SEISMIC SAFETY ELEMENT

Seismic Safety

State planning and zoning law requires a Seismic Safety Element of all City and County General Plans, as follows:

> A Seismic Safety Element consisting of an identification and appraisal of seismic hazards such as susceptibility to surface ruptures from faulting, to ground shaking, to ground failures, or to the effects of seismically-induced waves such as tsunamis and seiches.
>
> The Seismic Safety Element shall also include an appraisal of mudslides, landslides, and slopes stability as necessary geologic hazards that must be considered simultaneously with other hazards such as possible surface ruptures from faulting, ground shaking, ground failure and seismic induced waves.

The basic objective of the Seismic Safety Element is to reduce the risk of hazard resulting from future seismic and related events. The seriousness of seismic risk to public safety is a function not only of local seismic conditions, but also a public awareness of the seismic hazards present, and the effectiveness of mitigation policies and practices utilized to reduce the risk resulting from the hazards. This element attempts to identify existing and potential land use planning efforts which would be instrumental in planning for seismic safety.

The Seismic Safety Element importantly affects virtually all other General Plan elements through its identification of seismic and other geologic hazards, and its proffering of guidelines of relating land use classes to seismic risk zones.

FINDINGS

Geologic Hazards

Faults: An active fault is herein defined as one in which there has occurred significant subsurface earthquake activity, or any surface ground breakage, within the last 20,000 years.

Based on available information, the Elsinore fault zone is considered to contain those active faults nearest the City of San Diego. More specifically, the nearest fault in the Elsinore fault zone lies but twelve miles from San Pasqual Valley, 40 miles from Mission Valley, and 45 miles from San Ysidro. Although faults within the paralleling San Jacinto fault zone have greater historic and instrumental activity, their longer distances from the City would indicate lesser potential for damaging impacts.

Two offshore faults, the San Clemente Island and the Rampart, are significant to this area because of their suspected lengths. Of these two, the San Clemente Island fault appears most capable of earthquake activity that would affect San Diego because of its greater verified length and shorter distance away. This fault, which lies to the west-southwest, is approximately 40 miles from Mission Valley.

Known faults within the City of San Diego that appear capable of generating the most damaging earthquakes are located within the Rose Canyon fault zone and the La Nacion fault system, both of which have been described as potentially active in a study prepared for the City of San Diego in 1974. More recent independent studies have supported this theory and have gone further to state that the Rose Canyon Fault is active and is capable of producing a major seismic event.

The Rose Canyon fault zone extends south from the La Jolla Shores areas along the general alignment of Ardath Road, through Rose Canyon, and then along the east side of Mission Bay. Some evidence indicates that it may extend to the south along the alignment of the San Diego Bay-Tijuana fault through San Diego Bay.

It has been variously suggested that the Rose Canyon fault is a part of a large fault zone which includes the Newport-Inglewood fault in the Los Angeles area, and the Vallecito and San Miguel faults in Baja California.

Controversy exists as to the status of the Rose Canyon system. One argument states that the lack of recorded seismicity on the Rose Canyon fault is due to the fact that motion on the fault ceased years ago. However, the opposing view holds that the fault is locked up and that strain is building in preparation for an estimated 6.5 magnitude earthquake.

The La Nacion fault system, which essentially parallels the Rose Canyon fault zone, consists of two major faults: the La Nacion and the Sweetwater. The La Nacion, discovered in 1971, extends south from the Collwood Boulevard-Montezuma Road area along 54th Street, crosses State Highway 94 in the vicinity of Federal Boulevard, and then angles to the southeast through Paradise Hills. It reenters the City of San Diego at Otay Valley just easterly of Interstate 805 (I-805), and roughly parallels the latter into the San Ysidro area. It then takes a southeast turn into Mexico.

Within the City of San Diego, the Sweetwater fault is only known to extend southerly of Division Street along 58th Street, and adjacent to the westerly edge of the Paradise Hills community. However, several discontinuous traces of what is suspected to be southerly extension of the Sweetwater fault are found in the vicinity of Palm Avenue and Beyer Boulevard.

Ground Displacement. Directly related to faulting and earthquake activity is the phenomenon of ground displacement or fault rupture that may occur along the break of a fault. Ground displacement is characterized by slippage along the fault, or by surface soil rupture resulting from displacement in the underlying bedrock. Such displacement may be in any direction and can range from a fraction of an inch to tens of feet.

In San Diego, exposures are generally poor and most faults are either potentially active or inactive, which makes it difficult to define the traces of potential displacement. However, if ground displacement were to occur locally, it would most likely be on an existing fault.

Ground Shaking. When a break or rapid relative displacement occurs along the two sides of a fault, the tearing and snapping of the earth's crust creates seismic waves which are felt as a shaking motion at the ground surfaces. The most useful measure of severity of ground shaking for planning purposes is Modified Mercalli Intensity. This scale, ranging from Intensities I to XII, judges shaking severity by the amount of damage it produces. Intensity VII marks the point at which damage becomes significant. Intensity VIII and above correspond to severe damage and problems that are of great community concern.

The severity of seismic shaking at a given locale depends largely on the following factors:

- Earthquake magnitude and duration
- Distance from the zone of fault rupture
- Local soil conditions

Earthquake magnitude (M), as measured by the Richter Scale is an indication of the amount of energy released in the earthquake. It is estimated that the maximum probable earthquake (that is, the event of greatest magnitude that might occur with a fairly high order of probability) for both the San Jacinto and the Elsinore fault zones is between M 6.9 and 7.3, with a repeat interval of approximately 100 years. The maximum credible earthquake for both fault zones is estimated at M 7.6.

For maximum credible events, considerable damage (Modified Mercalli Intensities VII and VIII) would be likely in Northeast San Diego*, while only moderate damage (Intensities VI and VII) would probably be experienced in the remainder of the City. A magnitude 7.0 event on the Elsinore fault would still cause considerable damage in Northeast San Diego, but would cause only limited damage in Urban San Diego. As noted previously, the closeness of the Elsinore fault to San Diego makes it potentially more significant than the San Jacinto fault. Northeast San Diego is particularly close to the Elsinore fault; and the region encompassing San Pasqual Valley and the San Diego Wild Animal Park is especially subject to severe shaking from the earthquake source.

The largest fault within the California Borderland is the San Clemente Island fault, with an estimated length of 110 miles. This fault is about the same distance from downtown San Diego as the Elsinore fault, and their maximum credible events appear to be of the same order. However, since its historic recorded activity has been less, the San Clemente Island fault does not appear to pose as significant a hazard to the San Diego area.

There are two potentially active fault systems within the San Diego region having sufficiently verified length to produce large magnitude earthquakes. These fault systems, the Rose Canyon and La Nacion, could produce credible events of approximately M 7.1 and 6.7, respectively. While it seems unlikely that an event of such magnitude will occur, the damage resulting from it (under anticipatable Intensities of VIII and IX) would be especially severe in Urban San Diego.

Northeast San Diego would be less seriously affected, although ground shaking would probably achieve Modified Mercalli Intensities VII and VIII.

Local soil conditions and topography tend to modify the nature and severity of seismic waves. The specific way and extent to which local soil deposits modify earthquake ground motion depends largely upon their depth and their "softness." In general, deep soft deposits have long

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*That portion of the City of San Diego lying northeasterly of an imaginary line connecting the southeast corner of the NE 1/4 Sec. 10, T14S, R3W, SBBM and the Old Mission Dam. The remainder of the City so demarcated is hereafter referred to as "Urban San Diego."

characteristic site periods and shallow stiff deposits have short periods. Most amplification of earthquake ground motion is likely to occur at or near the characteristic period of the soil deposit. Consequently, structures which have their characteristic period similar to that of the soil deposit will generally be subjected to increased seismic forces due to quasi-resonance with the amplified motion. In other words, tall flexible structures will be most affected when located on deep soft soil deposits. Conversely, low rigid structures will be most affected when located on stiff or hard soil deposits or rock.

As indicated, the most predictable source of significant seismic shaking in San Diego is the Elsinore fault. The combination of long duration, low frequency, and low severity bedrock motions from a large event on the Elsinore fault makes the effect of the soil amplification especially important in determining damage severity from this earthquake source. The differences among, and extent of Modified Mercalli Intensities VI, VII, and VIII will likely be controlled by local soil conditions.

Seismically Induced Settlement. Settlement of the ground may come from fault movement, slope instability, and liquefaction and compaction of the soil at the site. Settlement per se is not necessarily destructive; rather, it is usually differential settlement that damages structures. Differential or uneven settlement occurs when the subsoil at a site is of non-uniform depth, density, or character, and when the severity of shaking varies from one place to another.

Liquefaction refers to the process in which a soil below the water table becomes converted to a fluid state and loses its strength. Typically, loose fine-grained sands and silts below the water table are most susceptible to this process, which often occurs during major earthquakes. Medium dense sands and silts below the water table may also liquefy if the shaking is of sufficient severity and duration. In that regard, Modified Mercalli Intensity VII may be sufficient to cause localized liquefaction of especially susceptible deposits.

The consequences of liquefaction depend mainly on local site and subsurface conditions. The most favorable condition is one in which the zone of liquefaction is limited to a small area at some depth below the ground surface and in which no lateral sliding takes place. Structures with specially designed foundations may be expected to maintain their foundation integrity and not suffer serious consequences due to liquefaction under these circumstances. Where sliding and lateral movement is likely because of sloping ground or bay bottom conditions, the effects of liquefaction should be more severe. In such cases acres of land may slide and break up as they move, thereby imperiling if not destroying any supported structures.

Soil lurching is the movement of land at right angles to a cliff, stream bank, or embankment due to the rolling motion produced by the passage of surface waves. It can cause severe damage to buildings because of the formation of cracks in the ground surface. The effects of lurching are likely to be most significant near the edge of alluvial valleys or shores where the thickness of soft sediments varies appreciably under a structure. Underground utilities placed in soft soils are especially subject to rupture.

Tsunamis and Seiches. A tsunami is a sea wave generated by a submarine earthquake, landslide, or volcanic action. A major tsunami from either of the latter two events is considered to be remote for the San Diego area. However, submarine earthquakes are common along the edge of the Pacific Ocean, and all of the Pacific coastal areas are therefore exposed to the potential hazard of tsunamis to a greater or lesser degree.

Tsunamis travel across the oceans as powerful, long but low waves typically more than 100 miles long, and only one to two feet high. Traveling at velocities of 300 to 400 miles per hour in the Pacific, such waves in the open cause no problems. However, as the tsunami waves approach the coastline, they are affected by shallow bottom topography and the configuration of the coastline, which transforms them into high and potentially devastating waves. Even if large waves do not occur, strong currents (as fast as 40 feet per second) can cause extensive coastal damage.

Because of the width of the continental shelf extending offshore from San Diego, it is believed that tsunamis of distant origin are necessarily too weakened upon their arrival in these waters to wreak more than minimal damage. Moreover, based on current information, any movements along San Diego's offshore fault system are expected to be primarily horizontal. Since the most damaging tsunamis are usually associated with vertical tectonic displacements, it is questionable whether a significant tsunami could be experienced locally.

A seiche is an earthquake-induced wave in a confined body of water, such as a lake, reservoir, or bay. Resulting oscillations could cause waves up to tens of feet high, which in turn could cause extensive damage along the shoreline. The most serious consequence of a seiche would be the overtopping and failure of a dam. Present data precludes the determination of the probability of damaging seiches within the City of San Diego.

Landslide and Slope Instability. Old landslides and landslide-prone formations are the principal non-seismic geologic hazards with the City. Conditions which should be considered in regard to slope instability include inclination, characteristics of the soil and rock orientation of the bedding, and the presence of groundwater.

The causes of landslides start with the preexisting condition inherent within the rock body itself that can lead to failure. The actuators of landslides can be both natural events such as earthquakes, rainfall and erosion and human activities.

Those induced by man are most commonly related to large grading activities which can cause new slides or reactivate old ones when compacted fill is placed on potentially unstable slopes. Cutting operations, another human activity, contribute to landslides when the lateral support near the base of unstable hillside areas is removed.

Some of the areas where landslides have occurred are: Otay Mesa; the east side of Point Loma; the vicinities of Mount Soledad, Rose Canyon, Sorrento Valley, and Torrey Pines; portions of Rancho Bernardo and Peñasquitos; and along Mission Gorge in the vicinity of the second San Diego Aqueduct.

San Diego's **coastal bluffs** are land features that have resulted from the actions of sea wave forces on geologic formations and soil deposits. Geologic factors that affect the stability of bluffs include jointing and fracturing, faulting and shear zones, and base erosion. Measures for their preservation must take into account whether the particular bluff area concerned is in a transitory state (that is, changing relatively quickly due to the action of the forces of nature), or whether it is relatively stable by virtue of the fact it is very resistant to natural forces. Where bluffs are changing relatively quickly by action of nature, measures to retain bluff degradation may be necessary in order to preserve the bluff line.

The coastal bluff areas generally extend from Los Peñasquitos Lagoon to Scripps Pier; from La Jolla Cove to the northern end of Mission Beach; and from Ocean Beach Pier to the southern tip of Point Loma. In the Torrey Pines area the coastal bluffs have experienced sizeable landslides where oversteepening of the seacliff has resulted in unstable conditions. In addition, rock falls have occurred in the Sunset Cliffs area due to undermining of the sandstone.

Existing Structural Hazards

General. Along with all other California cities, San Diego has been required to enforce the State Earthquake Protection Law (Riley Act) since its enactment in 1933. However, the seismic resistance requirements of the law were minimal for many years and San Diego did not embrace more restrictive seismic design standards until its first adoption of the Uniform Building Code in 1951. As a consequence, the seismic-resistant qualities of all buildings constructed prior to 1933, as well as those of higher buildings constructed prior to 1951, must be regarded as somewhat suspect.

It is roughly estimated that about 1,000 (mainly nonresidential) masonry buildings within the City may constitute structural hazards. The majority of these are located in the downtown area; however, appreciable numbers are also found in the older sections of the Hillcrest, North Park, and La Jolla business districts, among others. For the most part these buildings are of unreinforced masonry construction utilizing terra cotta hollow blocks joined by sand-lime mortar for bearing walls.

Recent experience, particularly that derived from the San Fernando earthquake in 1971, supports the following broad generalizations about the earthquake performance of various classes of buildings:

- **Ductile steel and ductile reinforced concrete frame buildings** (as defined in Uniform Building Code) - highly resistant to structural damage; may suffer nonstructural damage.

- **Vertical load-bearing steel and reinforced concrete frame buildings braced against lateral forces** - perform well but may suffer some structural as well as nonstructural damage.

- **Unreinforced masonry buildings of all types** - highly vulnerable to damage.*

- **Reinforced brick and concrete block masonry buildings** - perform well but may suffer some structural as well as nonstructural damage.

- **Pre-engineered and other light steel and sheet metal buildings** - usually perform extremely well.

- **Residential buildings** - Traditional wood frames with wood or stucco siding usually behave well but may suffer damage. Modern design open-type houses with large glass openings, split-level houses, and two-story houses or apartments with large garage openings in the first story are vulnerable to earthquake damage.

Schools. State legislation provides that all pre-Field Act (1933) school buildings found to be unsafe shall not be used for classroom purposes after June 30, 1975, if a construction contract to replace such unsafe structures had not been entered into by that date. Structural engineering surveys conducted locally in 1969 determined that there were unsafe school buildings at seventeen elementary and eight secondary school sites. All the schools in question have been replaced by structures built to meet current code standards.

Hospitals. Since 1972, the State Department of Public Health, through contract with the Department of General Services, has reviewed the plans for the construction or alteration of any hospital building. In performing this function it requires that geological data be reviewed by an engineering geologist and that structural design data be reviewed by a structural engineer. Under the same contract, the Department of Public Health observes the construction of, or addition to, any hospital building or, if the work alters structural elements, the reconstruction or alteration of any hospital buildings it deems necessary for the protection of life and property.

Dams, since 1929, the state of California has held full responsibility for the regulation and supervision of all dams and reservoirs within its territory that are not federally owned. This responsibility is exercised through the Department of Water Resources' Division of Safety of Dams, which conducts periodic inspections and reevaluations of all dams and reservoirs under state jurisdiction - including the fourteen owned by the City of San Diego.

Past inspections of City dams have resulted in major repairs and alterations being made on Lake Hodges Dam (in 1935) and on Murray Dam (in 1969) in order to bring these up to structural standards. More recently, Division of Safety of Dams engineers found that "under certain storm conditions, and also under certain earthquake loadings. Upper Otay Dam would be overstressed.” Therefore, the City was asked to make a study to determine an operating water level that would not permit high stresses to develop. In another action, division engineers restricted the maximum water surface of El Capitan Dam to an elevation 30 feet lower than spillway, although permitting the temporary storage of storm inflows above the specified level for short periods.

Utility Systems. The extent to which a modern city is dependent upon maintaining its utility services is obvious. Even brief interruptions in the flow of water, sewage, energy, and communications can have near-catastrophic results. Nonetheless, utility systems are peculiarly subject to failure in earthquakes because of their largely underground location, and the inevitability that some lines will cross faults. Further, the California Joint Committee on Seismic Safety contends that the state-of-the-art of "lifeline" earthquake engineering is comparatively low in relation to building earthquake engineering.

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* While this is generally true, it should be noted that individual un-reinforced masonry buildings because of their particular characteristics, i.e., high level of maintenance, location, roof system, interior partioning, etc., may be able to withstand greater lateral forces than this statement would imply.

Preventive measures can and must be undertaken. Major transmission lines crossing fault zones should be carefully designed and constructed so that ground movement can be accommodated. In general, this suggests the use of flexible pipe and rubber ring joints rather than rigid lengths of pipe that are welded or glued. Frequent valving to permit the isolation of broken mains is also indicated, along with provision for utilizing alternate ("redundant") routes or systems.

Question of Risk

A consideration of seismic safety inevitably evokes the question of risk. Within the San Diego area there is no absolute freedom from the associated threats of seismic activity, loss of life, and property damage. In response to this, various measures can be taken to diminish the scale of such threats. However most of these measures translate themselves into higher developmental and construction cost. Therefore, the dilemma arises - how much "protection" from risk should be purchased?

A major factor complicating the protection from risk calculation is the inability to accurately predict the time, place, and severity of a seismic occurrence. Another complicating factor of significance is the public's tendency to change its mind over time as to what constitutes an acceptable risk. Thus, immediately following a damaging earthquake there is typically a great clamor demanding that extreme protective measures be undertaken. Then, as the event recedes in human memory, a steadily lessened concern is likely to be manifested.

In the case of hazardous structures, the problems associated with risk and abatement are complex economic, social, psychological, political, legal, planning, and jurisdiction issues. The engineering problems are relatively easy to identify by comparison.

Because risk is a function of chance there is an inherent degree of uncertainty in using risk as a basis for land use planning. However, land use planning decisions can be made if the risks arising from environmental hazards coexisting with any proposed or existing development program or structure are identified, and the risks compared with risks of alternatives. If risk reduction measures are enacted, the amount of damage to property and injury to life will be reduced over a given period of time. In this respect, risk can be a framework for land use decision-making.

Every seismic hazard has an associated element or risk. This risk has two aspects: one is the chance that the hazard will in fact occur, the other aspect is the chance that if the hazard does occur, the measures taken to mitigate the hazard will be sufficient to reduce the damage to life and property to some pre-determined acceptable level. Acceptable risk could be defined as the level of risk below which no specific action of responsibility of local government is necessary, other than creating public awareness of the risk. While there is technological capability to control or reduce the occurrence of seismic hazards, adverse effects could be minimized by land use planning which is cognizant of seismic risk.

The City currently has a set of guidelines which correlates acceptable risk of various land uses with seismic (and geologic) conditions identified for the site. (see Tables 18, 19, 20). Large and complex structures, and places attracting large numbers of people, are most restricted as to geographic location based on site conditions. These facilities include dams, bridges, emergency facilities, hospitals, schools, churches, and high density residential structures (see Table 19, group I, II, and III). Low and medium residential development is considered land use of a lesser sensitivity and is therefore "suitable" or "provisionally suitable" (requiring mitigation) under most geologic conditions. Uses with only minor or accessory structures can be located on sites with relatively greater risk due to lower user-intensity associated with activities such as parks and open space, agriculture, and most industrial land uses. Further guidance for site development is provided in Table 20 as various types of geotechnical investigations which should be performed prior to site development. The scope of investigations can range from feasibility surveys to extensive field exploration and engineering/geologic/seismic analyses depending upon the complexity of site conditions and the intensity of the proposed land use. Continued consideration of this land use hazard matrix in land use decisions could provide a degree of risk evaluation.

GOALS

- GUIDANCE OF FUTURE DEVELOPMENT WHICH MAY BE INAPPROPRIATE LAND USE BASED ON IDENTIFIED SEISMIC RISK.

- ABATEMENT OF EXISTING STRUCTURAL HAZARDS WHICH COULD THREATEN LIFE AND PROPERTY IN CASE OF SEISMIC EVENT.

GUIDELINES AND STANDARDS

The generalized relationships that should prevail among seismic and geological hazards, risk zones, and land use types are portrayed in the following tables.

RECOMMENDATIONS

- Ensure that current and future community planning and other specific land use planning studies continue to include consideration of seismic and other geologic hazards. This information should be processed in the Environmental Impact reports which are a part of every plan.

- Keep updated those citywide maps showing faults, geologic hazards, and land use capabilities, and related studies used to determine suitable land uses.

- Utilize the findings of the beach and cliff erosion survey being undertaken to determine the rate and amount of coastline modification in the City.

- Continue to require submission to geologic and seismic reports, as well as soils engineering reports, in relation to applications for land development permits whenever geologic problems are suspected.

- Undertake a citywide program of identifying those structures that constitute seismic hazards. Judgments on hazardous-building abatement should take particular account of;

    - the desirability of preserving historical and unique structures and their architectural appendages;

    - special geologic and soils hazards;

    - the socio-economic consequences of the attendant relocation and housing programs.

- Continue to employ a qualified geologist/ seismologist on a consulting basis to review geologic/seismic studies required to be submitted to the City.

- Participate with other jurisdictions in setting up a geologic "data bank" for the San Diego area.

- Urge the State Legislature

    - to amend the Community Redevelopment Law so as to expressly provide that seismically hazardous structures may constitute a condition of blight;

    - to enact legislation that would empower local governing bodies to require owner of pre-Riley Act buildings to have detailed structural inspection made of these buildings and to have the remedial work done within a reasonable time.

- Create a committee to review local lifelines utility systems whether publicly or privately operated for the purpose of;

    - ascertaining their vulnerability to seismic and other geologic hazards and

    - to recommend specific measures for lessening of such vulnerability.

TABLE 18
Hazard-Risk Zone Correlation

Geotechnical	Feature or Phenomenon		Hazard Category No. (See Geologic Hazards Map)	Land-Use Capability Map Risk Zone: A		B		C		D	
				-- Increasing Relative Risk →							
GROUND RUPTURE	FAULTS	Active *(*As defined by State)	None Recognized								●
		Potentially Active*	See Fault Map							●	
		Inactive, Presumed Inactive or Activity Unknown	See Fault Map					●			
POTENTIAL SLOPE INSTABILITY	SLIDES	Confirmed, Known, or Highly Suspected	21							●	
		Possible or Conjectured	22					●			
	SLIDE-PRONE FORMATION	Friars Formation: Neutral or Favorable Geologic Structure	23					●			
		Friars Formation: Thick Section and/or Unfavorable Geologic Structure	24						●		
		Ardath Shale: Neutral or Favorable Geologic Structure	25				●				
		Ardath Shale: Thick Section and/or Unfavorable Geologic Structure	26						●		
		Otay Formation	27						●		
POTENTIAL GROUND FAILURE	LIQUEFACTION	Potential Relatively High: (Major Alluvial Valleys, Groundwater 25' ±)	31						●		
		Potential Relatively Low: (Upper Drainage Area of Major Valleys, Groundwater 25' ± (Fluctuates Seasonally)	32				●				
COASTAL BLUFF STABILITY	GENERALLY UNSTABLE	Numerous Landslides, High Steep Bluffs, Rapid Erosion	41							●	
		Unfavorable Bedding Places, Locally Rapid to Generally Rapid Erosion	42						●		
		Unfavorable Jointing, Locally Rapid Erosion	43						●		
	MODERATELY STABLE	Mostly Stable Formation With Some Locally Rapid Erosion	44					●			
		Some Landslides, Slow Erosion	45				●				
		Locally Unfavorable Geologic Structure, Slow or No Erosion	46				●				
	GEN. STABLE	Very Slow Erosion: No Slides	47			●					
		Broader Beach Areas: Developed Harbor	48			●					
ALL OTHER TERRAIN CONDITIONS	GENERALLY STABLE	Relatively Level Mesas – Underlain by Terrace Deposits and Bedrock	51	●							
		All Remaining Level and Sloping Areas, Minor Alluvial Valleys, Low Terraces, Rolling Hillside to Steep Mountainous Terrain	52		●	●	●	●			

** Table numbers correspond to numbers used in study report.

RISK ZONE RATING KEY
A - Nominal B – Low C – Moderate D – High
AB, BD, AC – Variable Risk (Hazard Category No. 52 only)
GENERAL NOTES:

All risk zone ratings and hazard area boundaries subject to change, based on new data. Although flood hazard was not specifically evaluated for this study, it is taken into account in a general manner in the risk rating of potential liquefaction.

Guidelines used for assigning risk rating within hazard category No. 52: *Rating*

1. *Mostly developed area, essentially on mesas or within tracts developed by minimal grading* .... *AB*
2. *Generally low slopes adjoining canyon or bay areas; may include low, nearly flat terraces; graded tracts having low to moderate slope heights* .... *AB or B*
3. *Moderate to high natural or graded slopes with no special hazards identified nearby* .... *B*
4. *Mostly moderate to high, locally steep natural or graded slopes; some hazards in adjoining areas or within area* .... *BC*
5. *Areas including all the above* .... *AC*

Multiple risk designations were permitted within a single category No. 52 area, without a line boundary separating then. Where a lesser hazard (e.g., an inactive fault) extended into a confirmed slide, the higher risk predominates; however, the approximately fault location is shown by a dashed boundary.

TABLE 19
Risk-Related Lane Uses

Building Type/Land Uses			Risk Zone --- Increasing Relative Risk → A	B	C	D
↓ Generally Increasing "Acceptable Risk"	Group I	Nuclear Facilities, Large Dams, Electrical Power Systems	•	O	X	X
	II	Hospitals; Fire, Police, Emergency Communication Facilities; Critical Transportation Elements, such as Bridges, Overpasses; Smaller Dams; Important Utility Centers	•	O	X	X
	III	Schools, Churches, Large or Highrise Buildings, or Other Places Normally Attracting Large Concentrations of People, such as Civic Buildings, Large Commercial Structures, Most Roads, Other Utilities.	•	•	O	X
	IV	Residential (Single-Family Residence, Apartments, etc.) Most Commercial and Minor Public Structures.	•	•	O	see foot – O Note No. 1
	V	Most Industrial, Other Minor Commercial (Warehouses, Wharves, Docks)	•	•	O	see foot – O Note No. 1
	VI	Agriculture, Marinas, Managed Mineral Resource Development, Parks, Other Open Space, Refuse Disposal Sites.	•	•	•	•

FOOTNOTES:

1. Development may be feasible in slide areas if adequate provisions are made for stabilization; not generally feasible in potentially active fault zones.

GENERAL NOTES: This chart is for general land-use planning only. Suitability for specific uses for a specific site must be confirmed by further investigation. An area evaluated as unsuitable for a particular does not necessarily preclude the use. If no other more suitable alternative sites are available, and provided that all potential hazards can be mitigated.

SYMBOLS:
• Suitable
O Provisionally Suitable
X Generally Unsuitable

TABLE 20
Recommended Geotechnical Investigations

Risk Zone (Geotechnical Land-Use Map*)	Geotechnical Hazard Category No. (Geologic Hazards Map*)	Type Investigation [1] By Bldg. Type/Land use Group			Comments, Special Considerations
		Geologic	Soil	Seismic	
A	51 52	I-II I-III	I-V I-V	I-III [2] I-III	Footnotes: (1) Scope of investigations can range from very preliminary, feasibility type studies utilizing available research data (at the planning stages of a project) to in-depth investigations requiring extensive field exploration and engineering/geologic/seismic analysis (at the design/construction stage) depending upon the complexity of site conditions and the importance of the proposed structure. (2) Refer to the special state regulations regarding investigation standards and construction codes for schools and hospitals; also federal regulations for nuclear facilities. Commonly only "high-rise" structures in Groups II and III would require a seismic investigation in Risk Zones A and B. (3) Land uses, such as disposal sites or mineral resource development (open-pit mines, oil fields) may require a geologic investigation to evaluate their environmental impact, as regards slope stability or subsidence effects. Environmental impact reports may be required to meet state as well as federal guidelines, depending on jurisdiction. (4) Refer to state legislation regarding identification of active and potentially active faults (Alquist-Priola Hazard Zones Act); investigations to evaluate ground rupture hazard and seismic shaking. H.U.D. requires seismic analysis of F.H.A. financed developments in vicinity of active or potentially active faults.
B	25, 45, 46 47, 52	I-V	I-V	I-III	
B	32 48	VI [3] ---	I-V I-V	I-III I-III	
C	Inactive Fault 22-24 26, 27 42-44 52	I-V	I-V	I-III	
C	31	VI	I-V	I-V	
D	Potentially Active Fault [4]	I-V	I-V	I-V	
D	27, 41	I-V	I-V	I-III	

* *Available at a scale of 1" – 800' from the City of San Diego Mapping Section.*

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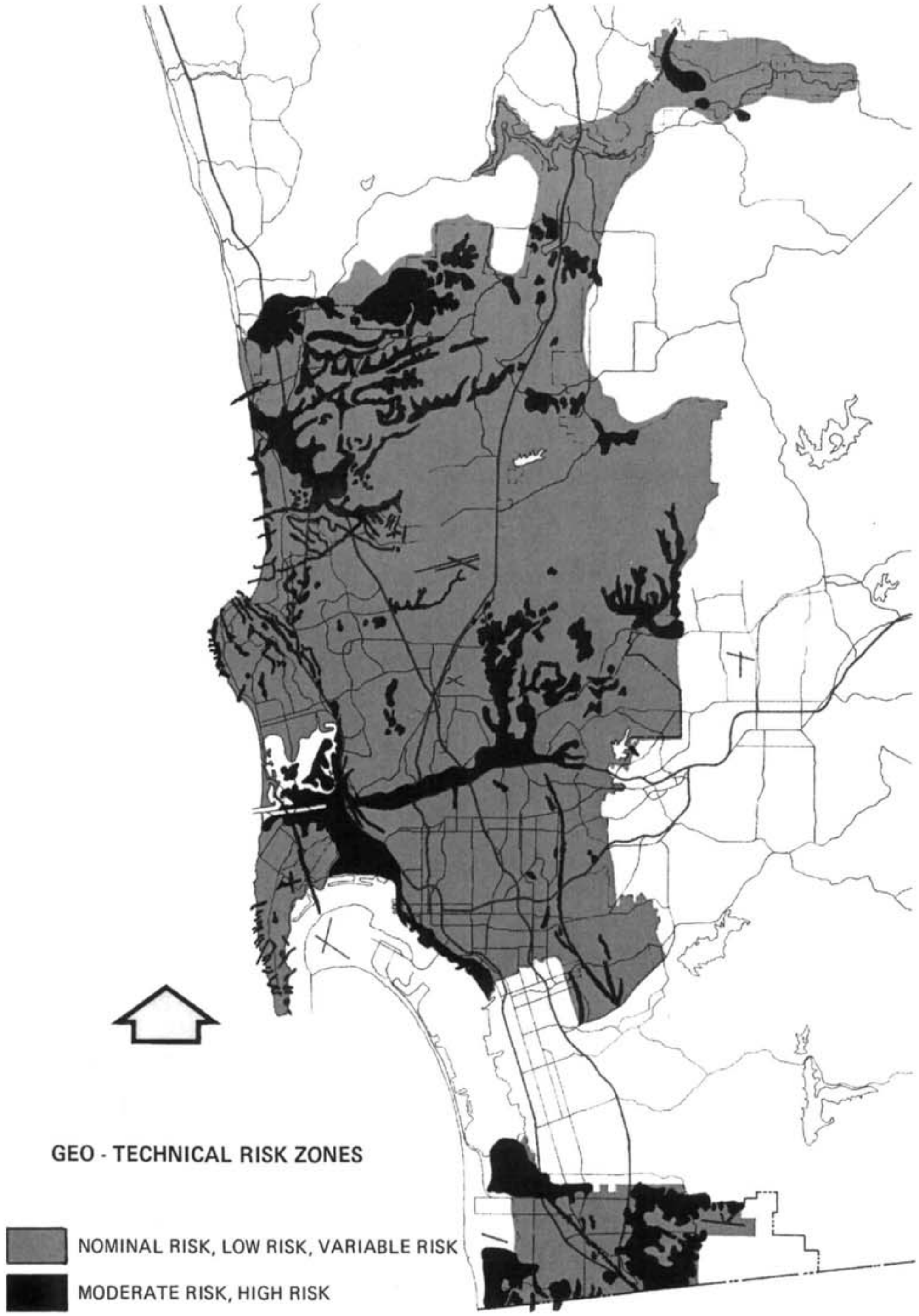
Model Seismic Safety Element, Final Report, Comprehensive Planning Organization, February 1974.



AREAS WHERE KNOWN OR SUSPECTED SEISMIC AND/OR GEOLOGIC HAZARDS EXIST (E.G. LANDSLIDES, FAULTS, SOILS, SUBJECT TO LIQUEFACTION). DEPENDING ON THE NATURE OF THE HAZARD, THE GEO-TECHNICAL RISK ZONE WAS ESTABLISHED. SOURCE: SEISMIC SAFETY STUDY FOR THE CITY OF SAN DIEGO, WOODWARD-GIZIENSKI & ASSOCIATES AND F. BEACH LEIGHTON & ASSOCIATES, MAP 1974.