupture in the area. Within Los Angeles County, there are over 50 active and potentially active fault segments, an undetermined number of buried faults, and at least 4 blind-thrust faults capable of producing damaging earthquakes.

Several active faults have been identified within close proximity or within the City boundaries which, most importantly, indicates that the community falls under the State Earthquake Fault

Zoning Act and the State Hazards Mapping Act. These Acts require that local governments, in the general plan update process, adopt policies and criteria to ensure the structural adequacy of buildings erected across active faults for human occupancy. In some cases, the development of structures must be prohibited.

Earthquakes that could affect the City would most likely originate from the San Andreas, Newport-Inglewood, or Puente Hills Faults. These faults are close enough in proximity or expected to generate strong enough shaking that could affect the City.

San Andreas Fault Zone

The San Andreas Fault Zone is located approximately 40 miles northeast of the City of Signal Hill. This fault zone extends from the Gulf of California northward to the Cape Mendocino area where it continues northward along the ocean floor. The total length of the San Andreas Fault Zone is approximately 750 miles. The activity of the fault has been recorded during historic events, including the 1906 (M8.0) event in San Francisco and the 1857 (M7.9) event between Cholame and San Bernardino, where at least 250 miles of surface rupture occurred. These seismic events are among the most significant earthquakes in California history. Geologic evidence suggests that the San Andreas Fault has a 50 percent chance of producing a magnitude 7.5 to 8.5 quake (comparable to the great San Francisco earthquake of 1906) within the next 30 years.

Newport-Inglewood Fault Zone

Locally, the Newport-Inglewood Fault System cuts diagonally across Signal Hill as shown on **Map: Regional Faults**. This is the most significant seismic feature in the area and is considered seismically active. The 1933 Long Beach earthquake resulted from activity on this fault. Within the Newport-Inglewood Fault System, five faults have been identified in and in the immediate vicinity of Signal Hill: the Cherry Hill Fault, Pickler Fault, Northeast Flank Fault, Reservoir Hill Fault, and Wardlow Fault. These faults are generally in a northwest-to-southeast alignment. The Wardlow Fault is a pre-quaternary fault that has not ruptured in at least 2 million years, and is therefore considered inactive. All other faults are considered active.

The Newport-Inglewood Fault System is a nearly linear alignment of faults extending 45 miles along the southwestern side of the Los Angeles basin. It can be traced as a series of topographic hills, ridges, and mesas from the Santa Monica Mountains to Newport Beach, where it trends offshore. Structures along the zone of deformation act as groundwater barriers and, at greater depths, as petroleum traps. Continuing seismic activity has been evidenced most prominently in recent times by the 1920 Inglewood and 1933 Long Beach earthquakes.

Puente Hills Fault

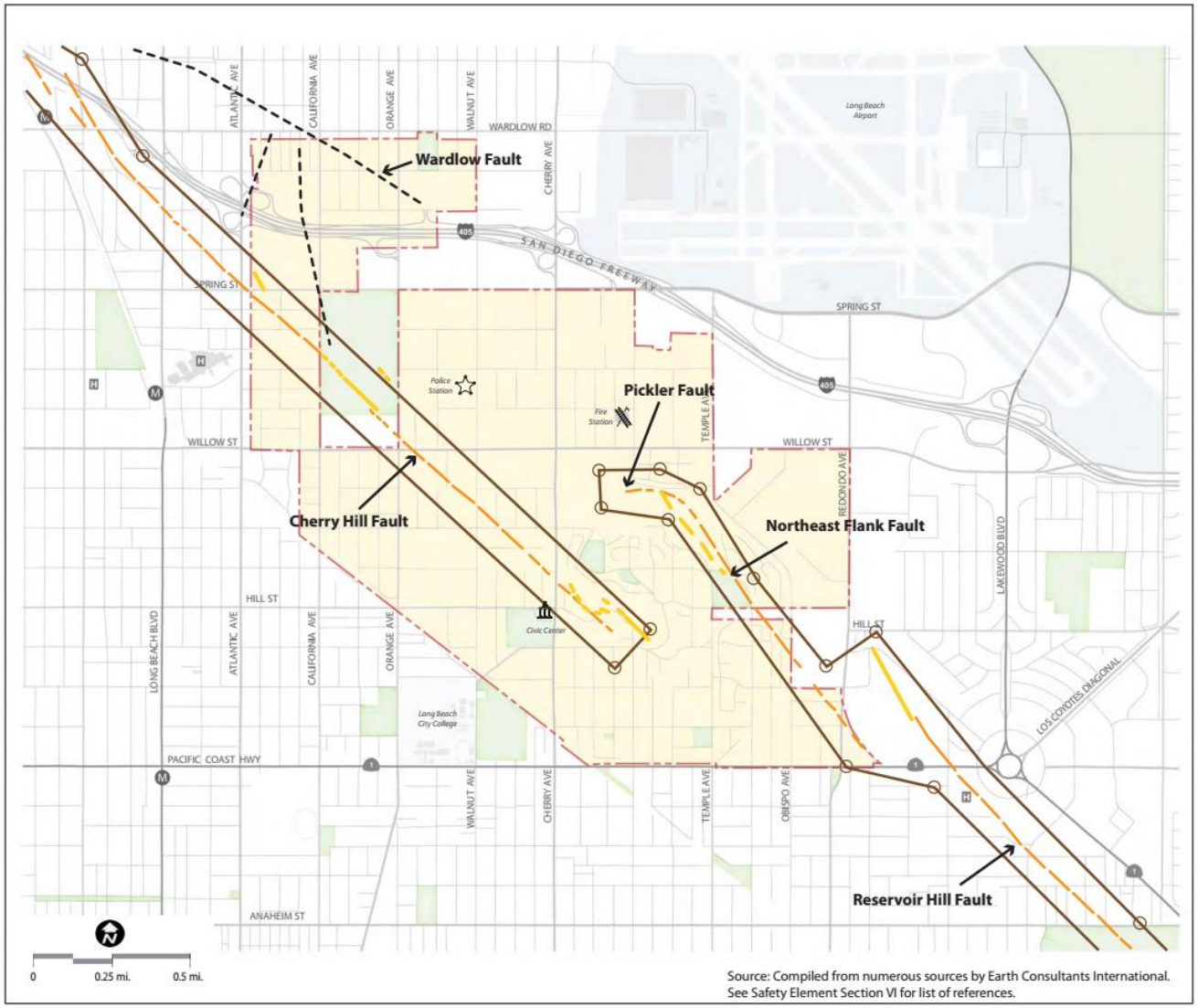
The Puente Hills fault is located approximately 15 miles northeast of the City. According to USGS, the Puente Hills Fault was most recently responsible for the M5.1 La Habra earthquake on March 28, 2014 which caused an estimated $2.6 million in damage. The USGS estimates that a future, larger M7.5 earthquake along the Puente Hills fault could kill 3,000 to 18,000 people and cause up to $250 billion in damage. In contrast, a larger M8.0 quake along the San Andreas would cause an estimated 1,800 deaths.

Whittier Fault

The Whittier Fault is a 25 mile right-lateral strike-slip fault that runs along the Chino Hills range between the cities of Chino Hills and Whittier. It is estimated that this fault could generate up to a magnitude 7.2 earthquake.

Map: Regional Faults
(Source: City of Signal Hill General Plan – Safety Element 2016)

Map: Local Faults
(Source: City of Signal Hill General Plan – Safety Element 2016)



City of Signal Hill
GENERAL PLAN

Safety Element
October 2010

- City of Signal Hill Boundary
- Active Faults
- Active and Potentially Active Fault Traces
- Pre-Quaternary Faults
- Alquist-Priolo Earthquake Fault Zones

Note:

All faults shown are part of the Newport-Inglewood Fault Zone.

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

Fault lines on the map are used solely to approximate the fault location. The width and location of the fults should not be used in lieu of site-specific investigations, evaluation, and design. Detailed geologic investigations, including trenching studies, may make it possible to refine the location and activity status of a fault. Not all faults may be shown. This map may be amended as new data become available and are validated.

Pre-quaternary faults are considered inactive and are not subject to the requirements of the Alquist-Priolo Earthquake Faults Zoning Act.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B3

Q: B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))

A: See **Impact of Earthquakes in the City of Signal Hill** below.

Impact of Earthquakes in the City of Signal Hill

Based on the risk assessment, it is evident that earthquakes will continue to have potentially devastating economic impacts to certain areas of the City. Impacts that are not quantified, but can be anticipated in future events, include:

- ✓ Injury and loss of life;
- ✓ Commercial and residential structural damage;
- ✓ Disruption of and damage to public infrastructure;
- ✓ Secondary health hazards e.g. mold and mildew;
- ✓ Damage to roads/bridges resulting in loss of mobility;
- ✓ Significant economic impact (jobs, sales, tax revenue) upon the community;
- ✓ Negative impact on commercial and residential property values; and
- ✓ Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.

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.

Map: Landslide and Liquefaction Zones shows the moderate risk of earthquake-induced landslide risk within the City. The areas found susceptible to landslides are found in the upper reaches of Signal Hill.

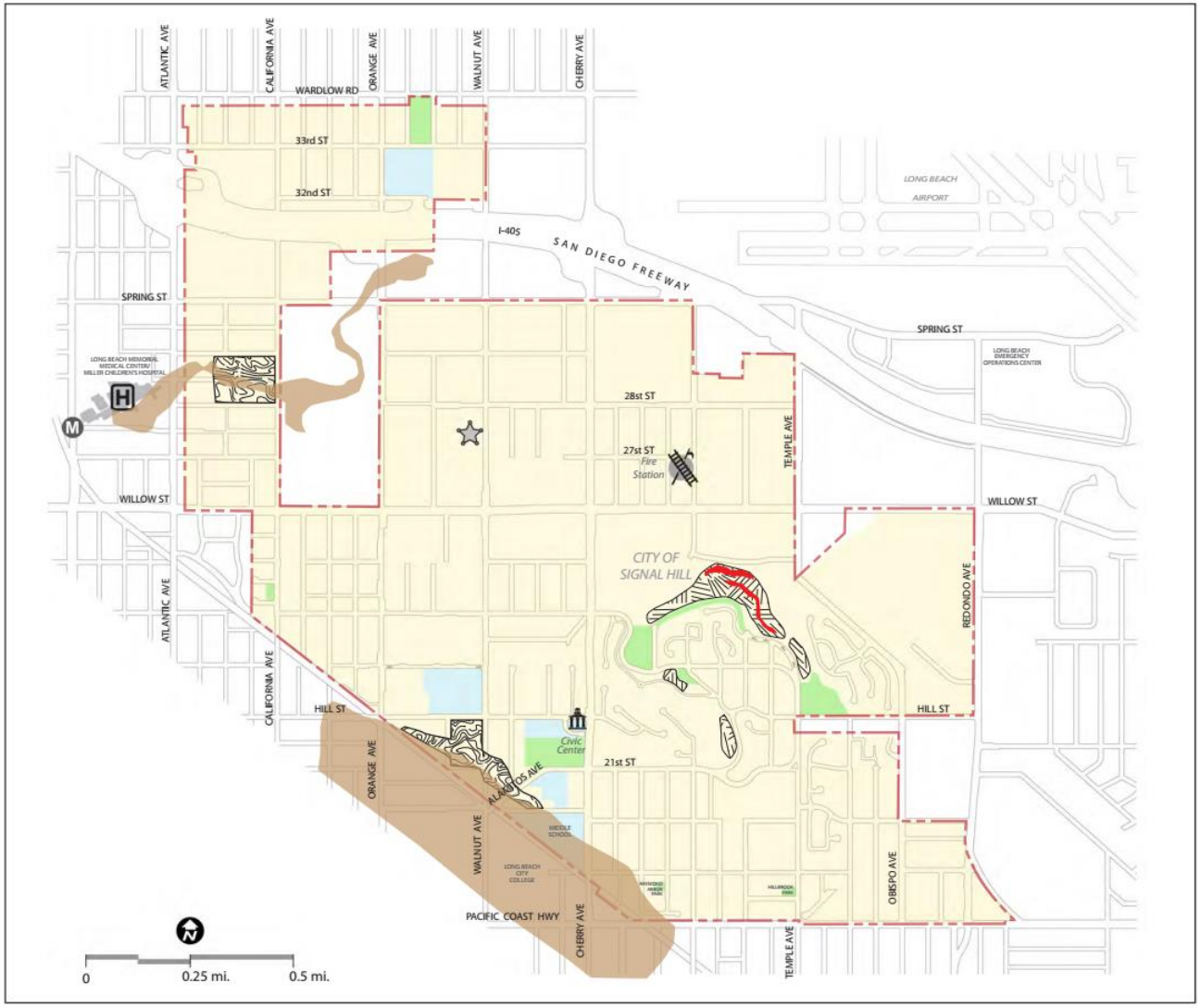
Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking or other events. Liquefaction occurs in saturated soils, which are soils in which the space between individual soil particles is completely filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Prior to an earthquake, the water pressure is relatively low. However, earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. Because liquefaction only occurs in saturated soil, its effects are most commonly observed in low lying areas. Typically, liquefaction is associated with shallow groundwater, which is less than 50 feet beneath the earth's surface.

According to the City of Signal Hill General Plan - Safety Element (2016), only two small portions of the City are considered at risk from liquefaction. One area consists of a strip of land adjacent

to and under the Columbia Street right-of-way (part of which is currently used for oil production) between Atlantic and California Avenues. The second area is a narrow band along the southwestern border of the City, adjacent to the right-of-way of the former Pacific Electric Railway. Notably, this area of liquefaction risk includes a large portion of Chittick Field Park and Jessie Elwin Nelson Academy located at 1951 Cherry Avenue.

Map: Landslide and Liquefaction Zones
(Source: City of Signal Hill General Plan – Safety Element 2016)



City of Signal Hill
GENERAL PLAN

Safety Element
October 2010

City of Signal Hill Boundary

Liquefaction Hazard

Undeveloped Land with Liquefaction Potential

Landslide Movement Hazard

Undeveloped Land with Landslide Potential

Source: Prepared by Earth Consultants International with data from the California Division of Mines and Geology.

Exposure

The data in this section was generated using the HAZUS-MH program for earthquakes. Once the location and size of a hypothetical earthquake are identified, HAZUS-MH estimates the intensity of the ground shaking, the number of buildings damaged, the number of casualties, the amount of damage to transportation systems and utilities, the number of people displaced from their homes, and the estimated cost of repair and clean up.

Building Inventory

HAZUS estimates approximately 77% of the building stock within the City of Signal Hill is residential housing. In term of building construction types found in the region, wood frame construction makes up 79% of the building inventory.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss facilities (HPL). Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

Table: Critical Facility Inventory – HAZUS

Essential Facilities	Count
Hospitals	1
Schools	3
Fire Stations	1
Police Stations	1
Emergency Operations Facilities	1

High Potential Loss (HPL) Facilities	Count
Dams	0
Levees	0
Military Installations	0
Nuclear Power Plants	0
Hazardous Material Sites	7

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. Transportation systems include highways, railways, light rail, bus, ports, ferry and airports. Utility systems include potable water, wastewater, natural gas, crude & refined oil, electric power and communications.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows:

- ✓ **Severity Level 1:** Injuries will require medical attention but hospitalization is not needed.
- ✓ **Severity Level 2:** Injuries will require hospitalization but are not considered life-threatening
- ✓ **Severity Level 3:** Injuries will require hospitalization and can become life threatening if not promptly treated.
- ✓ **Severity Level 4:** Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Building-Related Losses

Building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

HAZUS Earthquake Event Summary Results

Newport-Inglewood M7.1 Earthquake Scenario

Building Damage

Table: Expected Building Damage by Occupancy – Newport-Inglewood M7.1

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Agriculture	1	3	3	2	1
Commercial	48	89	155	110	53
Education	2	2	3	1	1
Government	1	1	1	1	0
Industrial	17	33	66	50	26
Other Residential	70	129	99	29	12
Religion	3	5	7	5	2
Single Family	466	884	585	77	22
Total	**608**	**1,146**	**919**	**275**	**117**

Table: Expected Building Damage by Building Type – Newport-Inglewood M7.1

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Wood	543	1,038	701	98	30
Steel	12	21	53	45	22
Concrete	14	28	40	29	14
Precast	11	23	56	45	23
RM	26	30	56	44	16
URM	2	5	12	11	11
MH	0	0	1	2	1
Total	**608**	**1,146**	**919**	**275**	**117**

Transportation and Utility Lifeline Damage

Table: Expected Utility System Pipeline Damage – Newport-Inglewood M7.1

System	Total Pipelines (Length km)	Number of Leaks	Number of Breaks
Potable Water	468	215	54
Waste Water	281	154	38
Natural Gas	187	44	11
Oil	0	0	0

Table: Potable Water and Electric Power System Performance – Newport-Inglewood M7.1

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	**4,173**	1,176	0	0	0	0
Electric Power		3,355	2,303	1,097	246	4

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 327 households to be displaced due to the earthquake. Of these, 201 people (out of a total population of 11,411) will seek temporary shelter in public shelters.

Casualties

The table below represents a summary of casualties estimated for Newport-Inglewood M7.1 earthquake scenario.

Table: Casualty Estimates – Newport-Inglewood M7.1

Time	Sector	Level 1	Level 2	Level 3	Level 4
2AM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	22	6	1	2
	Single-Family	13	2	0	0
	TOTAL	**37**	**8**	**1**	**2**
2PM	Commercial	64	19	3	6
	Commuting	0	0	1	0
	Educational	19	5	1	2
	Hotels	0	0	0	0
	Industrial	10	3	0	1
	Other-Residential	4	1	0	0
	Single-Family	3	0	0	0
	TOTAL	**100**	**29**	**5**	**9**
5PM	Commercial	45	13	2	4
	Commuting	5	6	11	2
	Educational	2	1	0	0
	Hotels	0	0	0	0
	Industrial	6	2	0	1
	Other-Residential	8	2	0	1
	Single-Family	5	1	0	0
	TOTAL	**72**	**24**	**14**	**8**

Economic Losses

The total economic loss estimated for the Newport-Inglewood M7.1 earthquake scenario is **$392.59 million dollars** which includes building and lifeline related losses based on the region's available inventory. The following tables provide more detailed information about these losses.

Table: Building-Related Economic Losses ($ Dollars) – Newport-Inglewood M7.1

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	$0	$260,000	$12,040,000	$760,000	$360,000	$13,420,000
	Capital-Related	$0	$110,000	$9,620,000	$490,000	$80,000	$10,300,000
	Rental	$1,020,000	$3,120,000	$8,680,000	$240,000	$110,000	$13,170,000
	Relocation	$3,920,000	$2,200,000	$13,010,000	$1,310,000	$1,180,000	$21,620,000
	Subtotal	**$4,940,000**	**$5,690,000**	**$43,340,000**	**$2,800,000**	**$1,730,000**	**$58,500,000**
Capital Stock Losses	Structural	$7,980,000	$5,450,000	$29,170,000	$6,810,000	$1,930,000	$51,340,000
	Non-Structural	$41,020,000	$38,890,000	$80,060,000	$25,550,000	$6,260,000	$191,780,000
	Content	$13,820,000	$10,210,000	$39,430,000	$16,410,000	$3,150,000	$83,010,000
	Inventory	$0	$0	$1,350,000	$2,480,000	$40,000	$3,870,000
	Subtotal	**$62,820,000**	**$54,550,000**	**$150,010,000**	**$51,240,000**	**$11,380,000**	**$330,000,000**
	TOTAL	**$67,760,000**	**$60,240,000**	**$193,350,000**	**$54,040,000**	**$13,110,000**	**$388,500,000**

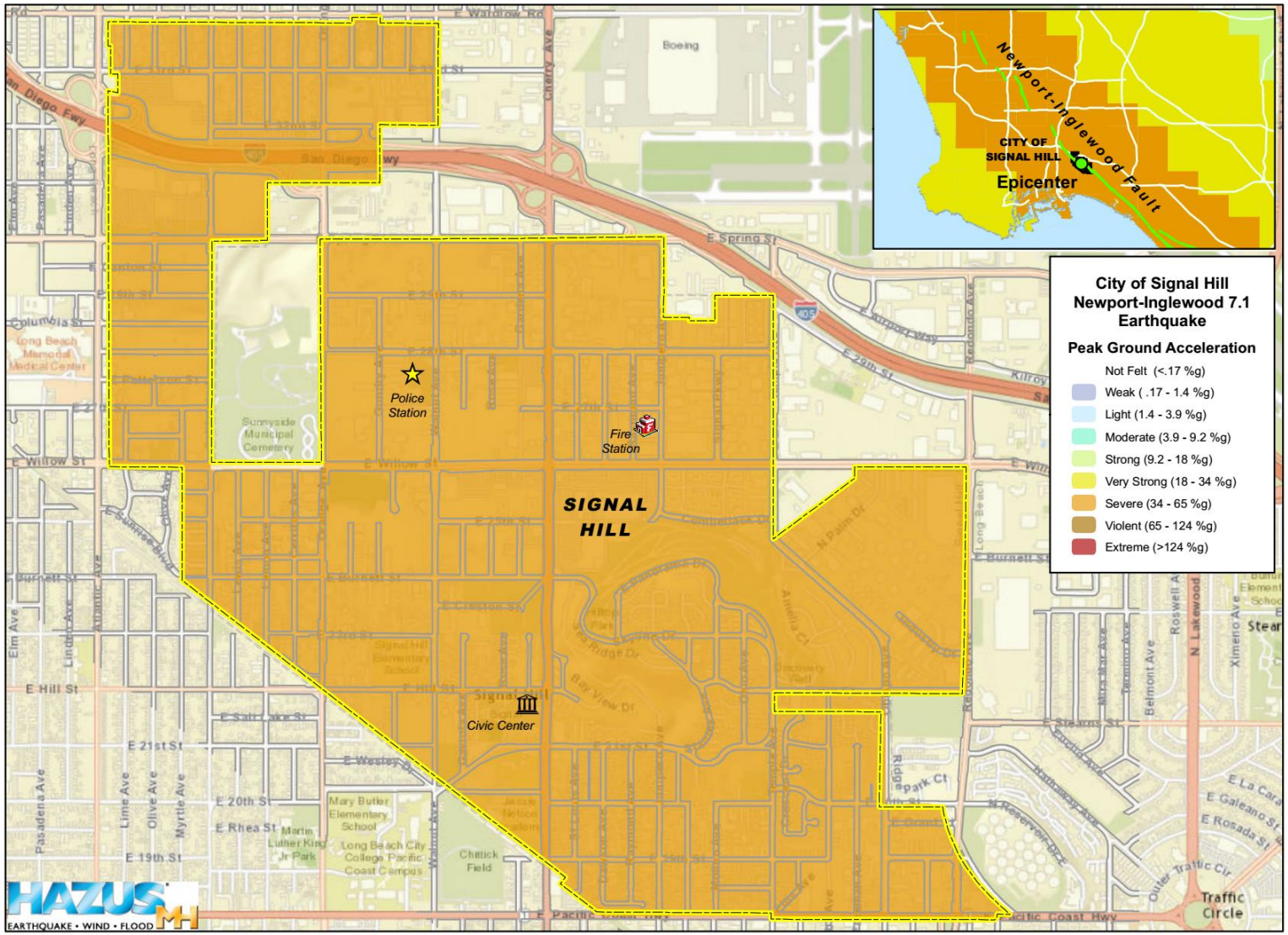
Table: Transportation System Economic Losses ($ Dollars) – Newport-Inglewood M7.1

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Highway	Segments	$49,000,000	$0	0%
	Bridges	$10,490,000	$2,000,000	19%
	Tunnels	$0	$0	0%
Railways	Segments	$5,030,000	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Light Rail	Segments	$0	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Bus	Facilities	$0	$0	0%
Ferry	Facilities	$0	$0	0%
Port	Facilities	$0	$0	0%
Airport	Facilities	$0	$0	0%
	TOTAL	**$64,520,000**	**$2,000,000**	

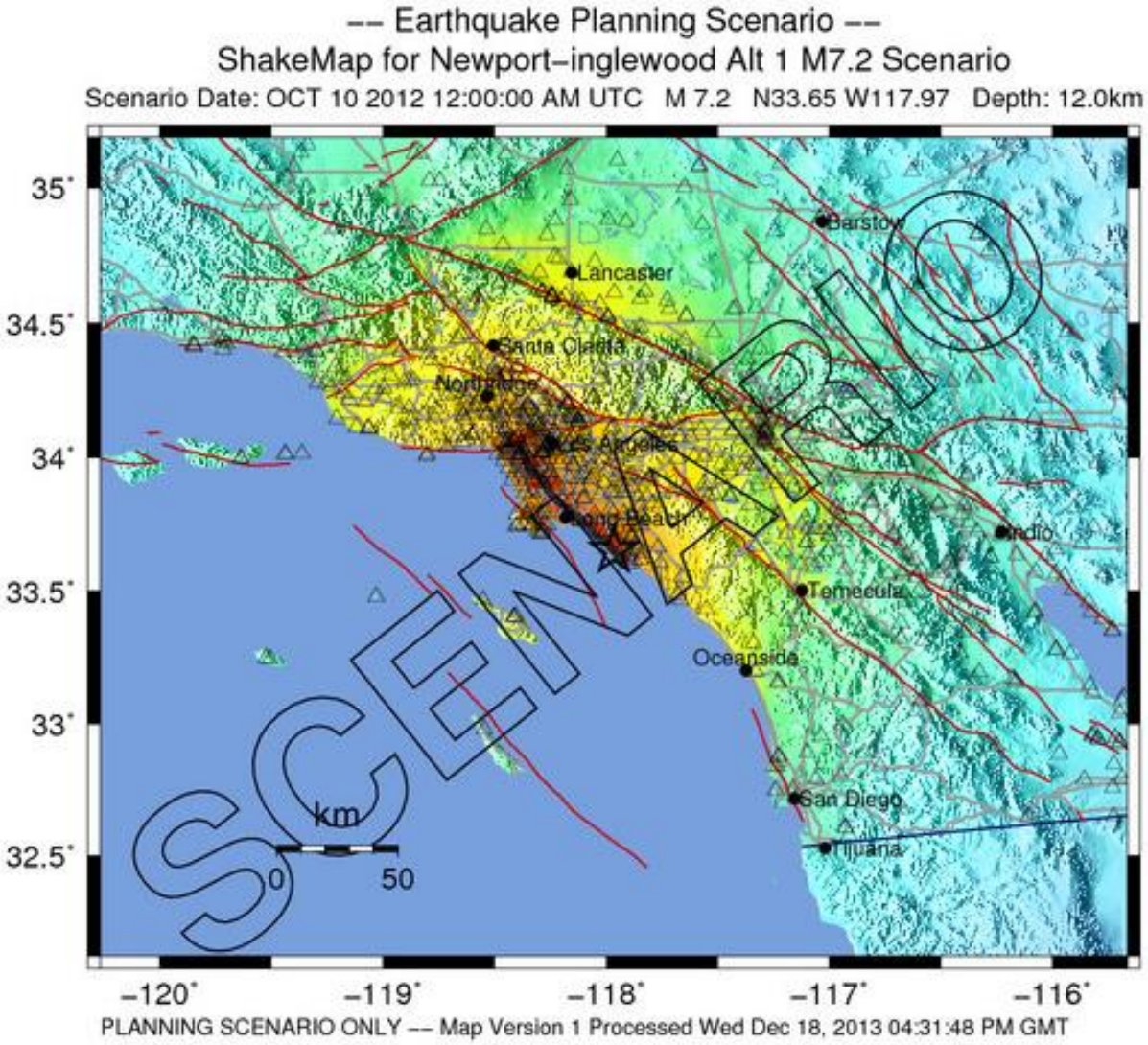
Table: Utility System Economic Losses ($ Dollars) – Newport-Inglewood M7.1

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Potable Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$9,400,000	$970,000	10%
Waste Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$5,600,000	$690,000	12%
Natural Gas	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$3,700,000	$200,000	5%
Oil Systems	Pipelines	$0	$0	0%
	Facilities	$500,000	$180,000	39%
Electrical Power	Facilities	$0	$0	0%
Communication	Facilities	$100,000	$50,000	50%
	TOTAL	**$19,300,000**	**$2,090,000**	

Map: Shake Intensity Map – Newport-Inglewood M7.1
(Source: Emergency Planning Consultants)



Map: Seismic Shaking Intensities for the Newport-Inglewood M7.2
(Source: State of California Department of Conservation)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<0.1*	*0.5*	*2.4*	*6.7*	*13*	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	*11*	*22*	*43*	*83*	*>160*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al.; 1999

San Andreas M8.0 Earthquake Scenario

Building Damage

Table: Expected Building Damage by Occupancy – San Andreas M8.0

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Agriculture	9	1	0	0	0
Commercial	416	30	7	1	0
Education	8	0	0	0	0
Government	4	0	0	0	0
Industrial	168	16	7	1	0
Other Residential	326	11	1	0	0
Religion	20	1	0	0	0
Single Family	1,975	60	0	0	0
Total	**2,927**	**119**	**16**	**2**	**0**

Table: Expected Building Damage by Building Type – San Andreas M8.0

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Wood	2,334	75	1	0	0
Steel	127	15	9	2	0
Concrete	115	9	2	0	0
Precast	144	11	2	0	0
RM	167	4	1	0	0
URM	36	4	0	0	0
MH	3	1	0	0	0
Total	**2,927**	**119**	**16**	**2**	**0**

Transportation and Utility Lifeline Damage

Table: Expected Utility System Pipeline Damage – San Andreas M8.0

System	Total Pipelines (Length km)	Number of Leaks	Number of Breaks
Potable Water	468	502	126
Waste Water	281	360	90
Natural Gas	187	103	26
Oil	0	0	0

Table: Potable Water and Electric Power System Performance – San Andreas M8.0

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	**4,173**	3,405	2,237	0	0	0
Electric Power		0	0	0	0	0

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 11,411) will seek temporary shelter in public shelters.

Casualties

The table below represents a summary of casualties estimated for San Andreas M8.0 earthquake scenario.

Table: Casualty Estimates – San Andreas M8.0

Time	Sector	Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	0	0	0	0
	TOTAL	**0**	**0**	**0**	**0**
2PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**1**	**0**	**0**	**0**
5PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**1**	**0**	**0**	**0**

Economic Losses

The total economic loss estimated for the San Andreas M8.0 earthquake scenario is **$11.79 million dollars** which includes building and lifeline related losses based on the region's available inventory. The following tables provide more detailed information about these losses.

Table: Building-Related Economic Losses ($ Dollars) – San Andreas M8.0

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	$0	$0	$280,000	$30,000	$10,000	$310,000
	Capital-Related	$0	$0	$200,000	$20,000	$0	$220,000
	Rental	$0	$10,000	$150,000	$10,000	$0	$180,000
	Relocation	$0	$10,000	$180,000	$60,000	$20,000	$260,000
	Subtotal	**$0**	**$30,000**	**$800,000**	**$110,000**	**$30,000**	**$980,000**
Capital Stock Losses	Structural	$80,000	$40,000	$360,000	$220,000	$40,000	$740,000
	Non-Structural	$630,000	$560,000	$1,680,000	$700,000	$140,000	$3,710,000
	Content	$240,000	$170,000	$940,000	$400,000	$70,000	$1,820,000
	Inventory	$0	$0	$30,000	$60,000	$0	$90,000
	Subtotal	**$940,000**	**$780,000**	**$3,020,000**	**$1,380,000**	**$240,000**	**$6,360,000**
	TOTAL	**$950,000**	**$800,000**	**$3,820,000**	**$1,490,000**	**$280,000**	**$7,340,000**

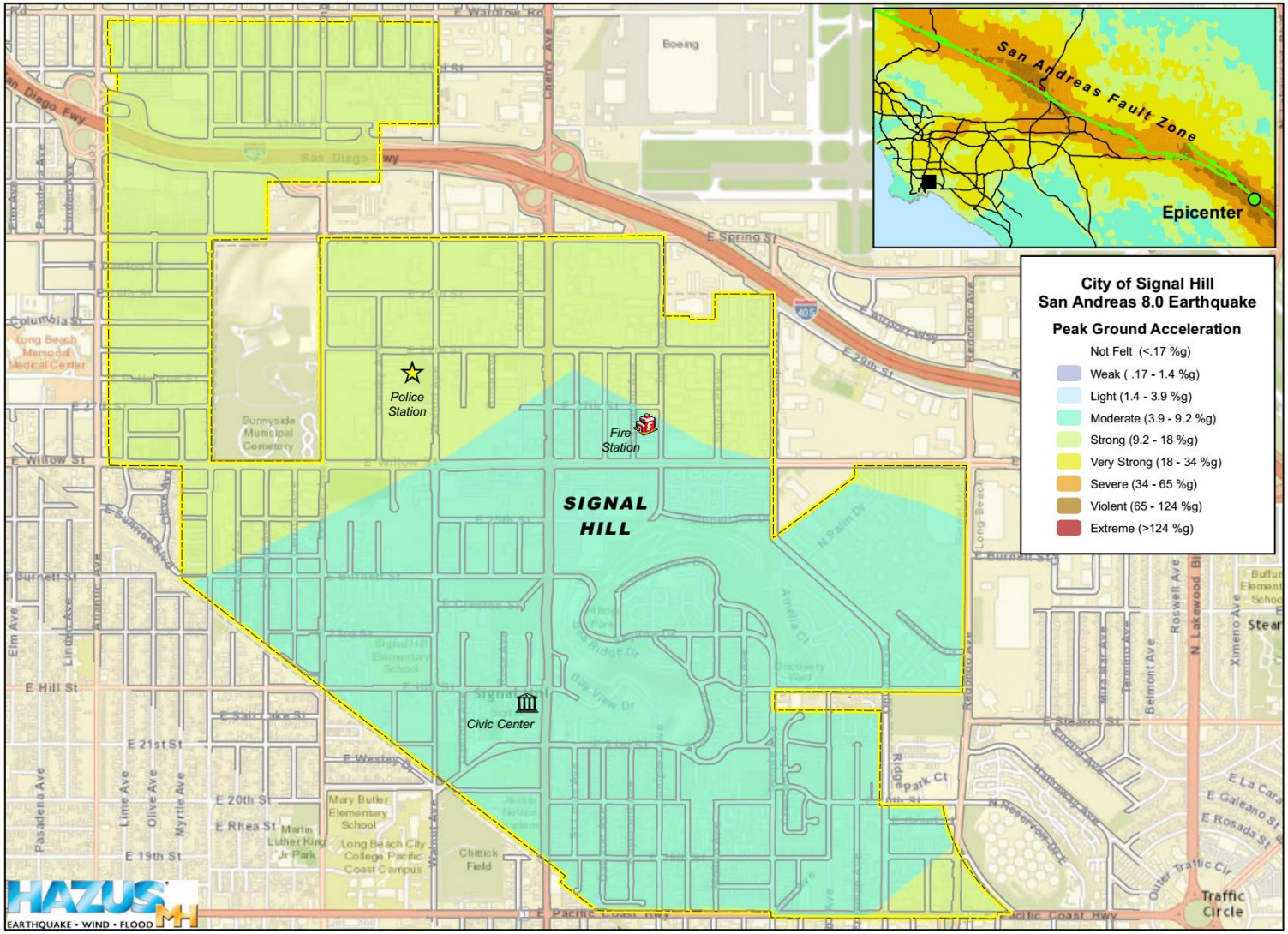
Table: Transportation System Economic Losses ($ Dollars) – San Andreas M8.0

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Highway	Segments	$49,000,000	$0	0%
	Bridges	$10,490,000	$90,000	1%
	Tunnels	$0	$0	0%
Railways	Segments	$5,030,000	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Light Rail	Segments	$0	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Bus	Facilities	$0	$0	0%
Ferry	Facilities	$0	$0	0%
Port	Facilities	$0	$0	0%
Airport	Facilities	$0	$0	0%
	TOTAL	**$64,520,000**	**$90,000**	

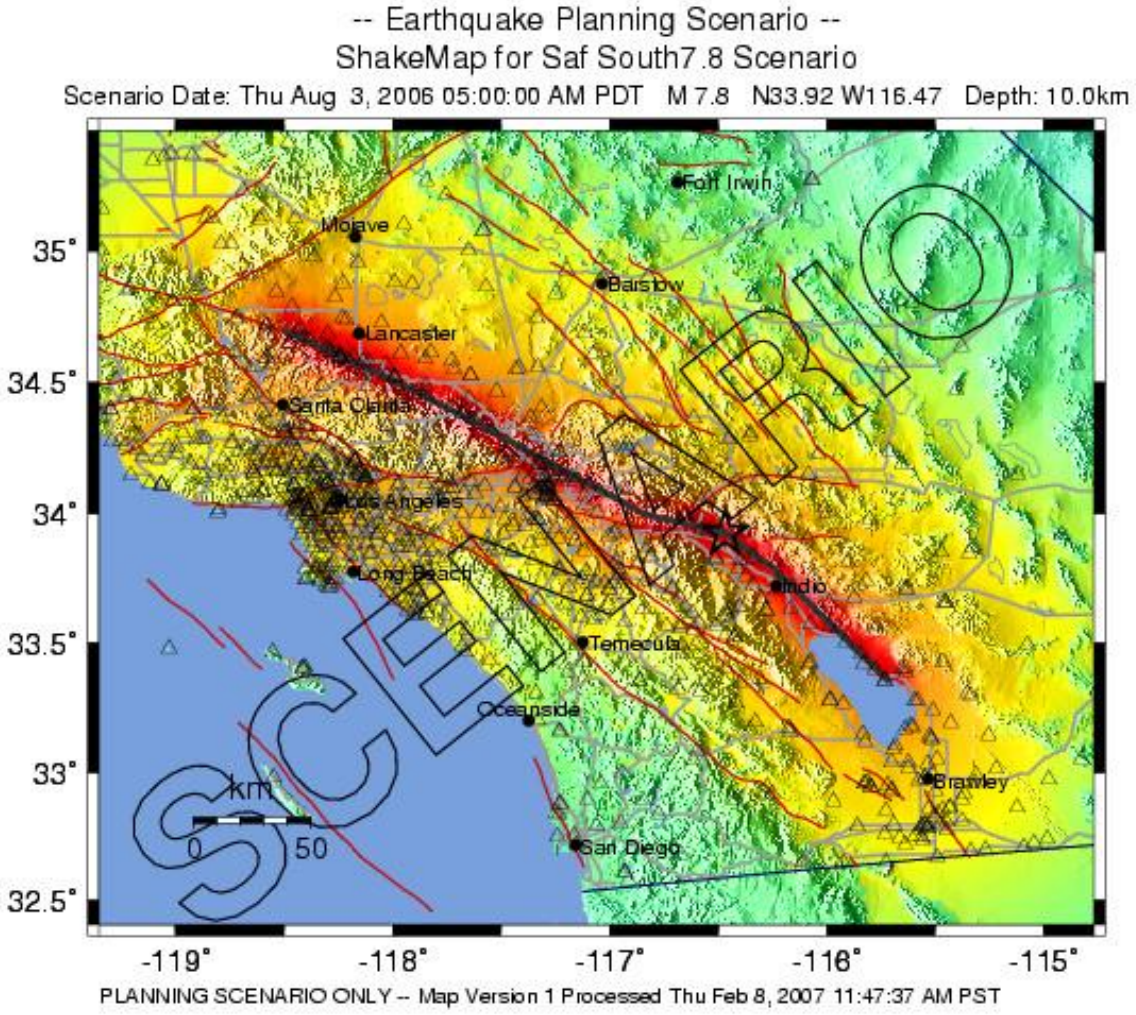
Table: Utility System Economic Losses ($ Dollars) – San Andreas M8.0

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Potable Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$9,400,000	$2,260,000	24%
Waste Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$5,600,000	$1,620,000	29%
Natural Gas	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$3,700,000	$460,000	12%
Oil Systems	Pipelines	$0	$0	0%
	Facilities	$500,000	$10,000	2%
Electrical Power	Facilities	$0	$0	0%
Communication	Facilities	$100,000	$0	0%
	TOTAL	**$19,300,000**	**$4,350,000**	

Map: Shake Intensity Map – San Andreas M8.0
(Source: Emergency Planning Consultants)



Map: Seismic Shaking Intensities for the San Andrea Fault M7.8
(Source: State of California Department of Conservation)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Puente Hills M7.1 Earthquake Scenario

Building Damage

Table: Expected Building Damage by Occupancy – Puente Hills M7.1

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Agriculture	5	3	2	1	0
Commercial	202	114	99	33	6
Education	5	2	1	0	0
Government	2	1	1	0	0
Industrial	79	47	46	17	4
Other Residential	186	106	38	7	1
Religion	11	6	4	1	0
Single Family	1,163	682	178	9	2
Total	**1,653**	**961**	**369**	**69**	**14**

Table: Expected Building Damage by Building Type – Puente Hills M7.1

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Wood	1,365	810	220	13	3
Steel	58	36	42	15	3
Concrete	56	33	25	10	2
Precast	64	37	39	14	2
RM	94	33	31	12	1
URM	15	11	10	4	1
MH	1	1	2	1	0
Total	**1,653**	**961**	**369**	**69**	**14**

Transportation and Utility Lifeline Damage

Table: Expected Utility System Pipeline Damage – Puente Hills M7.1

System	Total Pipelines (Length km)	Number of Leaks	Number of Breaks
Potable Water	468	61	15
Waste Water	281	44	11
Natural Gas	187	13	3
Oil	0	0	0

Table: Potable Water and Electric Power System Performance – Puente Hills M7.1

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	**4,173**	0	0	0	0	0
Electric Power		0	0	0	0	0

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 63 households to be displaced due to the earthquake. Of these, 38 people (out of a total population of 11,411) will seek temporary shelter in public shelters.

Casualties

The table below represents a summary of casualties estimated for the Puente Hills M7.1 earthquake scenario.

Table: Casualty Estimates – Puente Hills M7.1

Time	Sector	Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	4	1	0	0
	Single-Family	3	0	0	0
	TOTAL	**7**	**1**	**0**	**0**
2PM	Commercial	12	3	0	1
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	1	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**19**	**4**	**0**	**1**
5PM	Commercial	8	2	0	0
	Commuting	1	1	2	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**14**	**3**	**2**	**0**

Economic Losses

The total economic loss estimated for the Puente Hills M7.1 scenario earthquake is **$113.03 million dollars** which includes building and lifeline related losses based on the region's available inventory. The following tables provide more detailed information about these losses.

Table: Building-Related Economic Losses ($ Dollars) – Puente Hills M7.1

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	$0	$70,000	$3,640,000	$240,000	$120,000	$4,070,000
	Capital-Related	$0	$30,000	$2,820,000	$150,000	$20,000	$3,020,000
	Rental	$260,000	$10,000	$2,840,000	$90,000	$30,000	$4,050,000
	Relocation	$950,000	$600,000	$4,310,000	$530,000	$350,000	$6,740,000
	Subtotal	**$1,210,000**	**$1,530,000**	**$13,610,000**	**$1,010,000**	**$520,000**	**$17,880,000**
Capital Stock Losses	Structural	$2,260,000	$1,510,000	$8,100,000	$2,080,000	$550,000	$14,500,000
	Non-Structural	$12,730,000	$11,320,000	$21,740,000	$7,150,000	$1,760,000	$54,700,000
	Content	$4,390,000	$3,040,000	$10,980,000	$4,560,000	$900,000	$23,870,000
	Inventory	$0	$0	$370,000	$690,000	$10,000	$1,070,000
	Subtotal	**$19,380,000**	**$15,870,000**	**$41,190,000**	**$14,480,000**	**$3,220,000**	**$94,140,000**
	TOTAL	**$20,590,000**	**$17,400,000**	**$54,800,000**	**$15,490,000**	**$3,740,000**	**$112,020,000**

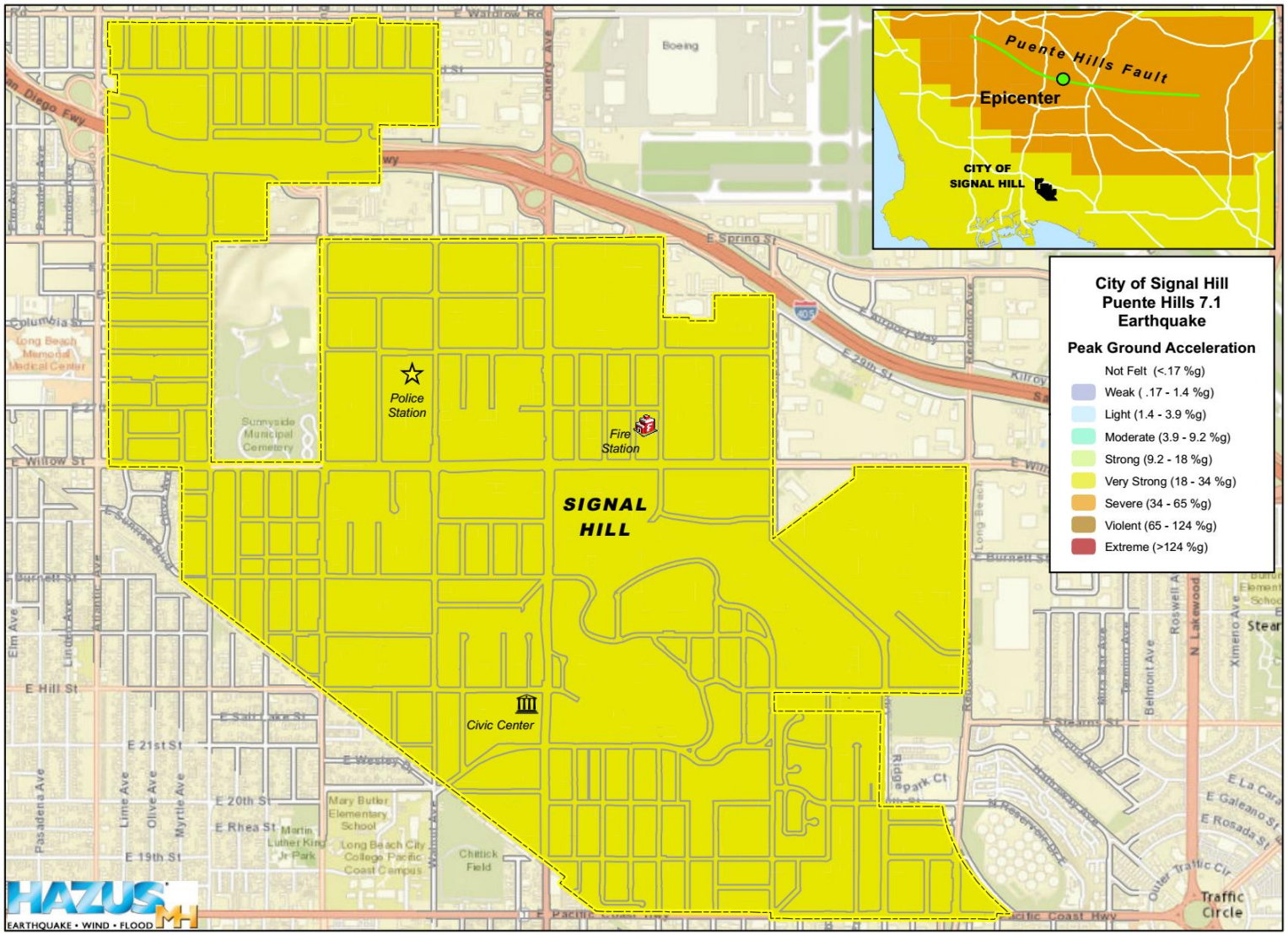
Table: Transportation System Economic Losses ($ Dollars) – Puente Hills M7.1

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Highway	Segments	$49,000,000	$0	0%
	Bridges	$10,490,000	$390,000	4%
	Tunnels	$0	$0	0%
Railways	Segments	$5,030,000	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Light Rail	Segments	$0	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Bus	Facilities	$0	$0	0%
Ferry	Facilities	$0	$0	0%
Port	Facilities	$0	$0	0%
Airport	Facilities	$0	$0	0%
	TOTAL	**$64,520,000**	**$390,000**	

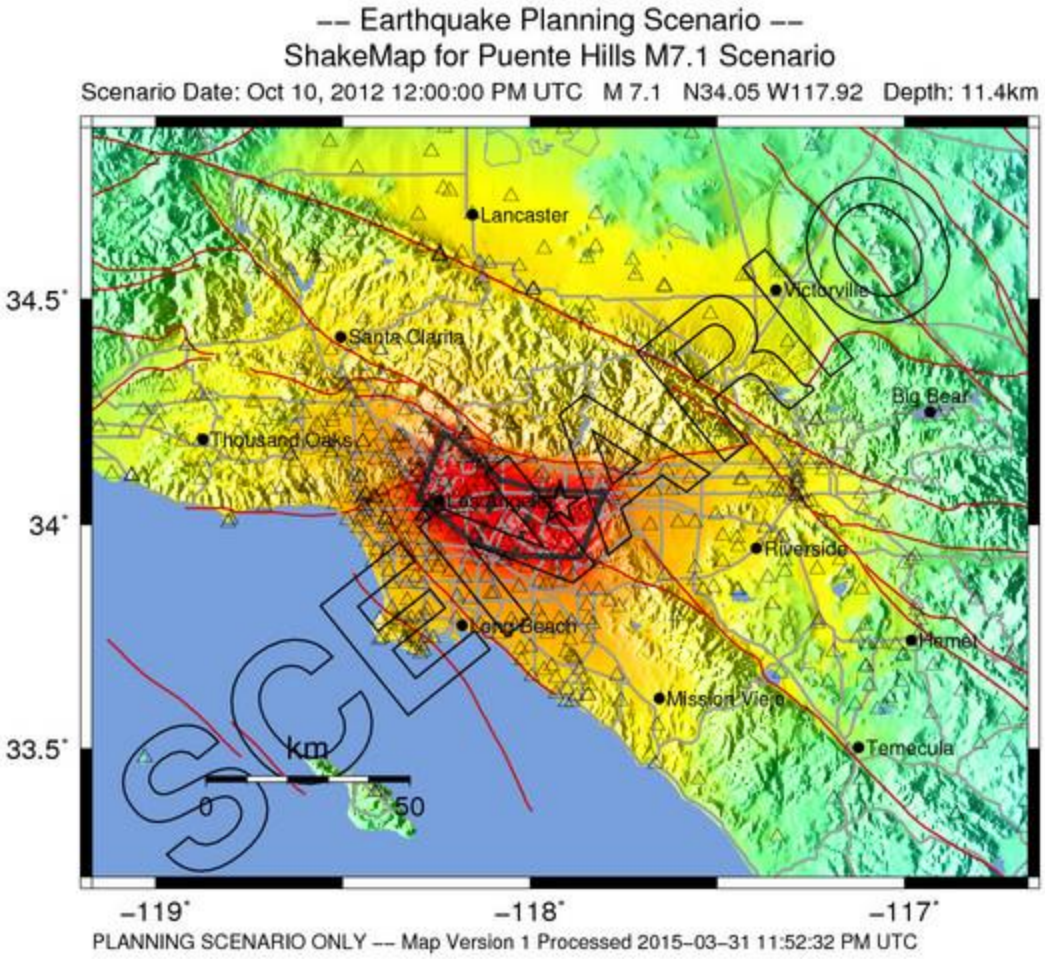
Table: Utility System Economic Losses ($ Dollars) – Puente Hills M7.1

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Potable Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$9,400,000	$280,000	3%
Waste Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$5,600,000	$200,000	4%
Natural Gas	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$3,700,000	$60,000	2%
Oil Systems	Pipelines	$0	$0	0%
	Facilities	$500,000	$70,000	14%
Electrical Power	Facilities	$0	$0	0%
Communication	Facilities	$100,000	$20,000	20%
	TOTAL	**$19,300,000**	**$630,000**	

Map: Shake Intensity Map – Puente Hills M7.1
(Source: Emergency Planning Consultants)



Map: Seismic Shaking Intensities for the Puente Hills M7.1 (Source: State of California Department of Conservation)



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<0.1*	*0.5*	*2.4*	*6.7*	*13*	24	44	83	>156
PEAK VEL.(cm/s)	<0.07	0.4	1.9	5.8	*11*	*22*	*43*	*83*	*>160*
INSTRUMENTAL INTENSITY	I	II–III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Wald, et al.; 1999

Whittier M6.8 Earthquake Scenario

Building Damage

Table: Expected Building Damage by Occupancy – Whittier M6.8

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Agriculture	9	1	0	0	0
Commercial	401	46	7	0	0
Education	8	1	0	0	0
Government	4	0	0	0	0
Industrial	167	22	4	0	0
Other Residential	309	27	2	0	0
Religion	20	2	0	0	0
Single Family	1,879	154	2	0	0
Total	**2,796**	**253**	**15**	**0**	**0**

Table: Expected Building Damage by Building Type – Whittier M6.8

	None	Slight	Moderate	Extensive	Complete
	Count	Count	Count	Count	Count
Wood	2,224	184	2	0	0
Steel	135	15	4	0	0
Concrete	112	13	2	0	0
Precast	130	22	5	0	0
RM	161	10	2	0	0
URM	32	7	1	0	0
MH	3	1	0	0	0
Total	**2,796**	**253**	**15**	**0**	**0**

Transportation and Utility Lifeline Damage

Table: Expected Utility System Pipeline Damage – Whittier M6.8

System	Total Pipelines (Length km)	Number of Leaks	Number of Breaks
Potable Water	468	502	126
Waste Water	281	360	90
Natural Gas	187	103	26
Oil	0	0	0

Table: Potable Water and Electric Power System Performance – Whittier M6.8

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	**4,173**	3,405	2,237	0	0	0
Electric Power		0	0	0	0	0

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 0 households to be displaced due to the earthquake. Of these, 0 people (out of a total population of 11,411) will seek temporary shelter in public shelters.

Casualties

The table below represents a summary of casualties estimated for Whittier M6.8 earthquake scenario.

Table: Casualty Estimates – Whittier M6.8

Time	Sector	Level 1	Level 2	Level 3	Level 4
2AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	0	0	0	0
	TOTAL	**0**	**0**	**0**	**0**
2PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**1**	**0**	**0**	**0**
5PM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single-Family	1	0	0	0
	TOTAL	**1**	**0**	**0**	**0**

Economic Losses

The total economic loss estimated for the Whittier M6.8 earthquake scenario is **$19.40 million dollars** which includes building and lifeline related losses based on the region's available inventory. The following tables provide more detailed information about these losses.

Table: Building-Related Economic Losses ($ Dollars) – Whittier M6.8

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses	Wage	$0	$1,000	$121,300	$10,500	$8,000	$140,800
	Capital-Related	$0	$400	$96,500	$6,600	$1,300	$104,800
	Rental	$8,600	$38,900	$164,300	$4,900	$1,000	$217,700
	Relocation	$8,800	$15,800	$158,000	$29,900	$8,400	$220,900
	Subtotal	**$17,400**	**$56,100**	**$540,100**	**$51,900**	**$18,700**	**$684,200**
Capital Stock Losses	Structural	$202,300	$106,000	$403,500	$118,900	$23,900	$854,600
	Non-Structural	$1,782,200	$1,714,400	$3,332,600	$1,332,400	$249,700	$8,411,300
	Content	$797,600	$585,900	$2,361,900	$917,100	$183,000	$4,845,500
	Inventory	$0	$0	$79,400	$138,900	$2,100	$220,400
	Subtotal	**$2,782,100**	**$2,406,300**	**$6,177,400**	**$2,507,300**	**$458,700**	**$14,331,800**
	TOTAL	**$2,799,500**	**$2,462,400**	**$6,717,500**	**$2,559,200**	**$477,400**	**$15,016,000**

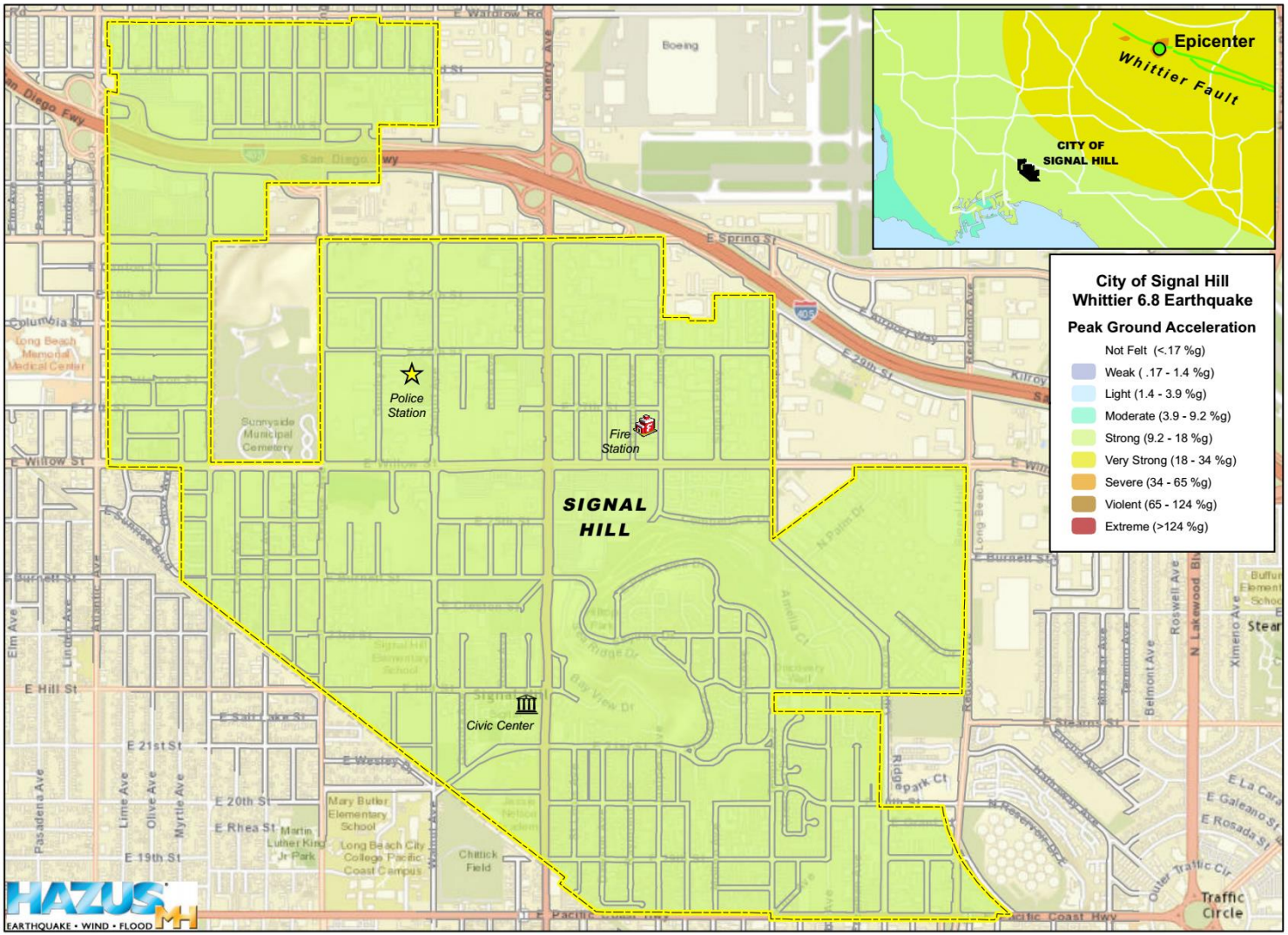
Table: Transportation System Economic Losses ($ Dollars) – Whittier M6.8

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Highway	Segments	$49,000,000	$0	0%
	Bridges	$10,490,000	$11,700	1%
	Tunnels	$0	$0	0%
Railways	Segments	$5,030,000	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Light Rail	Segments	$0	$0	0%
	Bridges	$0	$0	0%
	Tunnels	$0	$0	0%
	Facilities	$0	$0	0%
Bus	Facilities	$0	$0	0%
Ferry	Facilities	$0	$0	0%
Port	Facilities	$0	$0	0%
Airport	Facilities	$0	$0	0%
	TOTAL	**$64,520,000**	**$11,700**	

Table: Utility System Economic Losses ($ Dollars) – Whittier M6.8

System	Component	Total Inventory Value	Economic Loss	Loss Ratio %
Potable Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$9,400,000	$2,259,700	24%
Waste Water	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$5,600,000	$1,619,400	29%
Natural Gas	Pipelines	$0	$0	0%
	Facilities	$0	$0	0%
	Distribution Lines	$3,700,000	$464,500	12%
Oil Systems	Pipelines	$0	$0	0%
	Facilities	$500,000	$22,800	5%
Electrical Power	Facilities	$0	$0	0%
Communication	Facilities	$100,000	$5,700	6%
	TOTAL	**$19,300,000**	**$4,372,100**	

Map: Shake Intensity Map – Whittier M6.8
(Source: Emergency Planning Consultants)



Structures and Building Code

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 Signal Hill, many buildings were built before 1993 when building codes were not as strict. In addition, retrofitting is not required except under certain conditions and can be expensive. Therefore, the number of buildings at risk remains high. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of unreinforced masonry buildings. According to the City of Signal Hill General Plan – Safety Element (2016), all URM buildings within the City have been identified and upgraded to meet current requirements.

Implementation of earthquake mitigation policy most often takes place at the local government level. The City of Signal Hill Building Safety Department enforces building codes pertaining to earthquake hazards.

Additionally, the City has implemented basic building requirements that are above and beyond what the State demands for hazard mitigation. Newly constructed buildings in Signal Hill that are built in an area subject to Earthquake-induced landslide or liquefaction are typically built with extra foundation support. Such support is found in the post-tension reinforced concrete foundation; this same technique is used by coastal cities to prevent home destruction during cases of liquefaction.

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

Landslide Hazards

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B2

Q: B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))

A: See **Previous Occurrences of Landslides in the City of Signal Hill** below.

Previous Occurrences of Landslides in the City of Signal Hill

Signal Hill was most recently impacted in 1995 when a portion of Panorama Drive collapsed due to undermining of the asphalt roadway by heavy rains.

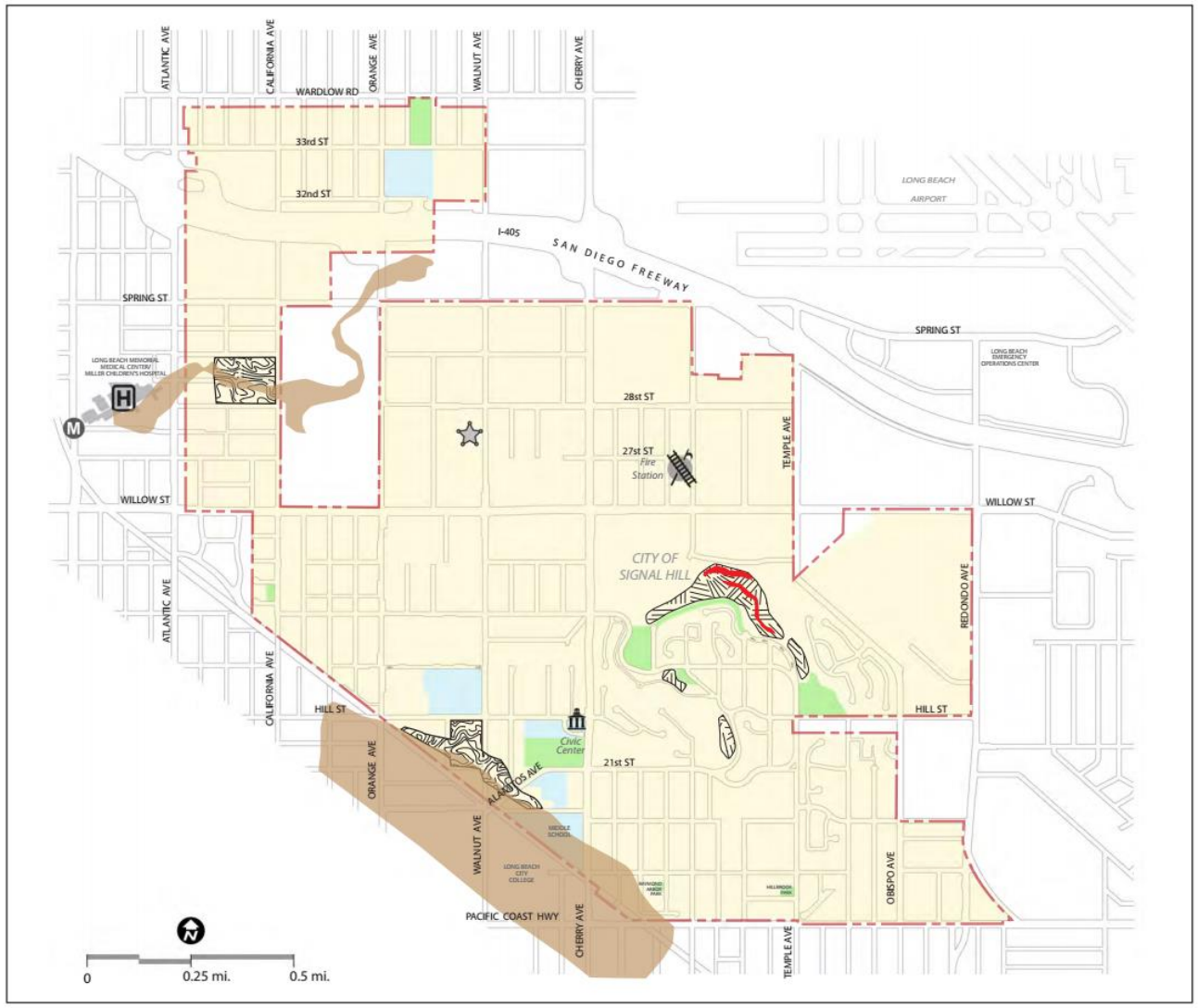
Since the writing of the 2012 Mitigation Plan, there have been no significant landslide events in the City of Signal Hill.

Local Conditions

According to the City of Signal Hill General Plan – Safety Element (2016), landslides can result from earthquake-related ground shaking or failure of steep slopes due to water saturation or unstable soil conditions. Landslides can overrun structures and other property, and cause human injury or death. They can sever utility lines and block roads, thereby hindering rescue operations following an earthquake. The Seismic Hazards Mapping Act requires identification of landslide zones in which the stability of hill slopes must be evaluated. Areas that previously experienced landslide movement and/or local topographic, geological, geotechnical, and groundwater conditions may indicate the potential for future, permanent ground displacements. If confirmed during site geotechnical analyses, site mitigation would be required.

The areas found susceptible to landslides are found in the upper reaches of Signal Hill. Development, mostly completed over the past decade, is located both above and below areas at risk of landslides. Geotechnical analyses were prepared for these developments, and risks associated with landslides were mitigated to reduce their potential impacts. As shown on **Map: Landslide Hazard Areas**, two areas remain with landslide potential in the city, located north of Panorama Promenade and southwest of Sunset View Park.

Map: Landslide Hazard Areas
(Source: City of Signal Hill General Plan – Safety Element 2016)



City of Signal Hill
GENERAL PLAN

Safety Element
October 2010

City of Signal Hill Boundary

Liquefaction Hazard

Undeveloped Land with Liquefaction Potential

Landslide Movement Hazard

Undeveloped Land with Landslide Potential

Source: Prepared by Earth Consultants International with data from the California Division of Mines and Geology.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B3

Q: B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))

A: See **Impacts of Landslides in the City of Signal Hill** below.

Impacts of Landslides in the City of Signal Hill

Based on the risk assessment, it is evident that landslides continue to have potentially devastating economic impact to certain areas of the City.

Impacts that is not quantified, but can be anticipated in future events, include:

- ✓ Injury and loss of life
- ✓ Commercial and residential structural damage
- ✓ Disruption of and damage to public infrastructure
- ✓ Secondary health hazards e.g. mold and mildew
- ✓ Damage to roads/bridges resulting in loss of mobility
- ✓ Significant economic impact (jobs, sales, tax revenue) upon the community
- ✓ Negative impact on commercial and residential property values
- ✓ Significant disruption to students and teachers as temporary facilities and relocations would likely be needed

Windstorm Hazards

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B2

Q: B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))

A: See **Previous Occurrences of Windstorms in the City of Signal Hill** below.

Previous Occurrences of Windstorms in the City of Signal Hill

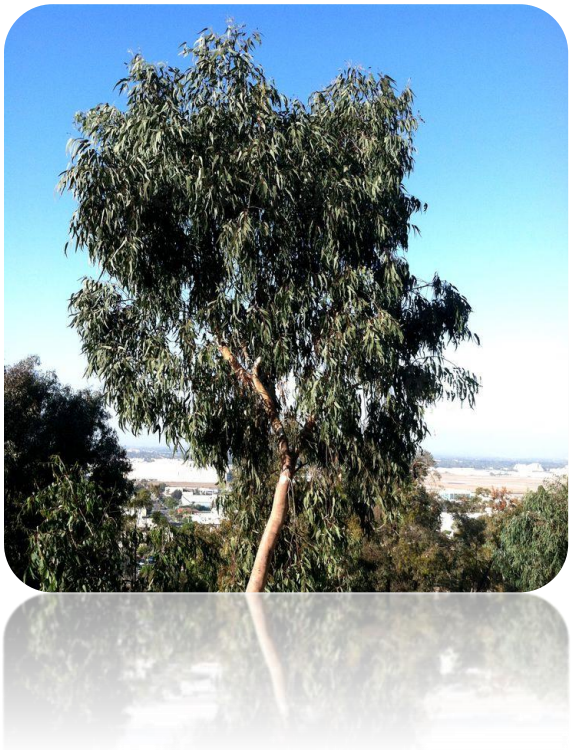
Severe windstorms pose a significant risk to life and property in the City of Signal Hill by creating conditions that disrupt essential systems such as public utilities, telecommunications, and transportation routes. High winds can and do occasionally cause tornado-like damage to local homes and businesses in and near the community. High winds have destructive impact, especially to trees, power lines, and utility services.

Since the writing of the 2012 Mitigation Plan, there have been no significant windstorm events in the City of Signal Hill.

Local Conditions

According to the City, Signal Hill is at increased risk of windstorm damage – especially from falling trees.

Recent drought conditions have significantly increased the vulnerability of trees due to lack of necessary water. Additionally, eucalyptus trees within Signal Hill are specifically and currently prone to pest infestation. The infected, dying trees are increasingly vulnerable to severe Santa Ana wind conditions.



Historically, high wind conditions have caused injury, death, property damage, and fanned wild fires. Windstorms with significant intensity have been responsible for the sinking of watercraft and the downing of aircraft resulting in the loss of life. The most common wind condition is a Santa Ana Wind. This condition has generated winds that have exceeded 100 mph. Wind velocities of up to 111 mph have been generated from the same Santa Ana wind, resulting in the loss of life due to flying debris.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B3

Q: B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))

A: See **Impacts of Windstorms in the City of Signal Hill** below.

Impacts of Windstorms in the City of Signal Hill

Based on the risk assessment, it is evident that Windstorms continue to have potentially devastating economic impact to certain areas of the City.

Impacts that is not quantified, but can be anticipated in future events, include:

- ✓ Injury and loss of life
- ✓ Commercial and residential structural damage
- ✓ Disruption of and damage to public infrastructure
- ✓ Secondary Health hazards e.g. mold and mildew
- ✓ Damage to roads/bridges resulting in loss of mobility
- ✓ Significant economic impact (jobs, sales, tax revenue) upon the community
- ✓ Negative impact on commercial and residential property values
- ✓ Significant disruption to students and teachers as temporary facilities and relocations would likely be needed.

Drought Hazards

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B2

Q: B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))

A: See **Previous Occurrences of Drought in the City of Signal Hill** below.

Previous Occurrences of Drought in the City of Signal Hill

Fortunately, there is no history of severe drought within the City of Signal Hill. Although there is no evidence of a drought having a significant impact on the City at the current time, California as a whole has experienced a serious drought since 2012.

Since the writing of the 2012 Mitigation Plan, there have been no significant damages to the City from a drought.

Previous Occurrences of Drought in Los Angeles County

The region's Mediterranean climate makes it especially susceptible to variations in rainfall. Though the potential risk to the City of Signal Hill is in no way unique, severe water shortages could have a bearing on the economic well-being of the community. Comparison of climate (rainfall) records from Los Angeles with water well records beginning in 1930 from the San Gabriel Valley indicates the existence of wet and dry cycles on a 10-year scale as well as for much longer periods. The climate record for the Los Angeles region beginning in 1890 suggests drying conditions over the last century. With respect to the present day, climate data also suggests that the last significant wet period was the 1940s. Well level data and other sources seem to indicate the historic high groundwater levels (reflecting recharge from rainfall) occurred in the same decade. Since that time, rainfall (and groundwater level trends) appears to be in decline. This slight declining trend, however, is not believed to be significant. Climatologists compiled rainfall data from 96 stations in the State that spanned a 100-year period between 1890 and 1990. An interesting note is that during the first 50 years of the reporting period, there was only one year (1890) that had more than 35 inches of rainfall, whereas the second 50-year period recording of 5 year intervals (1941, 1958, 1978, 1982, and 1983) that exceeded 35 inches of rainfall in a single year. The year of maximum rainfall was 1890 when the average annual rainfall was 43.11 inches. The second wettest year on record occurred in 1983 when the State's average was 42.75 inches.

The driest year of the 100-year reported in the study was 1924 when the State's average rainfall was only 10.50 inches. The region with the most stations reporting the driest year in 1924 was the San Francisco Bay area. The second driest year was 1977 when the average was 11.57 inches. The most recent major drought (1987 to 1990) occurred at the end of a sequence of very wet years (1978 to 1983). The debate continues whether "global warming" is occurring, and the degree to which global climate change will have an effect on local micro-climates. The semi-arid southwest is particularly susceptible to variations in rainfall. A study that documented annual precipitation for California since 1600 from reconstructed tree ring data indicates that there was a prolonged dry spell from about 1755 to 1820 in California. Fluctuations in precipitation could contribute indirectly to a number of hazards including wildfire and the availability of water supplies.

Local Conditions

According to the City of Signal Hill General Plan – Circulation Element (2009), the City's primary water supply comes from two groundwater wells located in north Long Beach. Additional water may be purchased from the Metropolitan Water District of Southern California.

The City has drilled a third groundwater well centrally located within Signal Hill and is in the process of developing plans and specifications for the necessary pumping and treatment facilities. The City has three storage reservoirs and pumping facilities, providing water for domestic purposes and firefighting. The Gundry reservoir and pumping facility was constructed in 1929 and has a storage capacity of 4.7 million gallons. This facility is located in the northern part of the city. Two hilltop reservoirs and pumping facilities were constructed in the late 1990s, having a combined storage capacity of 2.6 million gallons.

A significant drought has hit the state of California since 2012. The drought has depleted reservoir levels all across the state. In January of 2014, Governor Brown declared a state of emergency and directed state officials to take all necessary actions to prepare for water shortages. As the drought prolonged into 2015, to help cope with the drought, Governor Brown gave an executive order in April 2015 which mandated a statewide 25 percent reduction in water use. In January of 2016, the DWR and the U.S. Bureau of Reclamation have finalized the 2016 Drought Contingency Plan that outlines State Water Project and Central Valley Project operations for February 2016 to November 2016. The plan was developed in coordination with staff from State and federal agencies. Although the drought has more significantly impacted surfaces waters and other agencies that use water for agriculture, the City of Signal Hill is still affected by the drought, primarily due to reduced reliability of imported water.

Q&A | ELEMENT B: HAZARD IDENTIFICATION AND RISK ASSESSMENT | B3

Q: B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))

A: See **Impacts of Drought in the City of Signal Hill** below.

Impacts of Drought in the City of Signal Hill

Based on the risk assessment, it is evident that drought events continue to have potentially devastating economic impacts to certain areas of the City.

Impacts that are not quantified, but can be anticipated in future events, include:

- ✓ Injury and loss of life
- ✓ Disruption of and damage to public infrastructure
- ✓ Significant economic impact (jobs, sales, tax revenue) upon the community
- ✓ Negative impact on commercial and residential property values
- ✓ Uncontrolled fires and associated injuries and damage

PART III: MITIGATION STRATEGIES

Mitigation Strategies

Overview of Mitigation Strategy

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

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

The resources and information within the Mitigation Plan:

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

The Mitigation Plan is integrated with other City plans including the City of Signal Hill Emergency Operations Plan, General Plan as well as department-specific standard operating procedures.

Mitigation Measure Categories

Following is FEMA's list of mitigation categories. The activities identified by the Planning Team are consistent with the six broad categories of mitigation actions outlined in FEMA publication 386-3 *Developing the Mitigation Plan: Identifying Mitigation Actions and Implementing Strategies*.

- ✓ **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.
- ✓ **Property Protection:** Actions that involve modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
- ✓ **Public Education and Awareness:** Actions to inform and educate citizens, property owners, and elected officials about hazards and potential ways to mitigate them.

  Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- ✓ **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses preserve or restore the functions of natural systems. Examples include sediment and

erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

- ✓ **Emergency Services:** Actions that protect people and property during and immediately following a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- ✓ **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, retaining walls, and safe rooms.

Q&A | ELEMENT C. MITIGATION STRATEGY | C3

Q: C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))

A: See **Goals** below.

Goals

The Planning Team developed mitigation goals to avoid or reduce long-term vulnerabilities to hazards. These general principles clarify desired outcomes.

The goals are based on the risk assessment and Planning Team input, and represents a long-term vision for hazard reduction or enhanced mitigation capabilities. They are compatible with community needs and goals expressed in other planning documents prepared by the City.

Each goal is supported by mitigation action items. The Planning Team developed these action items through its knowledge of the local area, risk assessment, review of past efforts, identification of mitigation activities, and qualitative analysis.

The five mitigation goals and descriptions are listed below.

FEMA defines **Goals** as general guidelines that explain what you want to achieve. They are usually broad policy-type statements, long-term, and represent global visions.

FEMA defines **Mitigation Activities** as specific actions that help you achieve your goals and objectives.

Protect Life and Property

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

Improve hazard assessment information to make recommendations for avoiding new development in high hazard areas and encouraging preventative measures for existing development in areas vulnerable to natural, human-caused, and technological hazards.

Enhance Public Awareness

Develop and implement education and outreach programs to increase public awareness of the risks associated with natural, human-caused, and technological hazards.

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

Preserve Natural Systems

Support management and land use planning practices with hazard mitigation to protect life.

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

Encourage Partnerships and Implementation

Strengthen communication and coordinate participation with public agencies, citizens, non-profit organizations, business, and industry to support implementation.

Encourage leadership within the City and public organizations to prioritize and implement local 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.

The Planning Team also developed hazard-specific mitigation goals, which appear in the **Mitigation Strategies Section**.

How are the Mitigation Action Items Organized?

The action items are a listing of activities in which City agencies and citizens can be engaged to reduce risk. Each action item includes an estimate of the timeline for implementation.

The action items are organized within the following **Mitigation Actions Matrix**, which lists all of the multi-hazard (actions that reduce risks for more than one specific 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. The Matrix includes the following information for each action item:

Funding Source

The action items can 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, 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. 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 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 five areas:

- ✓ Protect Life and Property
- ✓ Enhance Public Awareness
- ✓ Preserve Natural Systems
- ✓ Encourage Partnerships and Implementation
- ✓ Strengthen Emergency Services

Q&A | ELEMENT C. MITIGATION STRATEGY | C5

Q: C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

A: See **Priority Ratings** below.

Benefit/Cost Ratings

The benefits of proposed projects were weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

High: Existing jurisdictional funding will not cover the cost of the action item so other sources of revenue would be required.

Medium: The action item could be funded through existing jurisdictional funding but would require budget modifications.

Low: The action item could be funded under existing jurisdictional funding.

Benefit ratings were defined as follows:

High: The action item will provide short-term and long-term impacts on the reduction of risk exposure to life and property.

Medium: The action item will have long-term impacts on the reduction of risk exposure to life and property.

Low: The action item will have only short-term impacts on the reduction of risk exposure to life and property.

Priority Rating

Going beyond rating "benefit and cost", the Planning Team adopted the following process for rating the "priority" of each mitigation action item. Designations of "High", "Medium", and "Low" priority have been assigned to each action item using the following criteria:

Does the Action:

- solve the problem?
- address Vulnerability Assessment?
- reduce the exposure or vulnerability to the highest priority hazard?
- address multiple hazards?
- benefits equal or exceed costs?
- implement a goal, policy, or project identified in the General Plan or Capital Improvement Plan?

Can the Action:

- be implemented with existing funds?
- be implemented by existing state or federal grant programs?
- be completed within the 5-year life cycle of the LHMP?
- be implemented with currently available technologies?

Will the Action:

- be accepted by the community?
- be supported by community leaders?
- adversely impact segments of the population or neighborhoods?
- require a change in local ordinances or zoning laws?
- positive or neutral impact on the environment?
- comply with all local, state and federal environmental laws and regulations?

Is there:

- sufficient staffing to undertake the project?
- existing authority to undertake the project?

As mitigation action items were updated or written the Planning Team, representatives were provided worksheets for each of their assigned action items. Answers to the criteria above determined the priority according to the following scale.

- 1-6 = Low priority
- 7-12 = Medium priority
- 13-18 = High priority

Q&A | ELEMENT C. MITIGATION STRATEGY | C1

Q: C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))

A: See **Mitigation Actions Matrix** below.

Q&A | ELEMENT C. MITIGATION STRATEGY | C4

Q: C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))

A: See **Mitigation Actions Matrix** below.

Q&A | ELEMENT C. MITIGATION STRATEGY | C5

Q: C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))

A: See **Mitigation Actions Matrix** below.

Q&A | ELEMENT D. MITIGATION STRATEGY | D2

Q: D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))

A: See **Mitigation Actions Matrix** below.

Q&A | ELEMENT D. MITIGATION STRATEGY | D3

Q: D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))

A: See **Mitigation Actions Matrix** below.

Mitigation Actions Matrix

Following is **Table: Mitigation Actions Matrix** which identifies the existing and future mitigation activities developed by the Planning Team.

Table: Mitigation Actions Matrix

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
Multi-Hazard Mitigation Action Items													
MH-1 Integrate the goals and action items from the City of Signal Hill Hazard Mitigation Plan into existing regulatory documents and programs, where appropriate.	A, CD, PW	Ongoing	X	X	X	X	X	GF	GF	H	L	H	Revised. Note: updated Safety Element and Ordinances
MH-2 Identify and pursue funding opportunities to develop and implement local mitigation activities.	A, CD, PW	Ongoing	X	X	X			GF	GF	H	L	H	Revised
MH-3 Enhance and implement education programs aimed at	A, PD, CS, PW	Ongoing	X	X		X	X	GF	GR	H	L	H	Revised

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
mitigating natural hazards, and reducing the risk to citizens, public agencies, private property owners, businesses, and schools. Existing programs include CERT, Map Your Neighborhood, and American Red Cross 21 Weeks to Prepare.													
MH-4 Establish policy to ensure mitigation projects are in place to safeguard critical facilities (as identified in the General Plan Safety Element).	PW	1 year	X					GF	GF	H	L	H	Revised
MH-5 Adopt California Building Code.	CD	Ongoing	X					GF	GF	L	L	L	Revised. Note: Adopted every 3 years
MH-6 Develop seismic inventory of at-risk City-owned buildings and infrastructure and prioritize mitigation projects.	PW, CD	2 years	X				X	GR	GR	H	H	H	Revised

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
MH-7 Improve communication between City and County road departments produce strategies to deal with transportation infrastructure..	PW	Ongoing	X			X	X	GR	GR	H	H	H	Revised
MH-8 Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.	PD, PW	Ongoing		X		X	X	GF	GF	M	L	M	Revised
~~MH-9 Compile a directory of out-of-area contractors to help with repairs/reconstruction so that restoration occurs in a timely manner.~~	~~F, PW~~	~~1 year~~					~~X~~						Deleted
~~MH-10 Ensure public utilities serving buildings identified for use as shelters are retrofitted.~~	~~PW~~	~~5 years~~	~~X~~				~~X~~						Deleted

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
MH-11 Install and improve back-up power in city owned critical facilities as cited in the GP Safety Element.	PW	Ongoing					X	GF	GF	H	H	H	Revised. Note: Already installed portable generators at PD, PW, and every traffic signal (2 hours).
MH-12 Continue to encourage the development of mutual aid systems between Signal Hill and surrounding cities for emergency building assessment, CERT training, ect.	PW/PD	Ongoing	X			X	X	GF	GF	H	M	M	Revised. Note: PW mutual aid agreements in place with County of Los Angeles and City of Long Beach.
MH-13 Promote public education and outreach to increase awareness of hazards and opportunities for mitigation. Continue to stock brochures from American Red Cross, FEMA, and Cal OES about preparedness and home mitigation.	PD	Ongoing	X	X				GF	GF	H	M	M	Revised. Note: Very active program in place at City Hall to distribute brochures and other materials relating to preparedness and mitigation.

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
~~MH-14 Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards.~~	~~PD~~	~~1 year~~	~~X~~	~~X~~									Merged with MH-13
MH-15 Distribute information about evacuation route maps.	F CD	1 year	X	X				GF	GF	H	M	M	Revised. Disaster Movement Routes part of updated General Plan Safety Element.
MH-16 Post the Hazard Mitigation Plan on the City's website.	A	Ongoing		X				GF	GF	H	M	M	Revised
~~MH-17 Hold a town-sponsored hazard mitigation seminar for the community residents.~~	~~PD, CS~~	~~1 year~~		~~X~~		~~X~~							Deleted
~~MH-18 Develop City Talk Show about pre-disaster information.~~	~~A, PD~~	~~1 year~~		~~X~~									Deleted

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
MH-19 Maintain primary and alternate Emergency Operations Centers.	PD	Ongoing	X	X			X	GF	GF	H	M	M	Revised. Primary EOC located in the new Police HQ, alternate EOC located at PW Yard.
MH-20 Continue to provide informational literature on animal disaster plans and supply kits.	CS	Ongoing	X	X				GF	GF	H	M	M	Revised. Note: Brochures distributed at City Hall.
MH-21 Encourage the American Red Cross to hold a variety of courses, including: CPR, Basic First Aid, Introduction to Disaster Services, Mass Care, Shelter Operations, babysitting, Healthcare Provider, pet first-aid and others at the Red Cross Office and at other locations throughout the City.	CS	Ongoing	X	X		X	X	GF	GF	M	L	L	Revised

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
~~MH-22 Advertise the availability of emergency management materials on the City's website.~~	~~A~~	~~1.5 years~~	~~X~~	~~X~~	~~X~~		~~X~~						Deleted - redundant
~~MH-23 Educate the public on existing self-help agencies available within the greater community.~~	~~A~~	~~2 years~~		~~X~~									Deleted - redundant
~~MH-24 Partner with other agencies such as Hospitals, County departments, neighboring cities, etc. to include the Website address as a link on their websites.~~	~~A, CS~~	~~1.5 years~~		~~X~~									Deleted - redundant
~~MH-25 The State and County Office of Emergency Services websites have information about disaster preparedness and related links. Expand and update links to those websites as needed and as appropriate.~~	~~A~~	~~1.5 years~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~						Deleted - redundant

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
~~MH-26 Maintain resource center at City Hall. Display rack should include the Emergency Preparedness Guidebook, FEMA's Are You Ready, the Special Needs Survey, brochures on disaster supplies kits and plans, etc.~~	~~CS~~	~~1 year~~		~~X~~									Merged with MH-13
MH-27 Involve Hazard Mitigation Planning Team in review of future updates of the City General Plan or Zoning Ordinance to ensure consideration of threats posed by hazards.	CD	Ongoing	X	X	X		X	GF	GF	M	L	M	Revised
MH-28 Identify and prioritize needs for additional shelter supplies for City employees to include but not limited to additional cots, blankets and shelter kits.	CS	Ongoing	X				X	GF	GF	H	M	M	Revised

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MH-29 Teach CERT classes to interested citizens in the City and CITY employees to assist their neighbors during emergencies. This course will be taught utilizing City staff and resources independent of Los Angeles Co. Fire. Promote CERT through the Chamber of Commerce to gain business participation.	PD	Ongoing	X	X			X	GR	GR	H	H	H	Revised. Note: City on 7th class.
MH-30 Train, law enforcement, public works, CERT members and other support personnel in the Incident Command System.	PD	Ongoing	X	X	X	X	X	GF	GF	M	H	M	Revised
~~MH-31 Promote CERT through the Chamber of Commerce to gain business participation.~~	~~PD~~	~~1 year~~	~~X~~	~~X~~									Merged with MH-29
MH-32 Provide copies of the Hazard Mitigation Plan to the	A	Completed	X		X			n/a	n/a	n/a	n/a	n/a	Revised

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
Community Development Department for their information during new development considerations.													
MH-33 The Community Development Department will review the General Plan to ensure that designated growth areas are not in high hazard areas identified in this plan.	CD	Completed	X		X			n/a	n/a	n/a	n/a	n/a	Revised
MH-34 Review and update all annexes of the City's Emergency Operations Plan. Include participation from all departments and outside providers of emergency services in the update process.	PD	Completed 2016	X	X		X	X	n/a	n/a	n/a	n/a	n/a	Revised
MH-35 Build a new E911 Communications Center or ECC in	PD	Completed 2013					X	n/a	n/a	n/a	n/a	n/a	Revised

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conjunction with the construction of a new VHF-trunked radio system. The new system will feature a combined ECC dispatch facility with a ten (10) workstation design to serve all public safety and local government agencies. The center's operation will be CAD based with Enhanced 9-1-1 interface that includes hard wire and wireless call number and location identification using a GIS/GPS digital mapping component. An optional feature for mobile units will include mobile data transmission capability using mobile mounted laptops to provide rapid access to information critical to most emergency response incidents.													

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MH-36 Ensure that when ECC/911 system upgrade is completed, there is a capability to communicate with all EOC agencies with redundant backups in voice and data communications.	PD	3 years	X				X	GF	GF	H	H	H	Revised
MH-37 Establish an offsite Emergency Communications Center (ECC), alternate Emergency Operations Center (EOC) at Public Works, and purchase and equip Mobile Command Center. In the event the primary sites must be vacated, the off-site back-up centers can be rapidly mobilized in a secured facility. Both centers will duplicate the primary points of operation.	PD	Completed	X				X	n/a	n/a	n/a	n/a	n/a	Revised

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
MH-38 Work with Volunteer Organizations Active in Disasters (VOAD), American Red Cross, and Salvation Army to ensure representation on the EOP Committee.	PD	Completed	X	X		X	X	n/a	n/a	n/a	n/a	n/a	Revised
MH-39 Conduct joint exercise with school district and other special districts located within the City boundaries.	PD	Completed	X	X		X	X	n/a	n/a	n/a	n/a	n/a	Revised. Note: Exercise was with National Guard
MH-40 Ensure that the actions and findings of the LEPC are incorporated into the City EOP and Mitigation Plan updates and revisions.	A	Completed				X		n/a	n/a	n/a	n/a	n/a	Revised
MH-41 Ensure training and exercise standards are maintained (as established in the Standardized Emergency Management System).	PD	Completed	X	X		X	X	n/a	n/a	n/a	n/a	n/a	Revised

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~~MH-42 Identify potential funding sources outside of City Government to continue a program of building and maintaining community partnerships, planning, public awareness and education and disaster mitigation and preparedness.~~	~~A, F~~	~~1 year~~		~~X~~		~~X~~	~~X~~						Deleted
MH-43 Amend job description of Emergency Operations Coordinator to include leading the City's Hazard Mitigation Advisory Committee in developing a sustainable process for implementing, monitoring, and evaluating the mitigation activities.		Ongoing		X	X	X	X	GF	GF	M	M	M	Revised
~~MH-44 Repeat the "Levels of Concern" survey in five years to monitor successes and failures of~~	~~A~~	~~5 years~~		~~X~~	~~X~~	~~X~~	~~X~~						Deleted

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~~natural hazard mitigation programs.~~													
~~MH-45 Develop and complete a baseline survey to gather perceptions of private citizens and the business community regarding natural hazard risks and identify mitigation needs.~~	~~CS~~	~~Done~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted
~~MH-46 Work with Community Planning Organizations (CPOs) and other neighborhood groups to establish a Community Emergency Response Team (CERT).~~	~~PD~~	~~Ongoing~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted - redundant
MH-47 Familiarize City Finance staff of requirements regarding public assistance (disaster cost recovery) following a declared disaster.	F, PD	Ongoing	X	X		X	X	GF	GF	H	L	H	Revised

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MH-48 Identify opportunities for partnering with citizens, private contractors, and other jurisdictions to increase availability of equipment and manpower for efficiency of response efforts.	A	Ongoing	X	X	X	X	X	GF	GF	H	L	H	Revised
~~MH-49 Develop hazard GIS database of all repetitive loss properties in the City to be used in future mitigation activities.~~	~~A, PW~~	~~5 years~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~						Deleted – no repetitive loss properties
~~MH-50 Continue working with the State of California to get updated repetitive loss information on properties in the City, in order to plan future mitigation activities.~~	~~PW, CD~~	~~1 year~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~						Deleted – no repetitive loss properties
MH-51 Enhance weather monitoring to attain earlier severe storm warnings.	PW	Ongoing	X	X	X	X	X	GF	GF	H	L	M	Revised

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MH-52 Routine maintenance of the community's infrastructure will be done to minimize the potential for system failure because of or during a disaster.	PW	Ongoing	X	X	X	X	X	GF	GF	H	L	H	Revised
~~MH-53 Enhance response capability of county fire, city police, and emergency medical services personnel.~~	~~PD~~	~~6 months~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – not mitigation
MH-54 Assess availability of backup power resources (e.g. generators, solar, etc.) of medical facility, nursing homes, and fire, police, rescue, and emergency management personnel; upgrade resources as necessary.	PD	Ongoing	X	X		X	X	GR	GR	H	H	H	Revised
~~MH-55 Develop mitigation strategies to protect identified at-risk historic properties.~~	~~CD~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted

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MH-56 Implement the National Incident Management System (NIMS) in each City department.	PD	Completed	X	X	X	X	X	n/a	n/a	n/a	n/a	n/a	Revised
~~MH-57 Conduct a full review of the Hazard Mitigation Action Plan every 5 years by evaluating mitigation successes, failures, and areas that were not previously addressed.~~	~~A~~	~~5 years~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – already mandated in regulations
~~MH-58 Determine what kinds of minor repairs and temporary protection activities (e.g., temporary roofing, protect against loss of life/injury, shoring, protect contents) can be done in the immediate aftermath of a disaster.~~	~~CD~~	~~1 year~~	~~X~~				~~X~~						Deleted
MH-59 Develop comprehensive all hazards debris management plan.	PW	2 years	X	X	X	X	X	GR	GR	H	H	H	Revised. Note: City prepared a debris management strategy

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													for use in El Nino events.
~~MH-60 Coordinate the maintenance of emergency transportation routes through communication among the county roads department, neighboring jurisdictions, and CalTrans.~~	~~PW~~	~~2 years~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – already addressed in the Safety Element's Disaster Movement Routes.
~~MH-61 Encourage interested individuals to participate in hazard mitigation planning and training activities.~~	~~PD, CS~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted
~~MH-62 Monitor and publicize the effectiveness of mitigation initiatives implemented in the community.~~	~~A~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted
~~MH-63 Educate the public about procedures for reporting human-caused incidents.~~	~~PD~~	~~18 months~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted

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~~MH-64 Educate the public about emergency sheltering and evacuation procedures.~~	~~PD~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted - redundant
MH-65 Educate the public about hazards prevalent to their area utilizing Map Your Neighborhood.	PD, A	Ongoing		X		X		GF	GF	H	L	H	Revised
MH-66 Purchased and trained EOC staff on Veoci – an emergency management software program.	PD	Completed	X		X	X	X	n/a	n/a	n/a	n/a	n/a	New
MH-67 Establish agreements with vendors for use of services, equipment, and/or facilities following a disaster.	F, PD	1 year	X	X	X	X	X	GF	GF	H	L	M	New. Note: Already established Memorandum of Understanding with trash hauler EDCO for City to have access to trucks and other equipment following a disaster.

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MH-68 Identify funding sources for structural and non-structural retrofitting of City-owned structures that are identified as vulnerable to seismic, flooding, and other hazards.	PW	1 year	X	X	X	X	X	GR	GR	H	H	H	New. Moved and revised from Earthquake action items.
MH-69 Encourage purchase of hazard insurances including earthquake and flood.	A	1 year		X		X		GF	GF	H	L	M	Revised
MH-70 Secure grant funding to conduct traffic study and engineering report on impact of hazardous material related heavy equipment movement on city street infrastructure.	CD/PW	3 years	X		X		X	GR	GR	H	M	H	New
MH-71 Secure grant funding for city based CERT training program and ongoing equipment procurement.	PD	3 years	X	X		X	X	GR	GR	H	H	H	New

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Earthquake Mitigation Action Items													
~~EQ-1 Incorporate the Regional Earthquake Transportation Evacuation Routes developed by the Regional Emergency Managers Group into appropriate planning documents.~~	~~PW~~	~~5 years~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – already addressed in updated Safety Element.
~~EQ-2 Identify funding sources for structural and nonstructural retrofitting of structures that are identified as seismically vulnerable.~~	~~CD, A~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – moved to Multi-Hazard action items.
~~EQ-3 Encourage seismic strength evaluations of critical facilities in the City to identify vulnerabilities for mitigation of schools and university, public infrastructure, and critical facilities to meet current seismic standards.~~	~~CD, PW~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted – no authority over non-City-owned properties.

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EQ-4 Encourage reduction of non-structural and structural earthquake hazards in homes, schools, and businesses.	CD	Ongoing	X	X		X	X	GF	GF	H	L	M	Revised
~~EQ-5 Minimize earthquake damage risk by retrofitting critical facilities.~~	~~PW~~	~~1 year~~	~~X~~	~~X~~		~~X~~	~~X~~						Deleted - redundant
EQ-6 Encourage purchase of earthquake hazard insurance.	A	1 year		X		X							Deleted – Revised action item and moved to Multi-Hazard
EQ-7 As updates become available, integrate new earthquake hazard mapping data for the City and improve technical analysis of earthquake hazards.	CD	Ongoing		X		X	X	GR	GR	H	H	H	Revised. Note: City stays updated with each seismic study submitted on development projects as well as updates from the State of California. Also,

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													General Plan Safety Element is being updated.
EQ-8 Secure grant funding for updated Technical Background Report associated with the General Plan Safety Element.	CD	5 years	X	X	X		X	GR	GR	H	H	H	New
Landslide Mitigation Action Items													
LS-1 Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.	BS	Ongoing	X	X	X	X	X	GF	GF	H	H	H	Revised
LS-2 Encourage construction and subdivision design that can be applied to steep slopes to reduce the potential adverse impacts from development	BS	Ongoing	X					GF	GF	M	M	M	Revised

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~~LS-3 Identify safe evacuation routes in high-risk debris flow and landslide areas.~~	~~CD~~	~~6 months~~	~~X~~		~~X~~	~~X~~	~~X~~						Deleted
~~LS-4 Investigate landslide warning systems to ensure effectiveness and efficiency and increase coordination between local jurisdictions and the state for landslide warning systems.~~	~~CD~~	~~6 months~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~						Deleted
LS-5 Limit activities in identified potential and historical landslide areas through regulation and public outreach.	CD	Ongoing	X	X	X	X	X	GF	GF	H	L	M	Revised
Windstorm Mitigation Action Items													
WS-1 Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.	PW	Ongoing	X	X			X	GF	GF	H	L	M	Revised

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WS-2 Monitor trees and branches in public areas at risk of breaking or falling in wind and sand storms. Prune or thin trees or branches when they would pose an immediate threat to property, utility lines or other significant structures or critical facilities in the community.	PW	Annual	X	X	X		X	GF	GF	M	M	M	Revised
Drought Mitigation Action Items													
DR-1 Distribute information to all property owners and renters on the importance of water conservation and different venues of purchasing water saving mechanisms for homes and businesses.	PW	Ongoing		X	X			GF	GF	H	L	M	Revised
~~DR-2 Develop public education program on water conservation~~	~~PW~~	~~1 year~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~						Deleted

Mitigation Action Item	Coordinating Agency A-Administration, CD-Community Development, CS-Community Services, PW-Public Works, F-Finance, BS-Building Safety	Timeline	Goal: Protect Life and Property	Goal: Public Awareness	Goal: Natural Systems	Goal: Partnerships and Implementation	Goal: Emergency Services	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: L-Low, M-Medium, H-High	Cost: L-Low, M-Medium, H-High	Priority: L-Low, M-Medium, H-High	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
~~techniques for homes and businesses.~~													
DR-3 Investigate possibility of extending (deepening) existing water wells.	PW	Completed	X			X	X	n/a	n/a	n/a	n/a	n/a	Revised. Note: Well was dug in 2008 and expected to be operational in 2016.
DR-4 Identify water resources management and conservation opportunities.	PW	Ongoing	X	X	X	X	X	GF	GF	H	L	H	Revised
DR-5 Implement use of recycled water to supplement imported/local water sources.	PW	Ongoing	X	X	X	X	X	GF	GF	H	M	H	Revised. Note: Already completed first phase of reclaimed water system.
DR-6 Practice water conservation by building demonstration gardens and retrofit public parks.	PW	Ongoing	X	X	X	X	X	GF	GF	H	M	H	New
DR-7 Write 20X2020 Water Conservation Plan.	PW	1 year	X	X	X	X	X	GF	GF	H	M	H	New

Plan Maintenance

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.

Q&A | ELEMENT A: PLANNING PROCESS | A6

Q: A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))

A: See **Method and Scheduling of Plan Implementation** below.

Method and Scheduling of Plan Implementation

The Planning Team that was involved in research and writing of the Plan will also be responsible for implementation. The Planning Team will be led by the Chair of the Planning Team and will be referred to as the Local Mitigation Officer.

	Year 1	Year 2	Year 3	Year 4	Year 5
Monitoring	X	X	X	X	X
Evaluating					X
Internal Planning Team Evaluation	X	X	X	X	X
Cal OES and FEMA Evaluation					X
Updating					X

Monitoring and Implementing the Plan

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

The City Council will be responsible for adopting the Mitigation Plan. This governing body has the authority to promote sound public policy regarding hazards. Once the plan has been adopted, the Local Mitigation Officer will be responsible for submitting it to the State Hazard Mitigation Officer at California Emergency Management Agency (Cal OES). Cal OES will then submit the plan to the Federal Emergency Management Agency (FEMA) for review and approval. This review will address the requirements set forth in 44 C.F.R. Section 201.6 (Local Mitigation Plans). Upon acceptance by FEMA, City of Signal Hill will gain eligibility for Hazard Mitigation Grant Program funds.

Local Mitigation Officer

Under the direction of the Local Mitigation Officer, the Planning Team will take responsibility for plan maintenance and implementation. The Local Mitigation Officer will facilitate the Planning Team meetings and will assign tasks such as updating and presenting the Plan to the members of the Planning Team. Plan implementation and evaluation will be a shared responsibility among all of the Planning Team members. The Local Mitigation Officer will coordinate with City leadership to ensure funding for 5-year updates to Plan as required by FEMA.

The Planning Team will be responsible for coordinating implementation of plan action items and undertaking the formal review process. The Local Mitigation Officer will be authorized to make changes in assignments to the current Planning Team.

The Planning Team will meet no less than quarterly. Meeting dates will be scheduled once the final Planning Team 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.

Q&A | ELEMENT C. MITIGATION STRATEGY | C6

Q: C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))

A: See **Implementation through Existing Program** below.

Implementation through Existing Programs

The City of Signal Hill addresses statewide planning goals and legislative requirements through its General Plan, its Capital Improvement Plan, and California Building and Safety Codes. The 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 Signal Hill will implement recommended mitigation action items through existing programs and procedures.

The City of Signal Hill Building Safety Department is responsible for adhering to the State of California's Building and Safety Codes. In addition, the Planning Team will work with other agencies at the state level to review, develop and ensure Building and Safety Codes are adequate to mitigate or present damage by hazards. This is to ensure that life-safety criteria are met for new construction.

Some of the goals and action items in the Mitigation Plan will be achieved through activities recommended in the CIP. Various City departments develop the CIP and review it on an annual basis. Upon annual review of the CIP, the Planning Team will work with the City departments to identify areas that the Mitigation Plan action items are consistent with CIP goals and integrate them where appropriate.

Upon FEMA approval, the Planning Team will begin the process of incorporating existing planning mechanisms at the City level. The meetings of the Planning Team will provide an opportunity for Planning Team 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

FEMA's approach to identify the costs and benefits associated with 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.

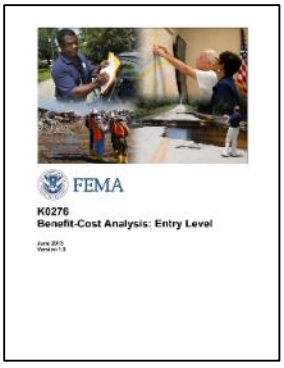
Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating hazards can provide decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to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

Given federal funding, the Planning Team will use a FEMA-approved benefit/cost analysis approach to identify and prioritize mitigation action items. For other projects and funding sources, the Planning Team will use other approaches to understand the costs and benefits of each action item and develop a prioritized list.

The "benefit" and "cost" of each mitigation action item was included in the Mitigation Actions Matrix located in Part III: Mitigation Strategies. A more technical assessment will be required in the event grant funding is pursued through the Hazard Mitigation Grant Program. FEMA Benefit-Cost Analysis Guidelines are discussed below.

FEMA Benefit-Cost Analysis Guidelines

The Stafford Act authorizes the President to establish a program to provide technical and financial assistance to state and local governments to assist in the implementation of hazard mitigation measures that are cost effective and designed to substantially reduce injuries, loss of life, hardship, or the risk of future damage and destruction of property. To evaluate proposed hazard mitigation projects prior to funding FEMA requires a Benefit-Cost Analysis (BCA) to validate cost effectiveness. BCA is the method by which the future benefits of a mitigation project are estimated and compared to its cost. The end result is a benefit-cost ratio (BCR), which is derived from a project's total net benefits divided by its total project cost. The BCR is a numerical expression of the cost effectiveness of a project. A project is considered to be cost effective when the BCR is 1.0 or greater, indicating the benefits of a prospective hazard mitigation project are sufficient to justify the costs.



Although the preparation of a BCA is a technical process, FEMA has developed software, written materials, and training to support the effort and assist with estimating the expected future benefits over the useful life of a retrofit project. It is imperative to conduct a BCA early in the project development process to ensure the likelihood of meeting the cost-effective eligibility requirement in the Stafford Act.

The BCA program consists of guidelines, methodologies and software modules for a range of major natural hazards including:

- ✓ Flood (Riverine, Coastal Zone A, Coastal Zone V)
- ✓ Hurricane Wind
- ✓ Hurricane Safe Room

- ✓ Damage-Frequency Assessment
- ✓ Tornado Safe Room
- ✓ Earthquake
- ✓ Wildfire

The BCA program provides up to date program data, up to date default and standard values, user manuals and training. Overall, the program makes it easier for users and evaluators to conduct and review BCAs and to address multiple buildings and hazards in a single BCA module run.

Q&A | ELEMENT A: PLANNING PROCESS | A6

Q: A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))

A: See **Evaluating and Updating the Plan** below.

Evaluating and Updating the Plan

Formal Review Process

The 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 Local Mitigation Officer or designee will be responsible for contacting the Planning Team members and organizing the annual meeting. Planning Team members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan.

The Planning Team 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 Planning Team will also review the **Risk Assessment** portion of the Plan to determine if this information should be updated or modified, given any new available data. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised.

The Local Mitigation Officer will assign the duty of updating the Plan to one or more of the Planning Team members. The designated Planning Team members will have three months to make appropriate changes to the Plan before submitting it to the Planning Team members. The Planning Team 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 at the California Office of Emergency Services and the Federal Emergency Management Agency for review.

At each of the quarterly Planning Team meetings, the Local Mitigation Officer will facilitate a discussion on each section of the FEMA-approved Plan:

Planning Process – Update as necessary, including regulatory changes.

Risk Assessment - Determine if this information should be updated or modified, given any new available data.

Mitigation Strategies - 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. Most importantly, is the thorough review of the Mitigation Action Matrix. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised.

Item Identifier	Action Item and Ideas for Implementation	Coordinating Agency	Timeline	Plan Goals Addressed	Protect Life and Property	Public Awareness	Natural Systems	Emergency Services	Partnerships and Implementation	Funding Source: GF- General Fund, GR-Grant	Planning Mechanism: GP-General Plan, CIP, GF-General Fund, GR-Grant	Benefit: (Low | Medium | High)	Cost: (Low | Medium | High)	Priority: (Low | Medium | High)	2016 Comments and Status - Completed, Revised, Deleted, New, Deferred, and Notes
MULTI-HAZARD ACTION ITEMS															
EARTHQUAKE ACTION ITEMS															

The Local Mitigation Officer will assign the duty of updating the Plan to one or more of the Planning Team members. The designated Planning Team members will have three months to make appropriate changes to the Plan before submitting it to the Planning Team members. The Planning Team 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 at the California Office of Emergency Services and the Federal Emergency Management Agency for review and approval.

Q&A | ELEMENT A: PLANNING PROCESS | A5

Q: A5. Is there discussion of how the community will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))

A: See **Continued Public Involvement** below.

Continued Public Involvement

The City of Signal Hill is dedicated to involving the public directly in the continual review and updates to the Mitigation Plan. Copies of the plan will be catalogued and made available at City Hall and at all City operated public libraries. The existence and location of these copies will be publicized in City newsletters and on the City website. This site will also contain an email address and phone number where people can direct their comments and concerns. A public meeting will also be held after each evaluation or when deemed necessary by the Planning Team. The meetings will provide the public a forum in which they can express their concerns, opinions, or ideas about the Plan.

The Local Mitigation Officer will be responsible for using City resources to publicize the annual public meetings and maintain public involvement through the public access channel, web page, and newspapers.

PART IV: APPENDIX

General Hazard Overviews

Earthquake Hazards

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 ground motion with a peak ground acceleration of 100%g is very severe. Peak Ground Acceleration (PGA) is a measure of the strength of ground motion. 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.

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.

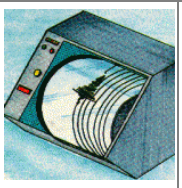
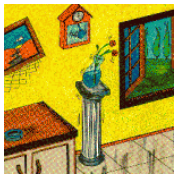
Another tool used to describe earthquake intensity is the Magnitude Scale. The Magnitude Scale is sometimes referred to as the Richter Scale. The two are similar but not exactly the same. The Magnitude Scale was devised as a means of rating earthquake strength and is an indirect measure of seismic energy 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.

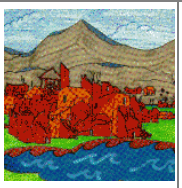
An earthquake generates different types of seismic shock waves that travel outward from the focus or point of rupture on a fault. Seismic waves that travel through the earth's crust are called body waves and are divided into primary (P) and secondary (S) waves. Because P waves move faster (1.7 times) 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 magnitude for the earthquake.

The duration of an earthquake is related to its magnitude but not in a perfectly strict sense. There are two ways to think about the duration of an earthquake. The first is the length of time it takes for the fault to rupture and the second is the length of time shaking is felt at any given point (e.g. when someone says "I felt it shake for 10 seconds" they are making a statement about the duration of shaking). (Source: www.usgs.gov)

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. The Modified Mercalli Intensity Scale below rates the level of severity of an earthquake by the amount of damage and perceived shaking.

Table: Modified Mercalli Intensity Scale

	MMI Value	Description of Shaking Severity	Summary Damage Description Used on 1995 Maps	Full Description
	I			Not Felt
	II			Felt by persons at rest, on upper floors, or favorably placed.
	III			Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.
	IV			Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motorcars rock. Windows, dishes, doors rattle. In the upper range of IV, wooden walls and frame creak.
	V	Light	Pictures Move	Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clock stop, start, change rate.

	MMI Value	Description of Shaking Severity	Summary Damage Description Used on 1995 Maps	Full Description
	VI	Moderate	Objects Fall	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked.
	VII	Strong	Nonstructural Damage	Difficult to stand. Noticed by drivers of motorcars. Hanging objects quiver. Furniture broken. Damage to masonry, including cracks. Weak chimneys broken at roofline. Fall of plaster, loose bricks, stones, tiles, cornices. Some cracks in masonry C. Small slides and caving in along sand or gravel banks. Concrete irrigation ditches damaged.
	VIII	Very Strong	Moderate Damage	Steering of motorcars affected. Damage to masonry C, partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, and elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Cracks in wet ground and on steep slopes.
	IX	Violent	Heavy damage	General panic. Damage to masonry buildings ranges from collapse to serious damage unless modern design. Wood-frame structures rack, and, if not bolted, shifted off foundations. Underground pipes broken.
	X	Very Violent	Extreme Damage	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land.
	XI			Rails bent greatly. Underground pipelines completely out of services.

	MMI Value	Description of Shaking Severity	Summary Damage Description Used on 1995 Maps	Full Description
	XII			Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into air.

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.

Seismic activity along nearby or more distant fault zones are likely to cause ground shaking within the City limits.

Earthquake-Induced Landslide Potential

Generally, these types of failures consist of rock falls, disrupted soil slides, rock slides, soil lateral spreads, soil slumps, soil block slides, and soil avalanches. Areas having the potential for earthquake-induced landslides generally occur in areas of previous landslide movement, or where local topographic, geological, geotechnical, and subsurface water conditions indicate a potential for permanent ground displacements.

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 structures. Liquefaction generally occurs during significant earthquake activity, and structures located on soils such as silt or sand may experience significant damage during an earthquake due to the instability of structural foundations and the moving earth. Many communities in Southern California are built on ancient river bottoms and have sandy soil. In some cases, the soil may be subject to liquefaction, depending on the depth of the water table.

Landslide Hazards

Hazard Characteristics

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 a significant number of locations impacted by landslides. Some landslides result in private property damage; other landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life.

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

The primary effects of mudslides/landslides include: abrupt depression and lateral displacement of hillside surfaces over distances of up to several hundreds of feet, disruption of surface drainage, blockage of flood control channels and roadways, displacement or destruction of improvements such as roadways, buildings, and water wells.

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 50-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, ten 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 Dollars) 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 eight inches of rain fell in a six-hour period in many locations. Records and personal observations in the field on February 16 and 17 showed that the mountains and slopes literally fell apart on those two days.

1983 San Clemente, 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 km^2. 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 two years before.

January 2005 Ventura County

On January 10, 2005, a landslide once again struck the community of La Conchita, killing ten 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 are initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by human-caused construction activities, or any combination of these factors. Landslides also occur underwater, causing tidal waves and damage to coastal areas. These landslides are called submarine landslides."

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

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides occur on relatively gentle slopes and 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 move with speeds greater than 20 miles per hour, and often move much faster. This high rate of speed makes debris flows extremely dangerous to people and property in its path.

Areas Particularly Susceptible to Landslides

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

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

Excavation and Grading

Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes results in slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes are at an increased risk for landslides.

The added weight of fill placed on slopes also results in an increased landslide hazard. Small landslides are 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 increases landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as does water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations results in damaging landslides. Ineffective storm water management and excess runoff also cause erosion, and increase the risk of landslide hazards. Drainage is 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 redirects water to other areas. Channels, streams, ponding, and erosion on slopes indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities concentrates and accelerates flow. Ground saturation and concentrated velocity flow are major causes of slope problems and triggers landslides.

Changes in Vegetation

Removing vegetation from very steep slopes increases 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 require constant watering to remain green. Changing away from native ground cover plants increases the risk of landslide.

Windstorm Hazards

Hazard Characteristics

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

Santa Ana winds commonly occur between October and February, with December having the highest frequency of events. Summer events are rare. Wind speeds are typically north to east at 35 knots through and below passes, and canyons with gusts to 50 knots. Stronger Santa Ana winds has gusts greater than 60 knots over widespread areas, and gusts greater than 100 knots in favored areas. Frequently, the strongest winds in the basin occur during the night and morning hours due to the absence of a sea breeze. The sea breeze which typically blows onshore daily, can moderate the Santa Ana winds during the late morning and afternoon hours. Santa Ana winds are an important forecast challenge because of the high fire danger associated with them. Also, unusually high surf conditions on the northeast side of the Channel Islands normally accompany a Santa Ana event.

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

Table: Beaufort Scale
(Source : NOAA Storm Center)

Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
0	Less 1	Calm - Mirror-like - Smoke rises vertically
1	1-3	Light - Air Ripples look like scales; No crests of foam - Smoke drift shows direction of wind, but wind vanes do not
2	4-7	Light Breeze - Small but pronounced wavelets; Crests do not break - Wind vanes move; Leaves rustle; You can feel wind on the face
3	8-12	Gentle Breeze - Large Wavelets; Crests break; Glassy foam; A few whitecaps - Leaves and small twigs move constantly; Small, light flags are extended
4	13-18	Moderate Breeze - Longer waves; Whitecaps - Wind lifts dust and loose paper; Small branches move
5	19-24	Fresh Breeze - Moderate, long waves; Many whitecaps; Some spray - Small trees with leaves begin to move

Beaufort Force	Speed (mph)	Wind Description - State of Sea - Effects on Land
6	25-31	Strong Breeze - Some large waves; Crests of white foam; Spray - Large branches move; Telegraph wires whistle; Hard to hold umbrellas
7	32-38	Near Gale - White foam from breaking waves blows in streaks with the wind - Whole trees move; Resistance felt walking into wind
8	39-46	Gale - Waves high and moderately long; Crests break into spin drift, blowing foam in well-marked streaks - Twigs and small branches break off trees; Difficult to walk
9	47-54	Strong Gale - High waves with wave crests that tumble; Dense streaks of foam in wind; Poor visibility from spray - Slight structural damage
10	55-63	Storm - Very high waves with long, curling crests; Sea surface appears white from blowing foam; Heavy tumbling of sea; Poor visibility - Trees broken or uprooted; Considerable structural damage
11	64-73	Violent Storm - Waves high enough to hide small and medium sized ships; Sea covered with patches of white foam; Edges of wave crests blown into froth; Poor visibility - Seldom experienced inland; Considerable structural damage
12	>74	Hurricane - Sea white with spray. Foam and spray render visibility almost non-existent - Widespread damage. Very rarely experienced on land.

Santa Ana Winds and Tornado-Like Wind Activity

Based on local history, most incidents of high wind in the City of Signal Hill are the result of the Santa Ana and El Niño related wind conditions. While high impact wind incidents are not frequent in the area, significant wind events and sporadic tornado activity have been known to negatively impact the City. In addition, the City is increasingly concerned with “global warming” ramifications and potential increases in wind related events.

What are Santa Ana Winds?

“Santa Ana winds are generally defined as warm, dry winds that blow from the east or northeast (offshore). These winds occur below the passes and canyons of the coastal ranges of Southern California and in the Los Angeles and Orange County basins. Santa Ana winds often blow with exceptional speed in the Santa Ana Canyon (the canyon from which it derives its name). Forecasters at the National Weather Service offices in Oxnard and San Diego usually place speed minimums on these winds and reserve the use of "Santa Ana" for winds greater than 25 knots.” These winds accelerate to speeds of 35 knots as they move through canyons and passes, with gusts to 50 or even 60 knots.

“The complex topography of Southern California combined with various atmospheric conditions create numerous scenarios that may cause widespread or isolated Santa Ana events. Commonly, Santa Ana winds develop when a region of high pressure builds over the Great Basin (the high plateau east of the Sierra Mountains and west of the Rocky Mountains including most of Nevada and Utah). Clockwise circulation around the center of this high pressure area forces air downslope from the high plateau. The air warms as it descends toward the California coast at the rate of five degrees F per 1,000 feet due to compressional heating. Thus, compressional heating provides the primary source of warming. The air is dry since it originated in the desert, and it dries out even more as it is heated.”

These regional winds typically occur from October to March, and, according to most accounts are named either for the Santa Ana River Valley where they originate, or for the Santa Ana Canyon, southeast of Los Angeles, where they pick up speed.

What are Tornados?

Tornadoes are spawned when there is warm, moist air near the ground, cool air aloft, and winds that speed up and change direction. An obstruction, such as a house, in the path of the wind causes it to change direction. This change increases pressure on parts of the house, and the combination of increased pressures and fluctuating wind speeds creates stresses that frequently cause structural failures.

In order to measure the intensity and wind strength of a tornado, Dr. T. Theodore Fujita developed the Fujita Tornado Damage Scale. This scale compares the estimated wind velocity with the corresponding amount of suspected damage. The scale measures six classifications of tornadoes with increasing magnitude from an "F0" tornado to a "F6+" tornado.

Table: Fujita Tornado Damage Scale
(Source: NOAA Storm Prediction Center)

Scale	Wind Estimated (mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys and TV antennas; breaks twigs off trees; pushes over shallow-rooted trees.
F1	73-112	Moderate damage. Peels surface off roofs; windows broken; light trailer houses pushed or overturned; some trees uprooted or snapped; moving automobiles pushed off the road. 74 mph is the beginning of hurricane wind speed.
F2	113-157	Considerable damage. Roofs torn off frame houses leaving strong upright walls; weak buildings in rural areas demolished; trailer houses destroyed; large trees snapped or uprooted; railroad boxcars pushed over; light object missiles generated; cars blown off highway.
F3	158-206	Severe damage. Roofs and some walls torn off frame houses; some rural buildings completely demolished; trains overturned; steel-framed hangar-warehouse-type structures torn; cars lifted off the ground; most trees in a forest uprooted snapped, or leveled.
F4	207-260	Devastating damage. Whole frame houses leveled, leaving piles of debris; steel structures badly damaged; trees debarked by small flying debris; cars and trains thrown some distances or rolled considerable distances; large missiles generated.
F5	261-318	Incredible damage. Whole frame houses tossed off foundations; steel-reinforced concrete structures badly damaged; automobile-sized missiles generated; trees debarked; incredible phenomena can occur.
F6-F12	319 to sonic	Inconceivable damage. Should a tornado with the maximum wind speed in excess of F5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc. will create serious secondary damage on structures.

Microbursts

Unlike tornados, microbursts are strong, damaging winds which strike the ground and often give the impression a tornado has struck. They frequently occur during intense thunderstorms. The origin of a microburst is downward moving air from a thunderstorm's core. But unlike a tornado, they affect only a rather small area. University of Chicago storm researcher Dr. Ted Fujita first coined the term "downburst" to describe strong, downdraft winds flowing out of a thunderstorm cell that he believed were responsible for the crash of Eastern Airlines Flight 66 in June of 1975.

A downburst is a straight-direction surface wind in excess of 39 mph caused by a small-scale, strong downdraft from the base of convective thundershowers and thunderstorms. In later investigations into the phenomena he defined two sub-categories of downbursts: the larger macrobursts and small microbursts.

Macrobursts are downbursts with winds up to 117 mph which spread across a path greater than 2.5 miles wide at the surface and which last from five to 30 minutes. The microburst, on the other hand is confined to an even smaller area, less than 2.5 miles in diameter from the initial point of downdraft impact. An intense microburst can result in damaging winds near 270 km/hr (170 mph) and often last for less than five minutes.

Downbursts of all sizes descend from the upper regions of severe thunderstorms when the air accelerates downward through either exceptionally strong evaporative cooling or by very heavy rain which drags dry air down with it. When the rapidly descending air strikes the ground, it spreads outward in all directions, like a fast-running faucet stream hitting the sink bottom.

When the microburst wind hits an object on the ground such as a house, garage or tree, it can flatten the buildings, and strip limbs and branches from the tree. After striking the ground, the powerful outward running gust can wreak further havoc along its path. Damage associated with a microburst is often mistaken for the work of a tornado, particularly directly under the microburst. However, damage patterns away from the impact area are characteristic of straight-line winds rather than the twisted pattern of tornado damage."

Tornados, like those that occur every year in the Midwest and Southeast parts of the United States, are a rare phenomenon in most of California, with most tornado-like activity coming from micro-bursts.

What is Susceptible to Windstorms?

Life and Property

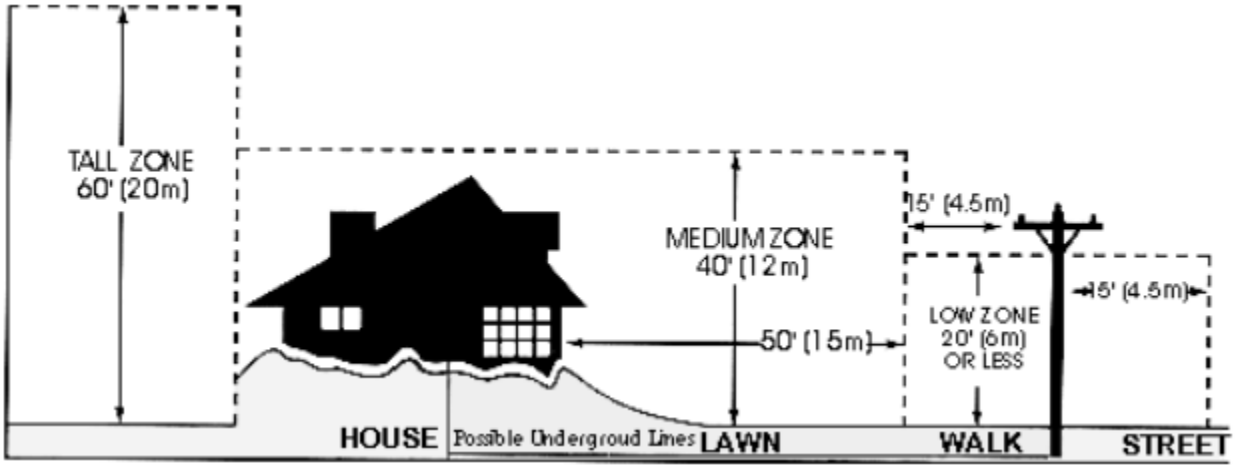
Based on the history of the region, windstorm events can be expected, perhaps annually, across widespread areas of the region which can be adversely impacted during a windstorm event. This can result in the involvement of City emergency response personnel during a wide-ranging windstorm or microburst tornadic activity. Both residential and commercial structures with weak reinforcement are susceptible to damage. Wind pressure creates a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents creates lift

suction forces that pull building components and surfaces outward. With extreme wind forces, the roof or entire building can fail causing considerable damage.

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

Utilities

Historically, falling trees are the major cause of power outages in the region. Windstorms such as strong microbursts and Santa Ana Wind conditions cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet, overhead power lines are damaged, even in relatively minor windstorm events. Falling trees bring electric power lines down to the pavement, creating the possibility of lethal electric shock.



Infrastructure

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

Increased Fire Threat

Perhaps the greatest danger from windstorm activity in Southern California comes from the combination of the Santa Ana winds with the major fires that occur every few years in the urban/wildland interface. With the Santa Ana winds driving the flames, the speed and reach of the flames is even greater than in times of calm wind conditions.

Transportation

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

Drought Hazards

Hazard Characteristics

Definition

Drought is defined as a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration (i.e., evaporation + transpiration) in a particular area, a condition often perceived as "normal". It is also related to the timing (e.g., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (e.g., rainfall intensity, number of rainfall events). Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity. Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this "natural" hazard.

One dry year does not normally constitute a drought in California, but serves as a reminder of the need to plan for droughts. California's extensive system of water supply infrastructure - its reservoirs, groundwater basins, and inter-regional conveyance facilities - mitigates the effect of short-term dry periods for most water users. Defining when a drought begins is a function of drought impacts to water users. Hydrologic conditions constituting a drought for water users in one location may not constitute a drought for water users elsewhere, or for water users having a different water supply. Individual water suppliers may use criteria such as rainfall/runoff, amount of water in storage, or expected supply from a water wholesaler to define their water supply conditions.

Many governmental utilities, the National Oceanic and Atmospheric Administration (NOAA), and the California Department of Water Resources, as well as academic institutions such as the University of Nebraska-Lincoln's National Drought Mitigation Center and the National Drought Mitigation Center, generally agree that there is no clear definition of drought. Drought is highly variable depending on location.

Drought Threat

The region’s Mediterranean climate makes it especially susceptible to variations in rainfall. Severe water shortages could have a bearing on the economic well-being of the community. Comparison of climate (rainfall) records from Los Angeles with water well records beginning in 1930 from the San Gabriel Valley indicates the existence of wet and dry cycles on a 10-year scale as well as for much longer periods. The climate record for the Los Angeles region beginning in 1890 suggests drying conditions over the last century. With respect to the present day, climate data also suggests that the last significant wet period was the 1940s. Well level data and other sources seem to indicate the historic high groundwater levels (reflecting recharge from rainfall) occurred in the same decade. Since that time, rainfall (and groundwater level trends) appears to be in decline. This slight declining trend, however, is not believed to be significant. Climatologists compiled rainfall data from 96 stations in the State that spanned a 100-year period between 1890 and 1990. An interesting note is that during the first 50 years of the reporting period, there was

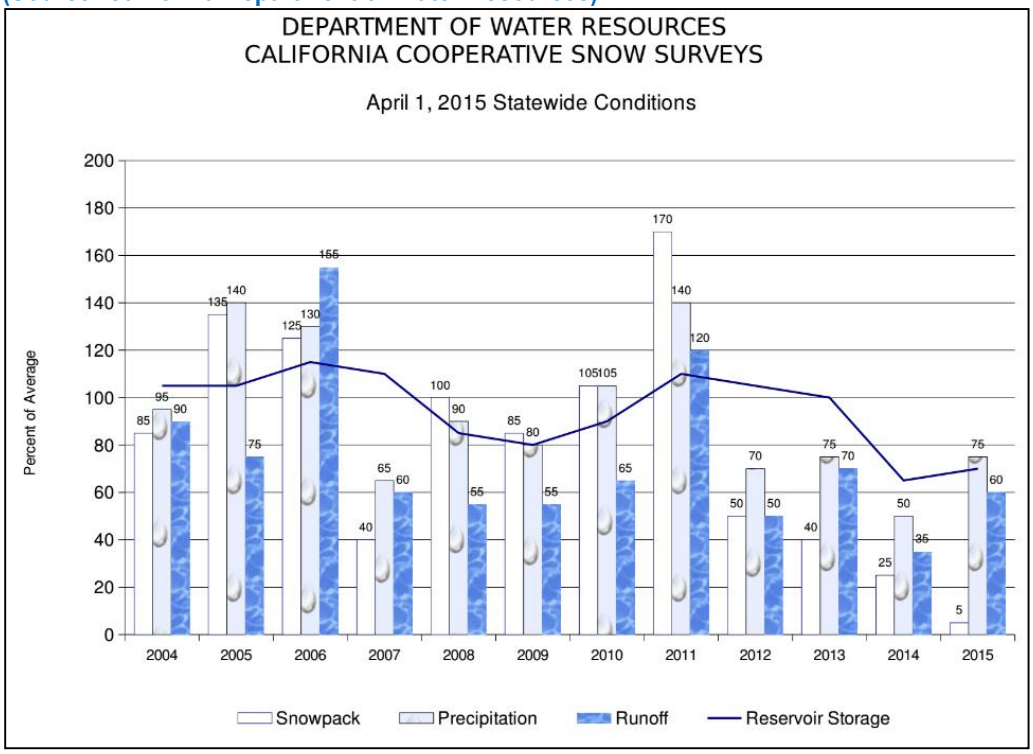
only one year (1890) that had more than 35 inches of rainfall, whereas the second 50-year period recording of 5 year intervals (1941, 1958, 1978, 1982, and 1983) that exceeded 35 inches of rainfall in a single year. The year of maximum rainfall was 1890 when the average annual rainfall was 43.11 inches. The second wettest year on record occurred in 1983 when the State's average was 42.75 inches.

The driest year of the 100-year reported in the study was 1924 when the State's average rainfall was only 10.50 inches. The region with the most stations reporting the driest year in 1924 was the San Francisco Bay area. The second driest year was 1977 when the average was 11.57 inches. The most recent major drought (1987 to 1990) occurred at the end of a sequence of very wet years (1978 to 1983). The debate continues whether "global warming" is occurring, and the degree to which global climate change will have an effect on local micro-climates. The semi-arid southwest is particularly susceptible to variations in rainfall. A study that documented annual precipitation for California since 1600 from reconstructed tree ring data indicates that there was a prolonged dry spell from about 1755 to 1820 in California. Fluctuations in precipitation could contribute indirectly to a number of hazards including wildfire and the availability of water supplies.

General Situation

Figure: Water Supply Conditions below illustrates several indicators commonly used to evaluate California water conditions. The percent of average values are determined for measurement sites and reservoirs in each of the State's ten major hydrologic regions. Snow pack is an important indicator of runoff from Sierra Nevada watersheds, the source of much of California's developed water supply.

Figure: Water Supply Conditions
(Source: California Department of Water Resources)



Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or forest fires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multiyear period. There is no universal definition of when a drought begins or ends.

Types of Drought

There are four different ways that drought can be defined:
(1) Meteorological - a measure of departure of precipitation from normal. Due to climatic differences what is considered a drought in one location may not be a drought in another location.
(2) Agricultural - refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop.
(3) Hydrological - occurs when surface and subsurface water supplies are below normal.
(4) Socioeconomic - refers to the situation that occurs when physical water shortage begins to affect people.

Historical California Droughts

A significant drought, reported by many of the ranchers in southern California, occurred in 1860. The great drought of the 1930s, coined the "Dust Bowl," was geographically centered in the Great Plains yet ultimately affected water shortages in California. The drought conditions in the plains resulted in a large influx of people to the west coast. Approximately 350,000 people from Arkansas and Oklahoma immigrated mainly to the Great Valley of California. As more people moved into California, including Los Angeles County increases in intensive agriculture led to overuse of the Santa Ana River watershed and groundwater resulting in regional water shortages. Several bills have been introduced into Congress in an effort to mitigate the effects of drought. In 1998, President Clinton signed into law the National Drought Policy Act, which called for the development of a national drought policy or framework that integrates actions and responsibilities among all levels of government. In addition, it established the National Drought Policy Commission to provide advice and recommendations on the creation of an integrated federal policy. The most recent bill introduced into Congress was the National Drought Preparedness Act of 2003, which established a comprehensive national drought policy and statutorily authorized a lead federal utility for drought assistance. Currently there exists only an ad-hoc response approach to drought unlike other disasters (e.g., hurricanes, floods, and tornadoes) which are under the purview of FEMA.

Droughts exceeding three years are relatively rare in Northern California, the source of much of the State's developed water supply. The 1929-34 droughts established the criteria commonly used in designing storage capacity and yield of large Northern California reservoirs. The driest single year of California's measured hydrologic record was 1977. According to USGS, California's most recent multi-year droughts occurred between 1987-92, 2006-2010 and 2012-2016.

The Long-term Climatic Viewpoint

The historical record of California hydrology is brief in comparison to geologically modern climatic conditions. The following sampling of changes in climatic conditions over time helps put California's twentieth century droughts into perspective. Most of the dates shown below are necessarily approximations.

Not only must the climatic conditions be inferred from indirect evidence, but the onset or extent of changed conditions may vary with geographic location. Readers interested in the subject of paleo-climatology are encouraged to seek out the extensive body of popular and scientific literature on this subject.

Past California Droughts

The historical record of California hydrology is brief in comparison to the time period of geologically modern climatic conditions. The following samplings of changes in climatic and hydrologic conditions help put California's twentieth century droughts into perspective, by illustrating the variability of possible conditions. Most of the dates shown below are approximations, since the dates must be inferred from indirect sources.

11,000 years before present

Beginning of Holocene Epoch- Recent time, the time since the end of the last major glacial epoch.

6,000 years before present

Approximate time when trees were growing in areas now submerged by Lake Tahoe. Lake levels were lower then, suggesting a drier climate.

900-1300 A.D. (Approximate)

The Medieval Warm Period, a time of warmer global average temperatures. The Arctic ice pack receded, allowing Norse settlement of Greenland and Iceland. The Anasazi civilization in the Southwest flourished, its irrigation systems supported by monsoonal rains.

1300-1800 A.D. (approximate)

The Little Ice Age, a time of colder average temperatures. Norse colonies in Greenland failed near the start of the time period, as conditions became too cold to support agriculture and livestock grazing. The Anasazi culture began to decline about 1300 and had vanished by 1600, attributed in part to drought conditions that made agriculture infeasible.

Mid - 1500s A.D.

Severe, sustained drought throughout much of the continental U.S., according to dendrochronology. Drought suggested as a contributing factor in the failure of European colonies at Parris Island, South Carolina and Roanoke Island, North Carolina.

1850s A.D.

Sporadic measurements of California precipitation began.

1890s A.D.

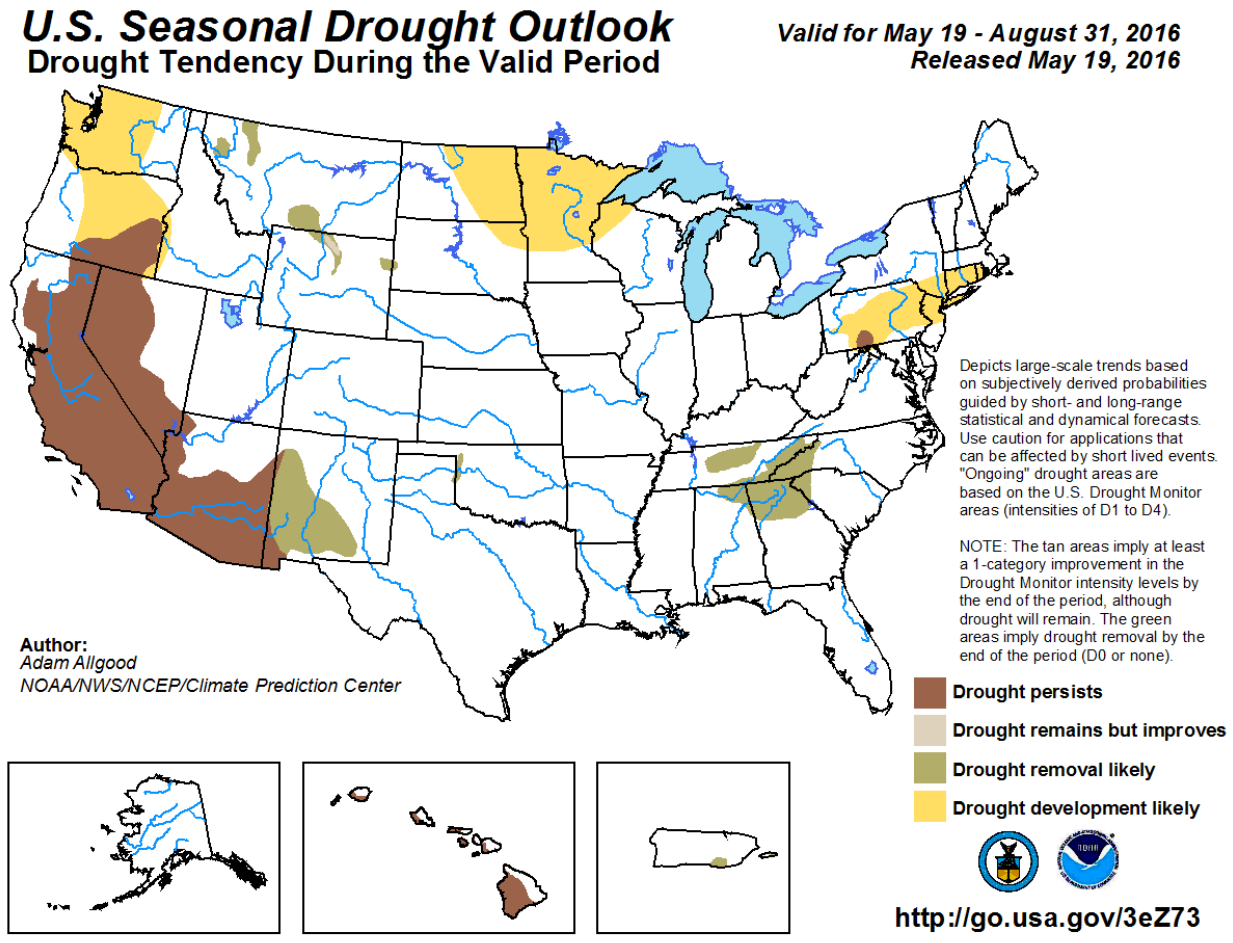
Long-term stream flow measurements began at a few California locations.

Palmer Drought Severity Index

Of the many varied indexes used to measure drought, the "Palmer Drought Severity Index" (PDSI) is the most commonly used drought index in the United States. Developed by meteorologist Wayne Palmer, the PDSI is used to measure dryness based on recent temperature compared to the amount of precipitation. It utilizes a number range, 0 as normal, drought shown in terms of minus numbers, and wetness shown in positive numbers. The PDSI is most effective at analyzing long-range drought forecasts or predications. Thus, the PDSI is very effective at evaluation trends in the severity and frequency of prolonged periods of drought, and conversely wet weather. The National Oceanic and Atmospheric Administration (NOAA) publish weekly Palmer maps, which are also used by other scientists to analyze the long-term trends associated with global warming and how this has affected drought conditions.

The following map is the most current snapshot of drought conditions across the U.S. It is provided by NOAA's Climate Prediction Center.

Map: U.S. Seasonal Drought Outlook
(Source: NOAA Climate Prediction Center)



Attachments

FEMA Letter of Approval

City Council Staff Report

City Council Resolution

Planning Team Sign-In Sheets

City of Signal Hill
Hazard Mitigation Planning Team Meeting #1
August 10, 2016

Name	Department
CAROLYN HARSHMAN	EMERGENCY PLANNING CONSULTANTS
MICHAEL LANGSTON	SIGNAL HILL P.D.
RICHARD JOHNSON	SIGNAL HILL P.D.
CHARLIE HONEYCUTT	ADMINISTRATION
ALY MANCINI	COMMUNITY SERVICES depart
SCOTT CHARNEY	COMMUNITY DEVELOPMENT
TERRI MARSH	FINANCE
TRAVIS BROOKS	PW

Signal Hill Hazard Mitigation Planning Meeting #2 08-31-2016

Name	Postion	
ALY MANCINI	DIR OF COMMUNITY SVCS	
Selena Adams	Associate Planner	
SCOTT CHARNEY	DIR. OF COMM DEV	
MEKE LANGSTON	CHIEF OF POLICE	
CHARLIE HONEYCUTT	CITY MANAGER	
RICHARD JOHNSON	EMER. OPS. COORD.	
TERRI MARSH	Dir of FINANCE	
STEVE MYRTER	Dir of PW	

Web Postings and Notices

Reference List