Safety Element

June 25, 1990

SAFETY ELEMENT

TABLE OF CONTENTS

	Page
Introduction	1
Purpose of the Element	1
Relationship to Other Elements	1
Existing Safety Hazards	3
Seismic Hazards	3
Geologic Hazards	13
Flood Hazards	19
Fire Hazards	19
Emergency Response Preparedness and Recovery	22
Goals and Policies	26

SAFETY ELEMENT

LIST OF TABLES

Table		Page
S-1	Seismic Parameters	5

LIST OF FIGURES

Figure		
S-1	Regional Fault Map	4
S-2	Landslide and Fault Rupture Hazards	14
S-3	Emergency Evacuation Routes	24

SAFETY ELEMENT

INTRODUCTION

Through the requirement of the Safety Element, State government has placed responsibility on the local entity for the evaluation of natural and man-induced hazards, and the formulation of programs to reduce risks associated with such hazards. By using the Safety Element as a tool, localities are to protect their citizens' health, safety and welfare.

Certain natural disasters, such as earthquakes and flooding, cannot be entirely handled on the local level, and must be considered within a regional context. In light of this, the City must join its efforts with other localities in the region.

Purpose of the Element

This element's specific focus is the reduction and/or prevention of injuries, loss of life, property damage, and economic and social disruption due to fires, floods, seismic activities, and other natural disasters. The Safety Element serves the following three key functions:

- Provide a framework by which safety considerations are introduced into the planning and development process;
- Identify and evaluate natural hazards; and
- Establish goals and policies which minimize potential adverse effects related to natural hazards.

Relationship to Other Elements

The Safety Element is related to all elements of the General Plan. The Conservation/Open Space Element provides for the protection of the area's natural resources, whereas the Safety Element tries to minimize the damage caused by these resources in the event of a natural disaster. Because of the need for safe and efficient use of streets, and traffic routes for emergency evacuation, a relationship exists between the Circulation and Safety Elements. The Noise

Element sets forth policies to ensure safe noise levels are maintained in the City. The Housing and Land Use Elements ensure that structures are of standard design and building materials, and are not subject to undue hazard based on their siting.

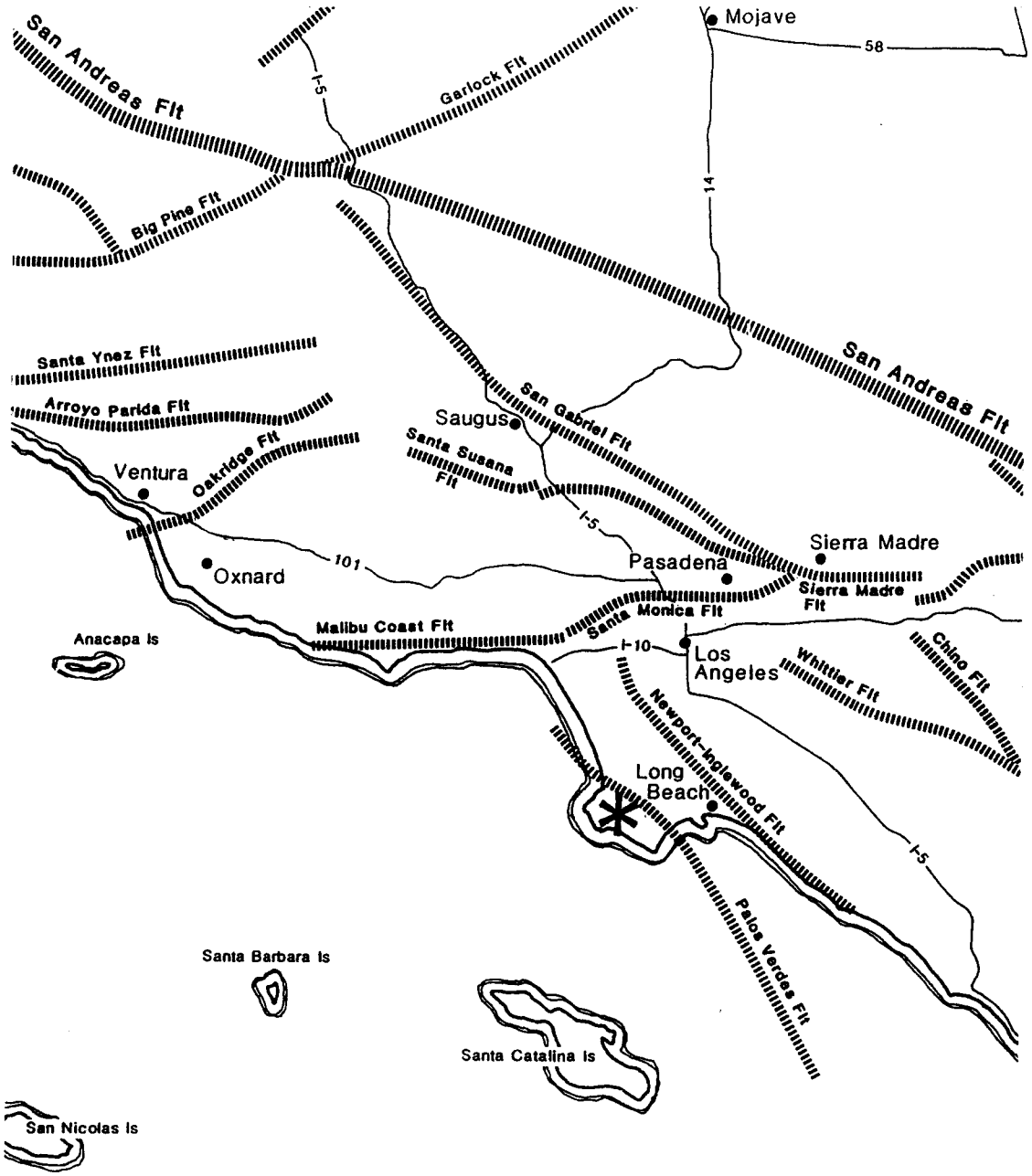
Seismic Hazards

Ground Shaking Hazard

The two principal seismic considerations of concern to the City of Rolling Hills are surface fault rupture and earthquake ground shaking. The major seismic sources that could produce significant ground shaking in the City include the Palos Verdes, Newport-Inglewood, Whittier, Santa Monica/ Malibu Coast, and the newly proposed Torrance-Wilmington fault system. (Refer to Figure S-1). For planning purposes, the Palos Verdes and Newport-Inglewood faults pose the greatest threat to the City of Rolling Hills. Seismic parameters of the Torrance-Wilmington fault system underlying the Palos Verdes Peninsula are not well defined and require further study to determine seismic risk.

The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude and distance from the source (epicenter) and the site response characteristics. Additional seismic characteristics that control ground response in the City include: (a) higher frequency seismic waves are more efficiently transmitted through bedrock materials; (b) topography may focus high frequency seismic energy, and (c) high frequency ground motion affects residential structures more readily than medium rise buildings. Higher frequency seismic ground motion will, therefore, tend to dominate a local earthquake along either the Palos Verdes or Newport-Inglewood fault, due to the influence of bedrock and the high frequency content of near-field earthquakes.

The Palos Verdes fault is potentially capable of producing the most intense ground acceleration in the City, due to its proximity (1+ mile). A worst-case earthquake on the Palos Verdes fault would produce seismic shaking with peak horizontal ground acceleration estimated at .53g. The Newport-Inglewood fault, located approximately 9+ miles from the City of Rolling Hills, is capable of producing a ground acceleration of .28g. These worst-case earthquakes (referred to as maximum credible earthquakes) may have shaking durations of up to 25 seconds. Several seismic parameters derived from selected potential causative faults are summarized for their respective maximum credible earthquake in the Table of Seismic Parameters. (Refer to Table S-1.)



North 0 20 scale in miles

SOURCE: California Division of Mines and Geology, "Fault Map of California", 1982

Rolling Hills General Plan

Figure S-1
Regional Fault Map

JUNE 25, 1990

POTENTIAL CAUSATIVE FAULT/FAULT ZONE	CLOSEST DISTANCE FROM FAULT TO SITE	LENGTH OF FAULT/ FAULT ZONE	MAXIMUM MAGNITUDE OF HISTORIC EARTHQUAKES [1]	APPROX. DATE OF MOST RECENT SURFACE RUPTURE	MAXIMUM CREDIBLE EVENT [5]: MAXIMUM CREDIBLE EARTHQUAKE MAGNITUDE [1,5]	MAXIMUM CREDIBLE EVENT [5]: RECURRENCE INTERVAL OF MAJOR EARTHQUAKE (Yrs.)	GROUND MOTION PARAMETERS [10]: PEAK HORIZ. GROUND ACCEL. (g). [11]	GROUND MOTION PARAMETERS [10]: PREDOMINANT PERIOD (IN BEDROCK) (Sec.) [12]	GROUND MOTION PARAMETERS [10]: DURATION OF STRONG SHAKING (Sec.) [13]
Whittier	39 Km. 24 Mi.	74 Km. 46 Mi.	6.0 (1910)[3] 5.5 (1938)	Historic[3] Post-1660	7.3	Approx. 730[8,9]	0.15	0.34	32
Santa Monica San Fernando	32 Km. 20 Mi.	24 Km. 15 Mi.	None Known	None	6.7	Approx. 3,960[1,7]	0.13	0.29	21
Malibu Coast	33 Km. 21 Mi.	34 Km. 8 Mi	None Known	Holocene	6.9	?	0.14	0.30	24
Newport- Inglewood	15 Km. 9 Mi.	73 Km. 46 Mi.	6.2 (1933)	Historic[4] 1933	6.9	Approx. 1,500[8,9]	0.28	0.30	24
Palos Verdes[2]	2 Km.	45 Km.	None Known	Holocene (?)	7.0	2,000-8,000	0.53	0.31	25

1. After Ziony and Yerkes 1985. Earthquake magnitudes reported as moment (M) magnitudes except where otherwise noted.
2. Dames and Moore and MESA-2 1983.
3. After Rockwell et al., 1986.
4. After Guptill and Heath 1981.
5. Estimate of the largest earthquake that can reasonably be expected to occur on a given fault.
6. Estimate for a given point along a fault.
7. Recurrence interval based upon documented evidence of faulting in sediments of known age.
8. Recurrence interval based upon estimated fault slip rate.
9. After Wesnousky 1986.
10. Parameters calculated for site response to Maximum Credible Earthquake.
11. After Campbell, 1988.
12. After Seed et al., 1969
13. After Dobry et al., 1978 (Soil)
14. Crook et al., 1987.

SOURCE: Leighton and Associates

Rolling Hills General Plan

Table S-1
Seismic Parameters

JUNE 25, 1990

Fault Rupture Hazard

The designation of a fault as "active" or "inactive" is largely dependent on the classification criteria used and the purpose of the designation. As a measure of the potential for ground rupture, "active" faults are defined by the State Alquist-Priolo Act and delineated through designated special study zones along the trace of the fault. This designation states that a fault is active if surface displacement can be proved within about the last 11,000 years, as interpreted through geological investigations.

In the last section, the Palos Verdes and Newport-Inglewood faults were considered "seismically active" based on their potential for producing an earthquake large enough to impact the City, not on the basis of their surface rupture potential, which the State has only recognized for Newport-Inglewood fault. Other faults may be considered "potentially active" by the State Mining Board. These faults may, or may not, have experienced surface rupture during the last 2 million years (Pleistocene) but are, nonetheless, considered potential seismic sources for grading and structural design purposes. The following is a discussion of evidence of more significant faults that may impact the City as a fault rupture hazard or as a potential seismic source.

Cabrillo Fault: The Cabrillo fault, and accompanying subsidiary faults, are the only major faults transecting the City of Rolling Hills, thus posing the only direct threat of fault rupture. It is not a "major" fault, meaning that it is not on the same order of regional importance as the Palos Verdes or Newport-Inglewood faults. However, displacement of deposits younger than 10,000 years on offshore portions of the fault has been documented, suggesting that the Cabrillo poses a potential fault rupture hazard, as defined by the State. The Cabrillo Fault is not currently recognized as active under the Alquist-Priolo Act, but is considered "active" in the recent revision of the County of Los Angeles Safety Element [draft].

The onshore portion of the fault presents special problems. The Alquist-Priolo Act allows individual jurisdictions to create special studies zones around faults not yet recognized by the State as active. The usual approach to special studies requires that the fault be accurately located, dated to determine potential for surface rupture, and have adequate residential setback distances away from the fault trace. The onshore portion of the Cabrillo fault within the City of Rolling Hills, however, is obscured by the prolific landsliding in the area. Recent attempts at confirming the age and

even the location of the fault by Dr. Roy Schlemon (1984) have been complicated by the landslides and thick slope soils. It is doubtful that stratigraphic evidence still exists that may confirm the activity or precise location of the onshore portion of the fault.

Several workers have speculated that some of the recognized fault traces onshore might even be attributed to ancient landsliding (Ehlig, 1989 personal communication; Schlemon, 1989 personal communication). As discussed in a later section on earthquake-induced slope instability, if this assumption is correct, it is possible that what many have interpreted as traces of the Cabrillo fault onshore may be discrete instances of landslide reactivation by earthquakes during extremely wet climatic periods. If so, appropriate setbacks or hazard reduction measures around the trace of the postulated fault may be still be warranted and possible.

Palos Verdes Fault Zone: The Palos Verdes fault is approximately 1 mile from Rolling Hills. Woodward Clyde Consultants (1983) point to several factors that suggest Holocene (less than 10,000 years) displacements have occurred along the onshore portion of the marine Palos Verdes fault. These factors include the extensive deformation of the 120,000 year old terrace on the Peninsula, and the apparent Holocene folding of the Gaffey [street] anticline, a feature related to probable drag movement on the Palos Verdes fault. The fault is designated as active in the revised Los Angeles County Safety Element, however, it is not considered to be a fault rupture hazard to the City of Rolling Hills. Instead, consideration should be given to the potential impact that fault rupture adjacent to the City may have on emergency and short-term earthquake recovery functions. A maximum credible earthquake of M7.0 (Richter Magnitude) has been assigned to this fault.

Newport-Inglewood Fault: Located approximately nine miles southwest of Rolling Hills, the Newport-Inglewood structural zone is a major fault structure in the Los Angeles Basin. Although no historical surface faulting has been associated with earthquakes along the Newport-Inglewood structural zone, various fault segments have a history of moderate to high seismic activity. The largest instrumentally-recorded event was the 1933 Long Beach earthquake, which occurred on the offshore portion of the Newport-Inglewood structural zone and registered a Richter Magnitude of 6.3. The fault system is recognized as active by the State Alquist-Priolo Act and considered a highly probable source of strong ground motion for the City.

Torrance-Wilmington Fault: The existence of this fault has been recently interpreted from seismicity and oil well log data. The Dume-Torrance-Wilmington Fold and Thrust Belt is an active area of compression and uplift that has come to be appreciated as a potentially significant seismic source as a consequence of analyses of the 1987 Whittier Narrows Earthquake. Since the main flat-lying fault lies at a depth of 15 kilometers and there is no surface expression of the fault, they have been referred to as blind thrust faults. Surface verging splays of these flat-lying faults may approach to within kilometers of the surface; however, their surface rupture potential is probably regionally distributed through general uplift of the hills that are formed as a result of the fault. The fault does pose a significant increase in the annual probability for strong ground motion to effect the City of Rolling Hills, however, the magnitude of this increase has not been quantified at this time.

Liquefaction and Ground Failure Hazard

Secondary earthquake hazards, such as liquefaction, lateral spreading, and seismically-induced dynamic settlement are generally associated with relatively high intensities of shaking, shallow ground water conditions, and the presence of loose, sandy soils or alluvial deposits. Although Rolling Hills is subject to moderate to high seismic shaking, the general lack of thick, loose, sandy soils and saturated alluvial deposits makes the potential for liquefaction low to very low.

Earthquake-Induced Subsidence

While subsidence commonly occurs from ground water or petroleum withdrawal, it can also occur in response to large local earthquakes which could result in the inundation of low-lying areas surrounding the City of Rolling Hills. Subsidence from either of these sources should have no direct effect on the City of Rolling Hills beyond the effect of the earthquake shaking. Although subsidence is not considered a geologic hazard, emergency response plans should recognize the potential for impaired transportation in the Long Beach area from inundation.

Earthquake-Induced Slope Instability and Landslide Reactivation

The City of Rolling Hills, because of the nearby seismic sources and presence of large landslides and steep road cuts in some locations, is vulnerable to earthquake-induced slope instability. The potential types of slope instability range from shallow soil slips and rock falls to bedrock slides. The most susceptible slopes for rock

falls would be steep embankments where the bedding is dipping out of slope. Almost all steep slopes would be susceptible to soil slips. Although the majority of surficial slides activated by a nearby large earthquake would be relatively small, their occurrence would be widespread and may block essential roads used for egress and regress. Such hazardous slopes can be identified and mitigated relatively simply.

The City of Rolling Hills has the potential for complex, shallow and deep-seated earthquake-induced hillslope failures particularly if combined with high rain fall. Rain-saturated slopes, could affect the run-out distance and velocity of soil slides. In the worst possible case, a potential soil slip could be completely saturated, resulting in the mobilization of the soil slide downslope as a high velocity debris flow. At the present time there is not enough data to determine the extent or risk of this type of down slope movement, but it is likely that some residences might be exposed to impact by such water-saturated failures.

If saturated conditions exist in the hillslope during strong ground motion, deep-seated landslides may be reactivated. This is especially relevant in the City of Rolling Hills where abundant, marginally stable landslides underlie several large areas of the City. There is some evidence to suggest that several such slides, specifically those adjacent to the Cabrillo fault, may have experienced earthquake-induced reactivation within the last 10,000 years. (Roy Schlemon, 1988; personal communication).

Residential Structural Vulnerability to Strong Ground Shaking

A trend in the new housing and modifications to existing housing in recent years has been the split level and irregular floor plan. Such designs naturally result in an asymmetrical configuration, and a probable deficiency in seismic design. This trend can be further compounded on hillslopes where pole platforms or pole structures are used to support the house structure, in lieu of conventional hillslope grading practices which place the entire foundation into bedrock or stable fill. Such foundation construction can result in "soft story" structural failures. Because some split level designs serve to mitigate landslide damage, this design may actually be encouraged in some instances. Each proposed split level should be carefully reviewed on a case by case basis.

In the event of a near-field earthquake, such as could occur on the Newport-Inglewood, Palos Verdes, or Torrance-Wilmington faults, residential structures are most vulnerable to structural damage.

The recent "Planning Scenario for a Major Earthquake on the Newport-Inglewood Fault" by the California Division of Mines and Geology predicts seismic intensities on the order of MM = VIII on bedrock areas on the Palos Verdes Peninsula. Such intensities are known to cause torsional racking of the foundation and wall elements of irregularly shaped structures, resulting in concentration of damages between wings of houses. Emphasis on symmetrical and/or simple floor plan residential design provides a viable option for reducing future earthquake losses in the City.

Nonstructural damage is perhaps the largest expected source of injury and monetary losses (i.e., the damage caused by toppling of furniture and components inside the house). In cases where continued function is paramount, such as an emergency operation center in the City, special strategies to secure needed communication, generators, or emergency equipment is warranted.

Emergency Earthquake Scenarios

The high frequency content produced from nearby large earthquakes will affect above ground electrical utilities, particularly electrical substations linked to the community. Dysfunction of electrical facilities is expected to last no longer than 3 days. Gas and water utilities suggest that 72 hours is an adequate estimate of maximum recovery times for service.

Dysfunction of computers, either through direct damage or electrical power failure, may affect the ability to use telephones. Telephone saturation, meaning the overuse of telephone lines in an emergency for nonemergency purposes, may also lead to loss in function of the telephone system. Residents and City emergency operators should be reliant on radio communication and consider using available phone service for emergencies only.

In a worst-case scenario any acute care hospitals having a patient capacity of 99-beds or less within 10 miles of the City of Rolling Hills will suffer at least a 50% loss in available bed space. Provisions for such a possibility should include the capability for transporting critically injured residents to hospitals and local capability to support the moderately injured. The City has emergency provisions for coordination with the Red Cross.

Transportation may be impeded in areas surrounding the City in the event of a magnitude 7 earthquake on the Newport-Inglewood or Palos Verdes fault. Specifically, liquefaction may disable bridge approaches such as the Vincent Thomas, Gerald Desmond, and

Schuyler Heim. Route 710 may also be closed between Route 91 and Long Beach, also from liquefaction damages.

The 1987 Whittier earthquake exposed the vulnerability of industries using or storing hazardous materials to accidental atmospheric releases. Atmospheric releases of hazardous materials pose the greatest hazard to the City of Rolling Hills because of the unpredictability of the toxic plume, which in many cases may be invisible. Although the plume may dissipate before reaching the jurisdiction of the City, there exist no sufficient studies to characterize the risk of the City to such an accident. Emergency response plans should consider the potential occurrence of such an accident.

Issues and Opportunities - Seismic Hazards

1) The Newport-Inglewood and Palos Verdes Faults present the greatest understood ground shaking threat to the City of Rolling Hills, but the newly recognized Torrance-Wilmington and related faults pose a new, yet uncharacterized threat.

2) The Cabrillo Fault poses the only fault rupture hazard to the City of Rolling Hills; however, the threat may be equally as great for seismically-induced reactivation of large deep-seat landslides which may have the same ground rupture and damage effect if sudden displacements are large.

3) The City of Rolling Hills is susceptible to shallow earthquake-induced landsliding. If saturated hillslope conditions are extraordinary, the potential for damages caused by debris flows and sudden reactivation of existing deep-seated landslides will increase accordingly.

4) Predicted seismic intensities on the order of MM = VIII in bedrock areas on the Palos Verdes Peninsula can be generated by an earthquake of magnitude 7 on the Newport-Inglewood fault, and commonly causes fall of chimneys, columns, and monuments.

5) Damages will be greater for asymmetrical, split level residences and residences with irregular floor plans than for residences with symmetrical design. Split level residences, however, may be designed to mitigate landslide damage, and therefore, should only be encouraged when landslide mitigation is an issue.

6) Torsional racking of the foundation and wall elements of

irregularly shaped houses may cause concentration of damage between wings of houses. Wall panels of all frame houses may be thrown out of plum.

7) Collapse of interior and exterior nonstructural components of houses and buildings will cause the greatest share of injuries.

8) A magnitude 7 earthquake on the Newport-Inglewood fault may cause a 50 percent reduction in available hospital bed space within 10 miles of the City, necessitating a reevaluation of current emergency medical plans.

9) Disaster planning scenarios should consider the fact that utility services may be out for as much as 72 hours and that transportation into the City may be impeded by rock falls, soil slides, and fallen utilities. Transportation will also be impeded across many bridge crossings and major freeways in liquefaction areas, as identified on County of Los Angeles Seismic Hazard maps.

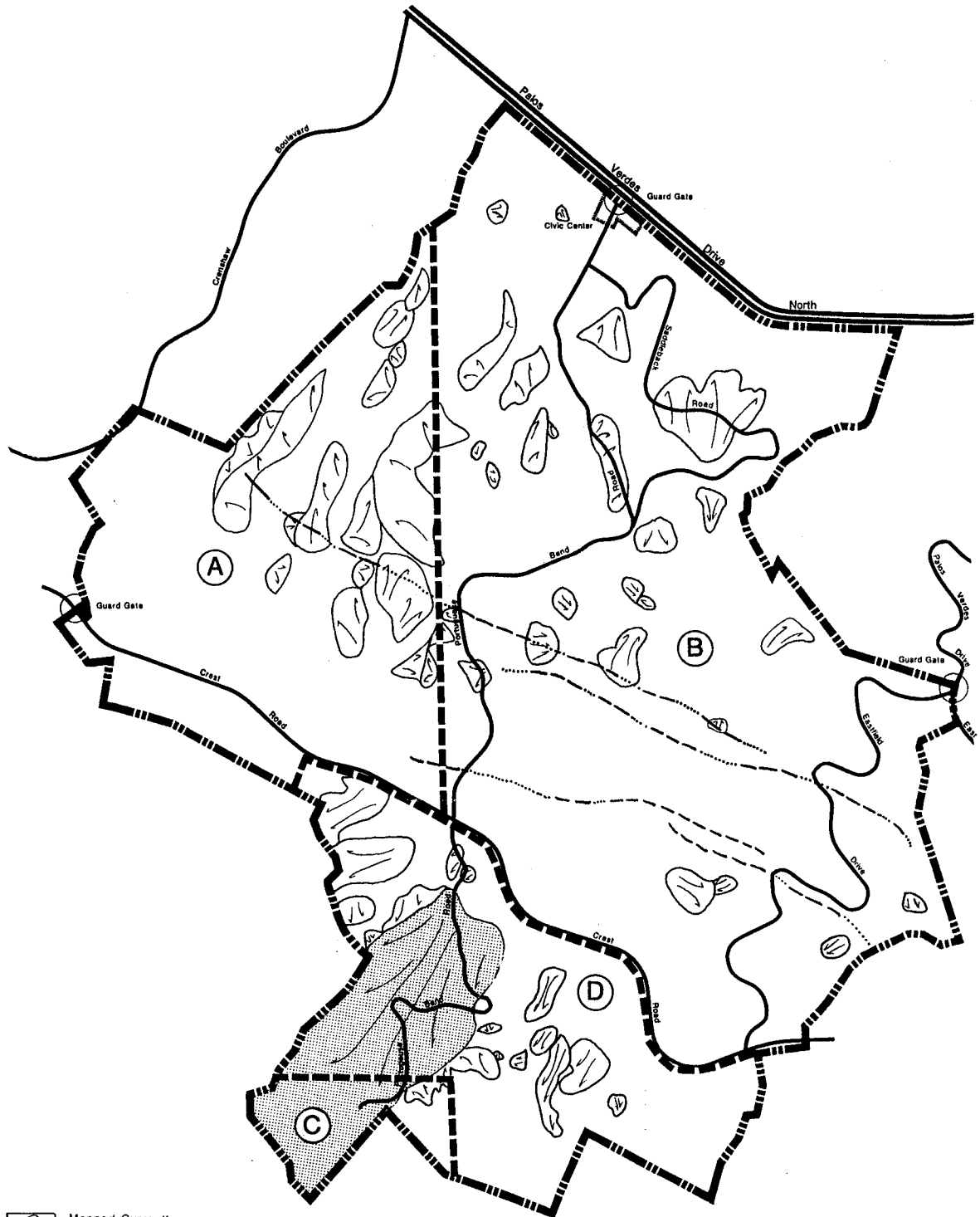
10) The potential for hazardous materials accidents in adjacent jurisdictions must be addressed in disaster planning scenarios for the City of Rolling Hills.

Geologic Hazards

Landslide Hazards and Corrective Analysis

Landslides are the most serious geologic hazard facing the residential community of Rolling Hills. Many residences in Rolling Hills have been built upon pre-existing, unrecognized, or recognized, but unstabilized landslides. The City is almost completely served by private sewage disposal systems which may exacerbate the hazard. A map illustrating both active and currently inactive landslides in the City of Rolling Hills is presented in the accompanying Geologic Hazards Map (refer to Figure S-2). The compilation of landslides shown in this figure relies primarily on previous field mapping and interpretation from published and unpublished map sources, ranging in scale from 1:12,000 to 1:200. The existence of smaller, indistinguishable landslides and areas of potential slope instability outside of the landslide areas delineated cannot be precluded. Thus, proposals for development outside of mapped landslide areas should be geologically investigated for landslide potential. The landslides that are shown in Figure S-2, however, should be stringently evaluated with respect to the potential impact of additional development or redevelopment in the vicinity.

Geologically, most of the landslides within the City occur in the Altamira Shale Member of the Monterey Formation. Landslide rupture surfaces are commonly along plastic clay beds or seams within clayey shale or siltstone units. These units experience a reduction in strength and move downslope in response to mass distribution within the slide, disequilibrium caused by movement on adjacent slides, or the added weight of incident rainfall and consequent increases in pore water pressures along the slide plane. The landslides presented in Figure S-2 consist of modern "active" (The Flying Triangle Landslide) or ancient "potentially active" block glides or rotational slumps. Secondary slumps and shallow surficial failure styles are often observed on the larger landslide masses, particularly where landslide debris is actively filling canyon bottoms. Potentially active landslides can be reactivated by natural processes, such as rainfall, or through the influence of man. Water can be introduced into the landslide by way of landscape irrigation and percolation of sewage effluent from septic tanks. Building or loading at the head of a slide can decrease the bedrock strength along an existing or potential rupture surface and "drive" the landslide down slope. Improper grading practices can also trigger existing landslides. For example, if the toe of a landslide or the lower, down slope support of dipping beds is removed, movement can be reactivated.



Mapped Currently Inactive Landslides

Mapped Active Landslides

Faults Dashed Where Approximately Located: Dotted Where Concealed

Note: Arrows show generalized direction of movement.
Letters "A-D" refer to references on following page.

cba ↑ North 0 1200 scale in feet

Note:

1. Hillside Areas with few or no landslides may reflect the status of landslide mapping or the presense of smaller unrecognized landslides. The map does not preclude the presense of existing landslides or the potential for slope failure outside of landslide-prone areas as complied.

2. Landslide geometry is based on terrain features. More detailed study is necesary to confirm this mapping.

SOURCE: See following page.

Rolling Hills General Plan

Figure S-2
Landslide and Fault Rupture Hazards

JUNE 25, 1990

References for Figure S-2

A. Cleveland, GB, 1976, Geologic map of the northeast part of the Palos Verdes Hills Los Angeles County, California: California Division of Mines and Geology; Map Sheet 27, Scale 1:12,000 Plate 1

B. Cleveland, GB, 1976, Geologic map of the northeast part of the Palos Verdes Hills Los Angeles County, California: California Division of Mines and Geology; Map Sheet 27, Scale 1:12,000 Plate 2

C. Slosson and Associates, 1987, Geologic map of the Flying Triangle Landslide, after topographic and geologic map compilation, Greater Klondike Canyon Plate VII, Scale 1:200

D. Jahns, R.H., undated, unpublished geologic maps of the southern part of the Palos Verdes Peninsula, Palos Verdes Corporation Map sheets 22, 28, 29, Scale 1:200

The Flying Triangle Landslide, located in Klondike Canyon, illustrates a local example of a reactivated landslide. The landslide became an issue when the first indications of movement became evident in 1980. The cause of the movement can be directly related to the period of unusual heavy precipitation during the years 1973 to 1983. It has also been suggested that activation may well have been set by the slow infiltration of sewage effluent and surface irrigation over the years as development continued on the landslide.

The major pressures on hillslope development in the City of Rolling Hills, both on the active Flying Triangle landslide and on other potentially active landslides, are caused by intensification of existing development on residential lots throughout the City and the resultant expansion into currently undeveloped areas. Intensification consists of additional construction and modification of existing construction or the complete demolition and redevelopment of a residential lot. Intensification expands the developed pad area into previously "natural" hillslope areas and often involves a corresponding increase in the size and volume of the onsite sewage disposal systems. The potential consequences of such development suggest that appropriate retroactive and proactive measures that govern the long-term stability of potentially active landslides should be part of a comprehensive hillslope management program, a program that recognizes the concern for future property damages incurred by residents. Steps have already been taken in this direction. Pursuant to building code provisions which prohibit construction in geologically unstable areas, the City has not permitted construction in the Flying Triangle since the slide activity in the early 1980s, except for repairs to existing structures. The General Plan in the Flying Triangle confirms and continues this policy.

Issues and Opportunities - Geologic Hazards

1) Active landslides and reactivation of potentially active landslides are the most serious geologic hazards facing the residential community of Rolling Hills, and are believed to be the result of many factors including the combined influence of years of heavy precipitation and development (effectiveness of drainage systems, over use of surface irrigation beyond the capability of the hillslope, infiltration of sewage effluent).

2) The major development pressures today come from intensified redevelopment of residential lots and expansion of new development into currently undeveloped areas, some of which

are on potentially active landslides.

3) Remedial measures to stabilize active landslides, including installation of sewage and dewatering measures, are economically costly to the City and residential community, but with increasing housing and land costs, retroactive and proactive comprehensive stabilization strategies may become viable due to changes in cost/benefit ratios.

4) Potential solutions for the control of retroactive and proactive landslides include regulating all artificial recharge, low irrigation vegetation, installation of monitoring and dewatering wells, effective drainage and sewer systems, removal or regrading of a slide in certain instances, or complete avoidance of extremely critical active landlides. Land use measures must be applied as early as possible, as hazardous area management becomes less effective with increasing development.

5) Several options are at the City's disposal to reduce the economic, and potentially life-threatening impact of landslide reactivation. Tax credits, property acquisition/purchase development rights, landslide overlay zones, assessment districts, or any combination of these measures, are potentially feasible solutions to the landslide dilemma. Any method requires the approval of the majority of the community. Any of the following measures may be appropriate in Rolling Hills:

   - Tax Credits: Reduces the property's tax liability as long as land is left undeveloped at a very low density. Tax credit programs take a variety of forms including current use value, deferred use, or as a restrictive agreement. This method provides incentive to limit development, although high property values reduce the effectiveness of the program.

   - Property Acquisition: The landslide areas can be managed to protect public safety, while meeting other community objectives, such as providing open space for recreation or low intensity uses. Appropriate financing options open to the City are grants, donations, or formation of an assessment district.

   - Landslide Overlay: An ordinance could be tied to a landslide inventory or a graduated landslide risk zone (e.g. high, moderate, low). Open space requirements, construction standards, effective slope maintenance, low irrigation vegetation, sewage disposal options, or density of

development are relevant measures that can be tied to a landslide overlay. If nonconforming uses within designated areas continue unchecked, zone variances are more likely. If tied to economic incentives or developer liability (impact on adjacent properties from accelerated movement caused by variance development), then program compliance and effectiveness of implementation are more likely.

- Assessment District: A plan can be formulated to provide funding for alternative landslide mitigation methods, open space or density restrictions, and financing for acquisiiton of landslide areas.

Flood Hazards

The City of Rolling Hills no longer participates in the Federal Emergency Management Agency, National Flood Insurance Program. Flood problems are primarily limited to the City's canyon bottoms. As development is prohibited in the canyon areas, flooding does not present a significant hazard to development in the community. Minor flooding problems related to run-off and inadequate drainage systems or grading design could occur in the City, potentially channelling run-off onto an adjacent residence. Such problems can be addressed during project review.

Fire Hazards

The City of Rolling Hills is vulnerable to small wildland fire hazards. Brush fires pose the primary threat, especially where residential development lies above chaparral filled canyons. The fuel in the canyons, if ignited, could threaten residences upslope with wind-carried cinders and direct ignition from uncontrolled fires. In the early 1970s, a serious fire occurred which destroyed many homes in the area, illustrating the potential for extensive damage.

The coastal sage plant community present in the canyon areas have historically shown a high susceptibility to brush fires in Los Angeles County. Although fire frequency tends to be highest in grassy areas, the coastal sage in the canyons and hillslope areas of the City present the greatest danger of high intensity fires i.e., the most difficult to contain, and a spreading rate that quickly exceeds the response rate. Fire danger in the City of Rolling Hills is most critical during late summer and fall months, especially when Santa Ana weather conditions prevail. Plant fuels posing the greatest threat during this period will be those located on the south-facing slopes.

The City of Rolling Hills is exposed to brush fire hazards from both outside and within the City's jurisdiction. Brush fire hazards along border areas of the City consist of the following: 1) the southern boundary with Rancho Palos Verdes, within the Klondike Canyon-Flying Triangle area and eastward, downslope of the Southfield Drive area, 2) the eastern boundary with Rancho Palos Verdes in the George F. Canyon area, 3) the Portuguese Canyon area, and 4) the western boundary with Rolling Hills Estates. Combined with the several canyons cutting through the City, the entire jurisdiction falls within the equivalent of Fire Zone 3, as defined by the Los

Angeles County Forester and Fire Warden.

The frequency of large brush fires in chaparral canyon areas on the Palos Verdes Peninsula is relatively low, although the City experienced a serious fire destroying many homes in the 1970s. While the low density of development in Rolling Hills reduces the chances for fire spread, a conflagration could develop should a fire ignite within any of the fire hazard areas in the City. A potential source of fire ignition is lightening, however, this is considered to be a highly improbable scenario on the Peninsula.

Electrical power lines may also pose a fire hazard, in the remote possibility that the lines are not automatically deenergized when knocked down by high winds or an earthquake. The majority of fires are caused by the accidental or deliberate actions of man. Considering that this is an essentially unpredictable parameter, and that the proximity of residences to dense brush filled canyons makes them extremely vulnerable, suggests that the risk is great enough to warrant more stringent fire prevention options than that afforded to Fire Zone 3. Such restrictions might emphasize adequate brush clearances, removal of flammable rubbish stored on the premises, or utilization of fire retardant or noncombustible roof construction, which are among the most significant factors which increase the fire hazard. The most immediate fire vulnerability of the City is the prevalence of combustible roof construction. An informal survey of residences conducted by the Los Angeles County Fire Department indicates that of the roughly 643 residences that were counted, 389 used wood shingle construction while 254 used some form of fire retardant materials. Because the survey was based only on a visual count and interpretation, a detailed inventory might adjust the total number of fire retardant or fire vulnerable roof construction by as much as 127 residences, which remain of uncertain construction. The City has recently passed on ordinance to require Class A, fire retardant roofs in all new construction.

A review of Los Angeles County Forester and Fire Warden activity reports suggests that the City of Rolling Hills possesses resident cooperation and efficient fire response capability. During 1988 through June 1989, 28 fire prevention inspections were performed at the request of residents in the City. During that time period, no brush clearance or rubbish storage violations occurred. Fire incidents over the last three years from 1987 through 1989 averaged approximately 20 a year, yet fire losses during that time amounted to only $3,350 through June, 1989. That damages were limited to roughly $55 per incident indicates that the response time of the

County of Los Angeles Fire Station (Station No. 56, located at 12 Crest Road West) contracted to the City for fire protection is adequate for fire incidents of such small magnitude. Significantly, no major brush fires occurred during that time.

Two other potential vulnerabilities of the City that are issues appropriate for the Safety Element are the lack of accessibility that exists in some sections of the community and the typical wooden construction used in residential development. Some residences, and particularly newer remote development taking place in the City, are more vulnerable to fire damage than others because of their relative seclusion. In some instances, road width requirements may be inadequate for maneuvering fire prevention equipment, including trucks and heavy equipment along narrow private roads. Road widths, although it has not yet been a problem, may impede fire prevention response activities. The residential construction of the City of Rolling Hills also exposes a vulnerability to earthquake-induced fires. Areas with wood-construction need protection from fire as much as, or more than, protection from ground shaking or faulting.

Issues and Opportunities - Fire Hazards

1) Fire retardant roofs are justified within the City of Rolling Hills because of the potentially hazardous situation posed by brush fires in canyon areas within the City and bordering undeveloped hillslope areas. The City recently strenghtened its long-standing requirement for fire retardant roof materials to require Class A roofing.

2) Fire retardant construction and fire buffer zones are appropriate building regulation and land-use planning options for reducing the threat of earthquake-induced fire hazards.

3) The potential for impeded fire response because of remoteness of certain residences and narrow private roads suggests that residents should have the capacity for self reliant fire prevention strategies and firefighting equipment, such as additional brush clearance zones, improved peak load water supply capability, high pressure hoses, and fire extinguishers and/or sprinkler systems.

4) Neighborhood self-help groups, composed of neighborhood residents, can provide for quick notification and response to potentially disasterous brush fire incidents.

Emergency Response Preparedness and Recovery

The Safety Element is essentially a long-range emergency response plan. The hazards analyses in this report are aimed at producing a safe environment, easing the task of disaster response organizations during emergencies and identifying hazards necessary for making long-term recovery decisions. Effective short-term emergency response strategies exist in the event of a disaster within the City limits of Rolling Hills or areas contiguous to City limits. A comprehensive Emergency Preparedness Plan will be developed for Rolling Hills that combines these strategies in a coordinated manner both internally and with existing regional multi-jurisidictional plans. In the County of Los Angeles, the Sheriff has primary coordinating responsibility with public and private agencies and the County Fire Department in the event of an emergency. The City also has contractual agreements with the County Sheriff and Fire Department to protect public safety and property within the city limits. Utility companies supplying services to the community, such as Southern California Edison, California Water Service, Southern California Gas Company, and General Telephone, all have aggressive emergency response plans in the event of a disaster. For planning purposes, the worst-case scenario provided by major utilities emphasizes a 72 hour recovery period for services.

In a worst-case scenario in which earthquake-induced ground failure occurs within the City, either from fault rupture on the Cabrillo fault or reactivation of any one of the marginally-stable landslides within the jurisdiction, peak load water supply could be reduced. Underground natural gas distribution lines, although composed of flexible polyvinyl plastic, could pose an additional fire hazard if displacements are large enough. Combined with the relative isolation of some segments of the community, these worst case scenarios underline the importance of alternative sources of water for firefighting or other strategies to reduce fire spread in the event of extensive rupture or failure of the ground surface.

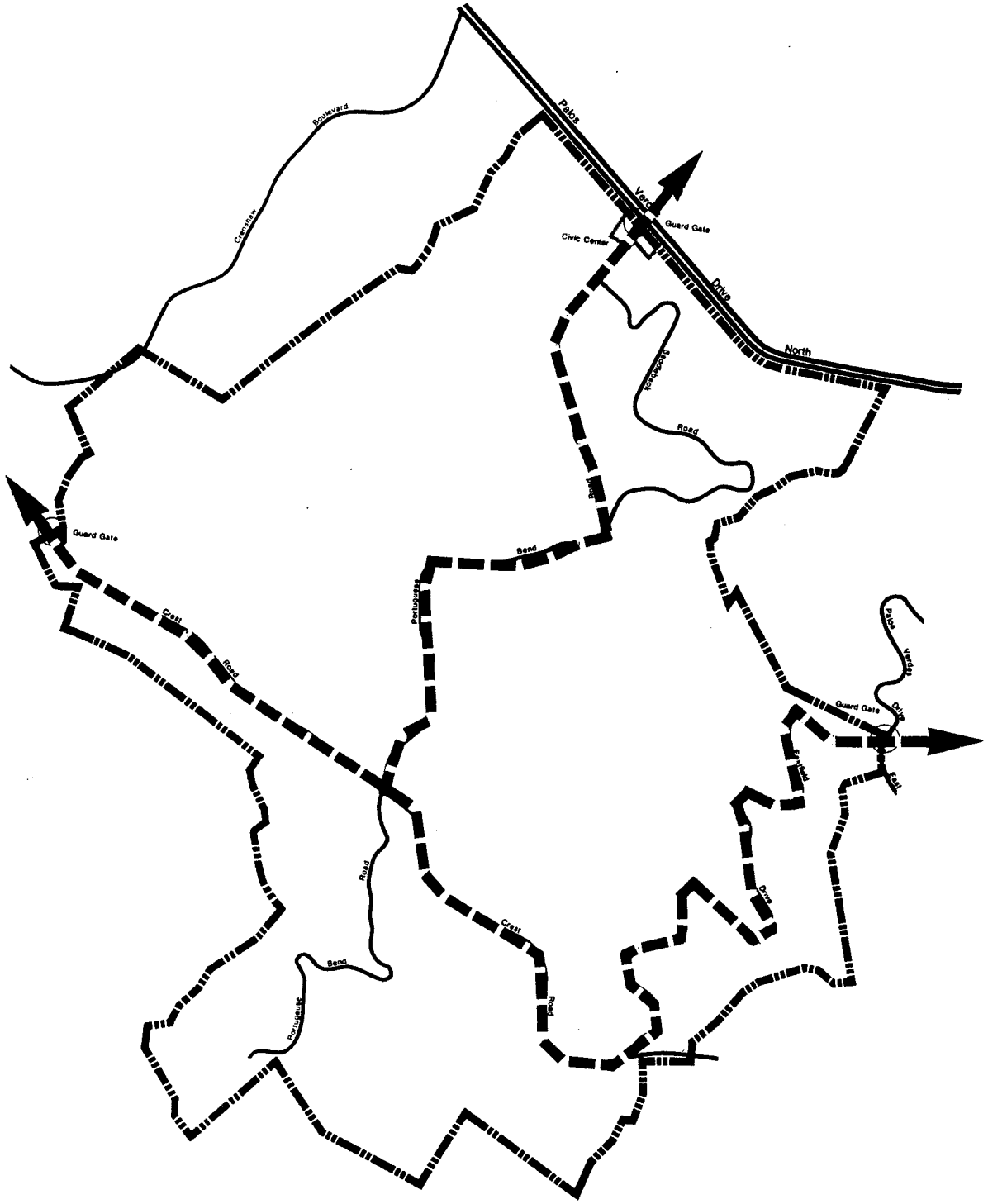
The most important observation related to the hazards discussed in this report, is the potential problem of lack of accessibility that exists in the City. In the event of a strong earthquake, small slides and slumps will block many of the private roads bordered by steep cut banks. This road blockage would have impact on emergency response capability, such as fire suppression at individual residences or the potential isolated fires which could be caused by malfunction of the electrical or gas utility systems. The expedient evacuation of injured residents could also be a problem, especially in the most

isolated areas of the community. One shall not anticipate having helicopter evacuation access for several days after a regional disaster.

Several mountainous areas in California with similar problems have turned toward developing and training self-help neighborhood groups. Individuals in the community are screened for specialized skills useful for self-reliance in an emergency, such as short-term medical care, utility damage assessment and repair, or knowledge of heavy equipment or fire suppression capability. Emergency provisions and supplies are inventoried and stockpiled, as well as necessary equipment for light rescue capability and radio communication. Chain of command is a key component of such groups. Residents are called upon to make rollcalls of neighbors and channel information back to central neighborhood commands. Some communities have designed these emergency groups around existing entities, such as the Neighborhood Watch Program. The City of Rolling Hills is well suited for this type of organized approach, because although these activities might take place following a major disaster, a significant number of lives can be saved by preparedness and efficient trained response.

The inaccessibility problem has been referred to frequently in the fire and emergency response sections because of the impact on firefighting and rescue functions. Primary transportation routes must also be planned in conjunction with designated neighborhood relief areas for those whose homes may be damaged. The three primary access and evacuation routes designated for the City are Crest Road from the west City boundary to Eastfield Drive, Eastfield Drive from Crest Road to the East City boundary and Portuguese Bend Road from Crest Road to the North City boundary. Figure S-3 shows the Emergency Evacuation Routes for Rolling Hills. A plan to identify and mitigate potential earthquake-induced road blockages from landsliding or fallen structures will be included in the Emergency Preparedness Plan. Road maintenance priorities and road clearance activities would have priority along the primary evacuation routes.

Long-term recovery and reconstruction is a potential issue in the City of Rolling Hills. It is imperative that local governments have appropriate procedures for rebuilding in heavily damaged areas, which in the worst-case scenario for the City of Rolling Hills would most likely be confined to reactivated landslide complexes. Because residential owners may wish to rebuild in these areas, appropriate policies must address decision making-processes and pre-selected alternatives for such instances. Hastily made decisions



North 0 2000 scale in feet

SOURCE: City of Rolling Hills

Rolling Hills General Plan

Figure S-3
Emergency Evacuation Routes

JUNE 25, 1990

on temporary rebuilding may rule out certain alternatives for reconstruction. Changes in land-use, such as open space, or additional building regulations might be appropriate in some instances.
Plans for rebuilding depend heavily upon surveys and analyses of geologic effects, as well as structural conditions of the damaged residences. The City has agreements with airphoto teams that may assist in this respect; however, site investigations of moderately to severely damaged areas is a critical prerequisite to land use planning and rebuilding after an earthquake or other disaster. Once damaged areas are identified, this information may be incorporated with existing knowledge of seismic and geologic hazards and post-disaster recovery procedures. Zoning and subdivision and building regulations are key devices for implementing changes during the redevelopment process.

Effective disaster preparedness will require the concerted efforts of City, County and Stage agencies and residents. Not only must effective plans and procedures be in effect, but those plans should be tested and improved through frequent disaster exercises.

Issues and Opportunities - Emergency Preparedness

1) In the aftermath of a large earthquake or other disaster, some areas of the community may be relatively isolated. Designated disaster control groups would improve the effectiveness of short-term emergency response.

2) Primary transportation routes and disaster response routes are an integral part of a local emergency response plan.

3) Appropriate land use and building regulations alternatives provide the greatest degree of flexibility during the reconstruction and rebuilding in the aftermath of a disaster.

4) Existing emergency response plans involving multiagency, multigovernment, and nonprivate and private sector should be periodically reviewed to account for new information on seismic or geologic hazards within the community.

5) The General Plan update process provides the City an ideal opportunity to prepare its own comprehensive Emergency Preparedness Plan.

The following goals and were developed as part of the General Plan Update, and policies provide the framework for reducing the social and economic disruptions caused by the effects of natural hazards.

GOAL 1: Recognize Rolling Hills' risk of earthquake-induced hazards and implement appropriate policies and programs to address this risk.

Policy 1.1: Restrict expansion of existing development and construction of new development near active faults or landslide areas.

Policy 1.2: Continue enforcement of site investigation (such as seismic, geologic, and soils investigations), and implementation of adequate hazard mitigation measures for development proposals near active faults and areas vulnerable to direct or secondary impact from earthquake-induced slope instability.

Policy 1.3: Advocate the development of easily maintained and earthquake resistant utility lifelines, including natural gas, water, power and communications.

Policy 1.4: Promote the construction of new residences or modifications to existing residences to be built in simple geometrical configurations.

Policy 1.5: Improve knowledge of the hazards and mitigation of nonstructural interior and exterior components, especially in high occupancy building and emergency operation centers.

GOAL 2: Protect public safety and minimize the social and economic impacts from landslides hazards.

Policy 2.1: Continue to restrict new development and expansion of existing development in areas susceptible to landsliding, debris flow, and rockfalls, unless these geological hazards can be mitigated by conventional structural or alternative nonstructural methods.

Policy 2.2: Explore and implement hazard mitigation and slope maintenance plans for existing and continuing development in hillside areas, especially areas underlain by large landslide complexes.

Policy 2.3: Consider the alternative use of properties for a natural preserve in active landslide areas.

Policy 2.4: Promote and facilitate conversion from septic tank to sewage system to help mitigate slope failure.

GOAL 3: Minimize injury, loss of life and property, and economic disruption caused by flood hazards.

Policy 3.1: Continue to restrict expansion of development in flood prone areas, especially in canyon bottoms and stream areas.

Policy 3.2: Continue to ensure that runoff caused by new development does not impact existing development.

GOAL 4: Reduce threats to public safety and protect property from brush fire hazards.

Policy 4.1: Strengthen review requirements of new projects and modifica-tions to existing development in the City of Rolling Hills to continue emphasis upon the use of fire retardant materials.

Policy 4.2: Continue to coordinate fire fighting efforts with adjacent communities to prevent the rapid spread of brush fires and to ensure efficient response.

Policy 4.3: Advocate and support the creation of neighborhood fire education programs and fire fighting capability, especially in the result of post-earthquake residential fires.

Policy 4.4: Encourage the use of natural fire resistant landscaping in development.

GOAL 5: Reduce threats to the public health and safety from hazardous materials and wastes and the transport of such materials.

Policy 5.1: Adopt Los Angeles County Hazardous Waste Management Plan by reference.

Policy 5.2: Strengthen emergency response plan for accidental atmospheric releases of hazardous materials in adjacent industrialized communities.

Policy 5.3: Promote the safe transportation and storage of hazardous materials in areas surrounding the City of Rolling Hills.

Policy 5.4: Educate homeowners on appropriate storage and use of hazardous materials.

GOAL 6: Strengthen Rolling Hills' short-term emergency response and long-term recovery capability.

Policy 6.1: Develop an Emergency Preparedness Plan for Rolling Hills that is comprehensive and responds to regional multi-jurisdictional emergency planning efforts.

Policy 6.2: Promote greater public awareness and understanding of safety hazards and emergency preparedness and response procedures.

Policy 6.3: Promote the development of community or neighborhood self-help and disaster control groups to improve effectiveness of local emergency response, light search and rescue, and short-term medical care.

Policy 6.4: Improve inter-agency and multi-jurisdictional planning to ensure efficient and integrated emergency response capability to all disasters.

Policy 6.5: Promote improved cooperation with nonprofit and private sector emergency response organizations.

Policy 6.6: Maintain designated evacuation and disaster routes in Rolling Hills.

Policy 6.7: Develop appropriate land use and building regulation alternatives for areas heavily damaged in a disaster.