X. HAZARDS

A. INTRODUCTION

The Coastal Act is explicit in directing those communities exposed to natural and man-made hazards to minimize risks to life and property in areas that are subject to such hazards.

Morro Bay is a community that is vulnerable to a wide range of hazards:

(1) Flooding occurs in the lower reaches of the Morro and Chorro Creek watershed: within the city, the drainage plagued developed hillside areas and in the drainage-poor lowlands to the east of State Highway One.

(2) Geologic hazards exist in the hillsides forming the eastern backdrop of the City and are characterized by steeply sloping, highly erosive, and landslide prone terrain.

(3) Natural and man-made fire hazards exist to the grassy hillsides from oil and jet fuel storage tanks near residential areas.

(4) There is erosion of the bluffs overlooking the Embarcadero.

Given these hazards and the Coastal Act's mandate to minimize the risks associated with them, Morro Bay must go beyond its existing Safety and Seismic Safety elements, its Flood Insurance Program and other policies it has developed in the past to deal with the potential hazards that impinge upon the community.

B. COASTAL ACT POLICIES

In its aim to assure that new development in coastal areas respects any natural or man-made hazards to which these areas may be exposed, the Coastal Act contains one primary policy governing hazards.

Section 30253. "New development shall:

(1) Minimize risks to life and property in areas of high geologic, flood, and fire hazard.

(2) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along the bluffs and cliffs."

There are other Coastal Act policies that must be considered in addressing coastal hazards, such as those concerning shorefront structures, provisions for shoreline access, protection of sensitive habitats and scenic qualities, and the location of new development.

While these related policies are discussed in other components of this report, one of these policies does deserve discussion in this Chapter:

Section 30236. "Channelizations, dams or other substantial alterations of rivers, and streams shall incorporate the best mitigation measures feasible, and be limited to: (1) necessary water supply projects; (2) flood control projects where no other method for protecting existing structures in the flood plain is feasible and where such protection is necessary for public safety or to protect existing development; or, (3) developments where the primary function is the improvement of fish and wildlife habitat."

The other policies of the coastal Act mentioned above that have implications for areas exposed to coastal hazards will not be the object of any extensive analysis in this chapter, but they have been kept in mind, as the policy recommendations for hazards were developed.

C. HAZARD ISSUES

1. Flooding

As evidenced by the floods of 1969 and 1973, Morro Bay suffers from flooding problems that could have been worse if the now relatively development-free Morro Bay flood plain had been developed with homesites or other urban uses.

The greatest damage occurred during the storms of early 1969. Although storm waters were generally contained by those portion of Morro Creek that lie within the City, there was significant damage to telephone, power and gas lines, water wells and bridges. Though the majority of overland flood flow occurred in the low lying agricultural areas of the Morro and Chorro Valleys, there was severe damage to property within the city.

Some of the major reasons for flooding was due to the pile up of debris on bridge piers, behind culverts, constricted channels, and utility crossings and the failure of earthen dikes to contain the storm waters.

The storm of January, 1973, considered a storm of only a20-year magnitude, brought flooding to the critical Highway One under pass where Highway 41 meets Main Street, and a number of areas in north Morro Bay east of Highway One. Flooding resulted due to backwater from culverts that were unable to handle the storm.

Following the flooding that occurred in those years, Morro Bay applied for HUD's Federal Flood Insurance program which prompted the preparation of flood prone area maps and City passage of a model ordinance governing development in flood prone areas.

As a result, a map of flood prone areas and the model ordinance were prepared and were only recently adopted by the City. The findings of the flood study and mapping concluded that the City suffered from a variety of flooding problems:

(1) The lower Morro Creek and Chorro Creek Valleys, now undeveloped, the areas subject to 100-year flood inundation.

(2) The hillside areas in the northern end of the City area are plagued by development-aggravated drainage problems -- undersized culverts under State Highway One, City streets, and some private developments -- which cause flood waters to back up and inundate areas upstream from the drainage constrictions.

(3) The large open area east of State Highway One between Morro Bay High School and the Atascadero Beach Tract suffers from very poor drainage. During storms, water stands on the marshy property, unable to escape down any drainage courses. The entire area is shown as subject to inundation from the 100-year flood.

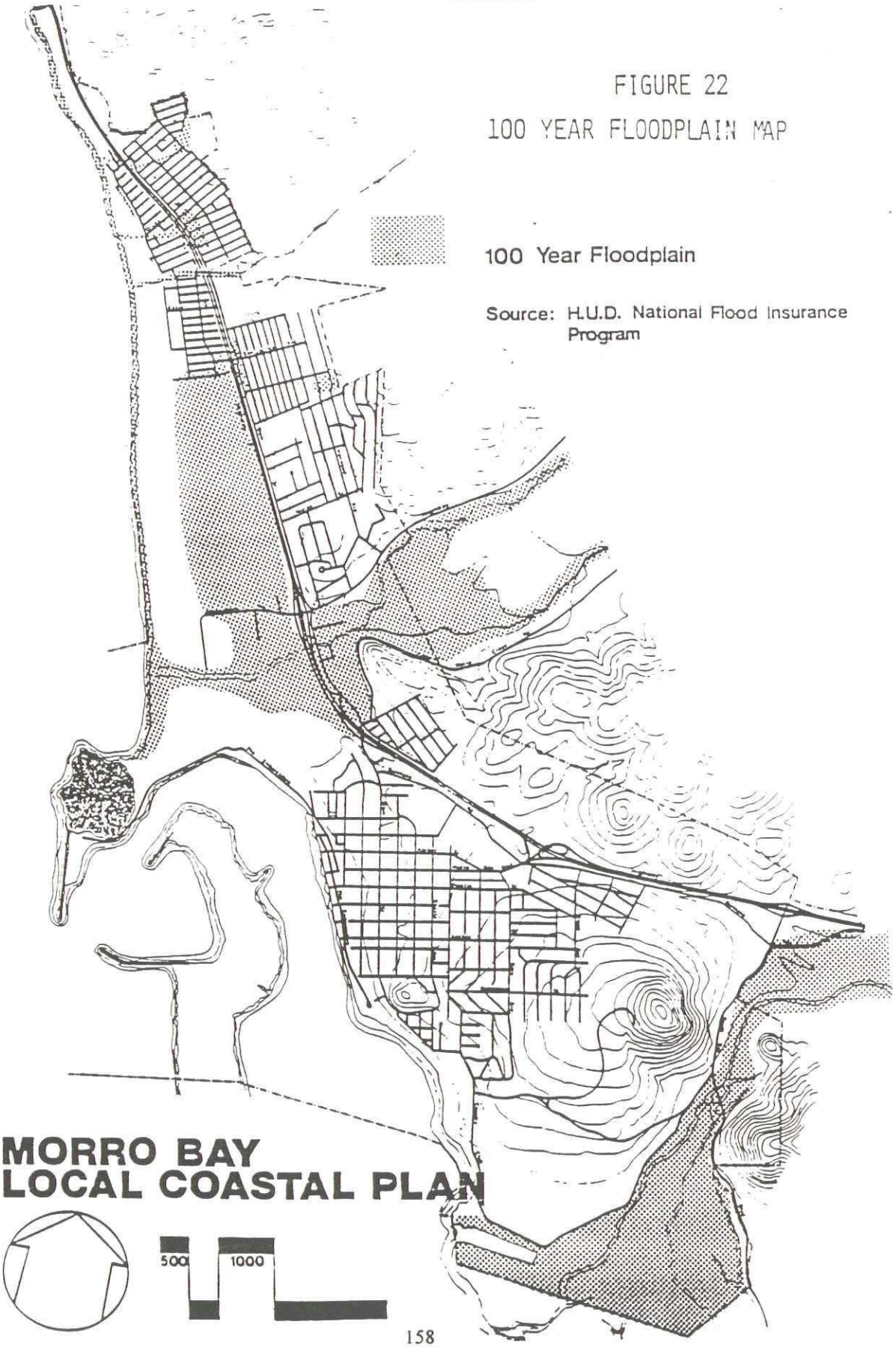
(4) The site of the high school itself, as well as the site of the City's sewage treatment plant and a portion of PG&E's property -- all near the lower reach of Morro Creek as it empties to the sea -- are subject to the 100-year flood.

(5) State Highway One, the most critical regional transportation link in Morro Bay, is subject to flooding during a 100-year storm where it crosses Morro Creek and at numerous locations in north Morro Bay where the highway crosses Unnamed and Noname Creeks, the drainage area at the foot of Nevis and Nassau Streets, and at the extreme northern end of the City where Toro Creek meets the highway.

Figure 22 is a schematic depiction of the flood prone areas as adapted from the Federal Flood Insurance Rate maps developed for the City of Morro Bay. The map, along with a model Flood Damage Prevention ordinance regulating development activities in flood prone areas, was only recently adopted by the City Council in November, 1979. As yet, however, there are no city policies or standards short of the incremental permit review requirements of the Flood Damage Prevention ordinance, to guide City planning decisions as to the appropriateness of flood prone areas for development or open space uses.

FIGURE 22

100 YEAR FLOODPLAIN MAP



2. Seismic Hazards

While the city of Morro Bay is in a seismically active area, there are no known active faults within or adjacent to the community. Nonetheless, potential threats to life and property from earthquakes and groundshaking, liquefaction, and tsunamis.

These and other hazards were discussed in detail in the City's Seismic Safety (1974) and Safety (1976) Elements. These reports also contained policies and recommendations necessary to minimize impacts from these hazards. The following discussion will identify those areas in the community subject to these hazards and incorporate by reference policies from the adopted elements.

a. Groundshaking

Though not located close to the state's largest fault, the City may expect strong groundshaking from an earthquake on the San Andreas Fault Zone. This fault, located at its closest 41 miles from the City, is expected to generate an earthquake of 8.0 to 8.5 in the near future.

The level of groundshaking is based on the distance from the earthquake and the geologic strata underlying the City. As shown in Figure 23, those portions of the community underlaid by dune sand or alluvium may expect the greatest amount of shaking. The amount of groundshaking in other portions of the community underlaid by landslide deposits and active sand dunes may vary greatly.

Other small faults, both on and off shore can also cause groundshaking in the community but these are not expected to be as severe as that generated by the San Andreas Fault.

b. Liquefaction

This condition results when a coarse grained, saturated soil loses it structure due to groundshaking. The result is a fluid material, not unlike quicksand. Areas in the community potentially subject to high liquefaction risk are those underlaid by bay muds, landslide deposits and recent alluvium as shown in Figure 24.

c. Tsunamis

Seismic tidal waves or tsunamis, can be triggered by earthquakes or undersea landslides. These may be local with the tsunami striking shore within minutes after the quake or be thousands of miles away and taking hours to reach the coast.

Morro Bay has suffered from tsunami damage in recent years, once in 1960 and then again in 1964. Triggered by an earthquake off the coast of Chile, the 1960 tsunami caused minor damage to a pier in the Morro Bay harbor. The 1964 tsunami resulted from an earthquake off Alaska and caused over $2,500 damage in the harbor to wharves, piers and buoys.

FIGURE 23
GROUND SHAKING MAP

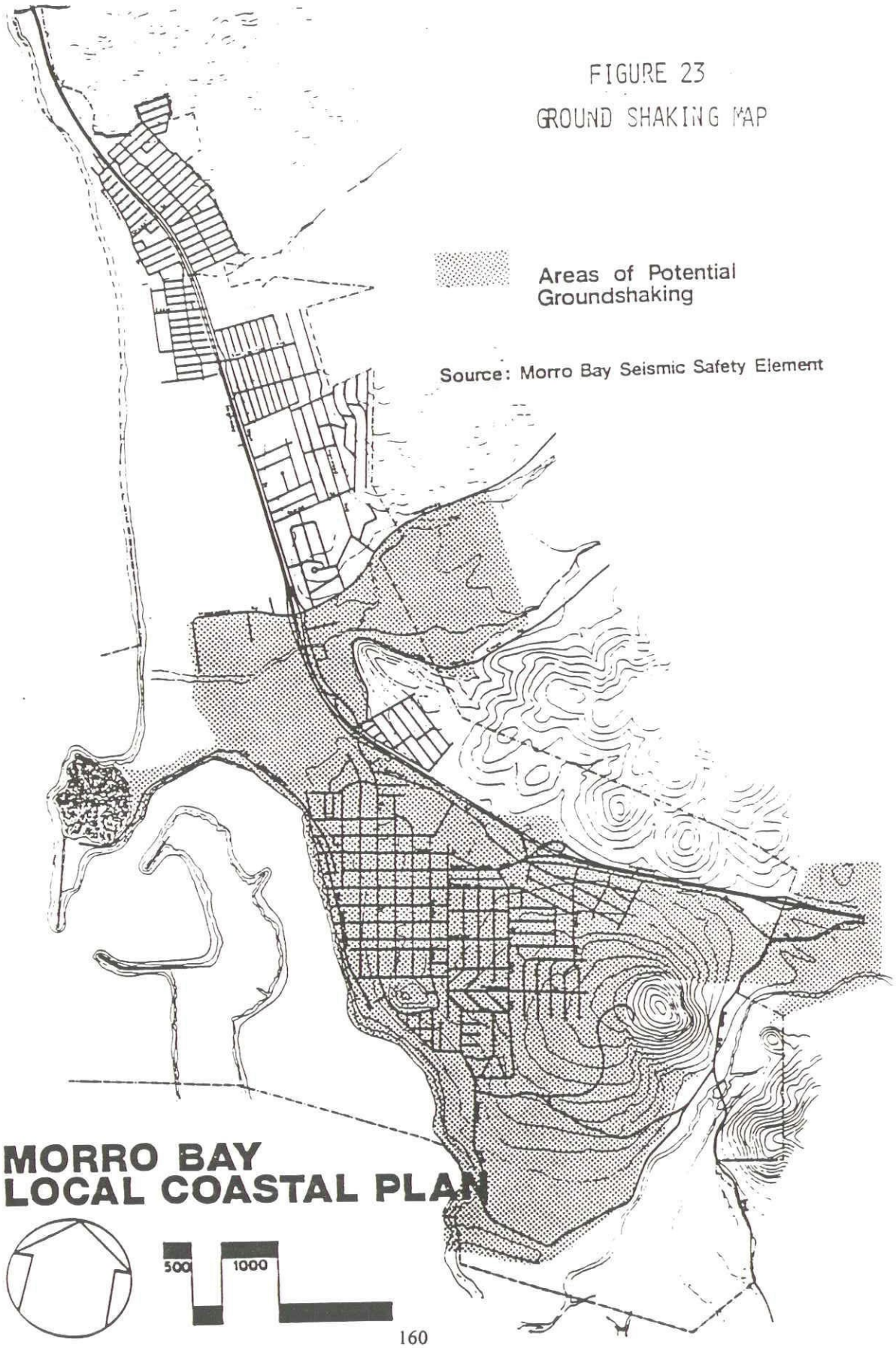
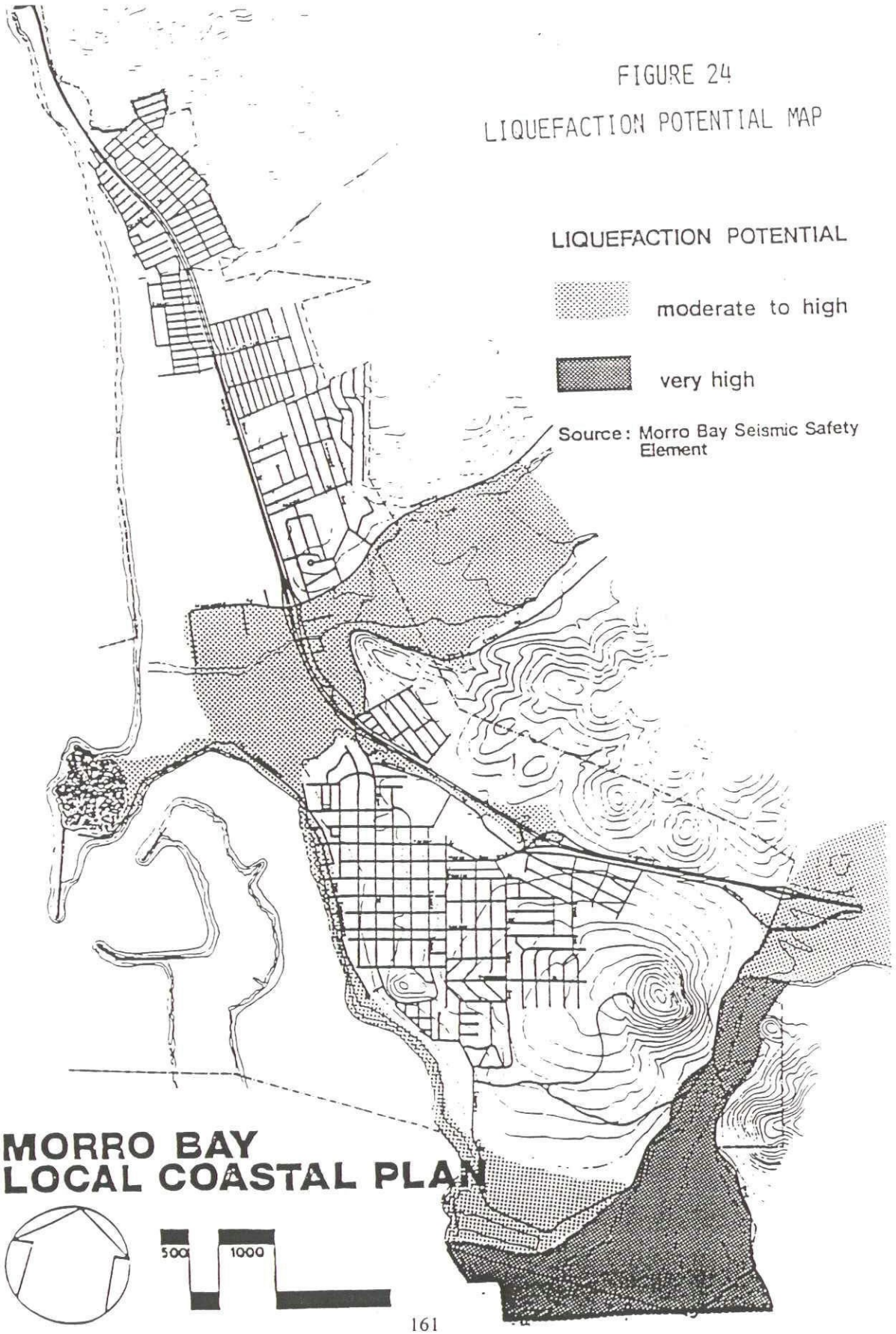


FIGURE 24

LIQUEFACTION POTENTIAL MAP



For planning purposes, tsunami risk is indicated by potential run up areas. Broadly speaking, this would include any area within one mile of the coast with an elevation of less than 50 feet. This would then include the Embarcadero, and all areas up to State Highway One in the Atascadero Beach area. Due to the sand spit and narrow entrance channel providing protection to the harbor, water level fluctuations here should be minimal. The California Division of Mines and geology (1972) classifies the Morro Bay coast as "potentially dangerous if tide and tsunami are in phase." The major protection from tsunamis is a system of warning and evacuation. Warning is handled by the U.S. Weather Service and other agencies with evacuation in the hands of the local officials. The primary concern in evacuation is the low lying beach areas north of Coleman Park, heavily used for recreation.

The City's Seismic Safety (1974) and Safety (1976) Elements contain a series of policies to address these geologic hazards. These policies are:

"1.0 Provide for the identification and evaluation of existing structural hazards, and abate those hazards to acceptable levels of risk.

2.0 Ensure that new development within the City's jurisdiction is designed to withstand natural and man-made hazards to acceptable levels of risk.

3.0 Regulate land use in areas of significant potential hazards.

4.0 Provide for the maintenance and improvement of emergency response planning and organization.

5.0 Provide for more detailed scientific analysis of natural and man-caused hazards in the City.

6.0 Educate the public in the nature and extent of natural hazards in the area and in ways of minimizing the effects of disasters.

7.0 Review and upgrade the Safety and Seismic Safety Elements on a regular basis."

Accompanying these policies are implementing measures necessary to ensure protection of life and property in the City. Those policies from the Seismic Safety and Safety Element addressing seismic hazards meet the intention of the Coastal Act.

3. Geologic Hazards

The hazards discussed here are those usually not directly related to earthquake activity, but still present a threat to life and property within the community.

Abutting the City on three sides are steep hillsides. Development on these hillsides will alter the natural slope and topography often leading to landslides and erosion. Landslides are the downslope movement of rock and soil which may occur in a few minutes or through many years. Erosion refers to the breakdown and the washing away of surface material, usually soil.

a. Landslides

Due to the structural weakness of the underlying rocks, the hills to the east and north of the community have been subject to naturally caused slides throughout the ages (see Figure 25). While most of these slides are stable in their present condition, new development could reactivate them. This often results from grading practices accompanying development that steepen the slope angle or increase the slope height.

These hillside areas have been identified by the Seismic Safety Element (1974) as a high landslide risk zone. To provide more specific hazard information within this area (Zone F), the City commissioned a detailed geologic analysis which also identified appropriate development standards. These standards are based upon the individual parcels, geologic, slope and soil characteristics, and ensure development is consistent with Coastal Act Policies.

The special study was conducted by Central Coast Laboratory on a parcel-by-parcel basis for the subdivided areas of the City. In addition, the City currently has a policy that, in unsubdivided areas, a geology study must be conducted to determine landslide potential in Zone F areas. Further, the study divided Zone F into five subzones based on percent slope, landslide evidence other geological hazards and soil types. The five subzones are given generally as follows:

Sub-Zone 1: Those land areas having slopes less than ten percent, free of landslides and other significant geological hazards and having soil types which are considered only moderately expansive and of low plasticity.

Sub-Zone 1C: Same as Subzone 1 with soil types which are considered expansive to highly expansive.

Sub-Zone 2A: Those land areas having slopes of 10 percent to 30 percent, free of landslides and other significant geological hazards which exhibit soil types which are either of volcanic or sandstone origin and exhibit low expansion and plasticity.

Sub-Zone 2C: Those land areas having slopes of 10 percent to 30 percent, free of landslides and other obvious geological hazards which exhibit soils of high plasticity, medium to high expansion characteristics and moderate to low shear strength when wet.

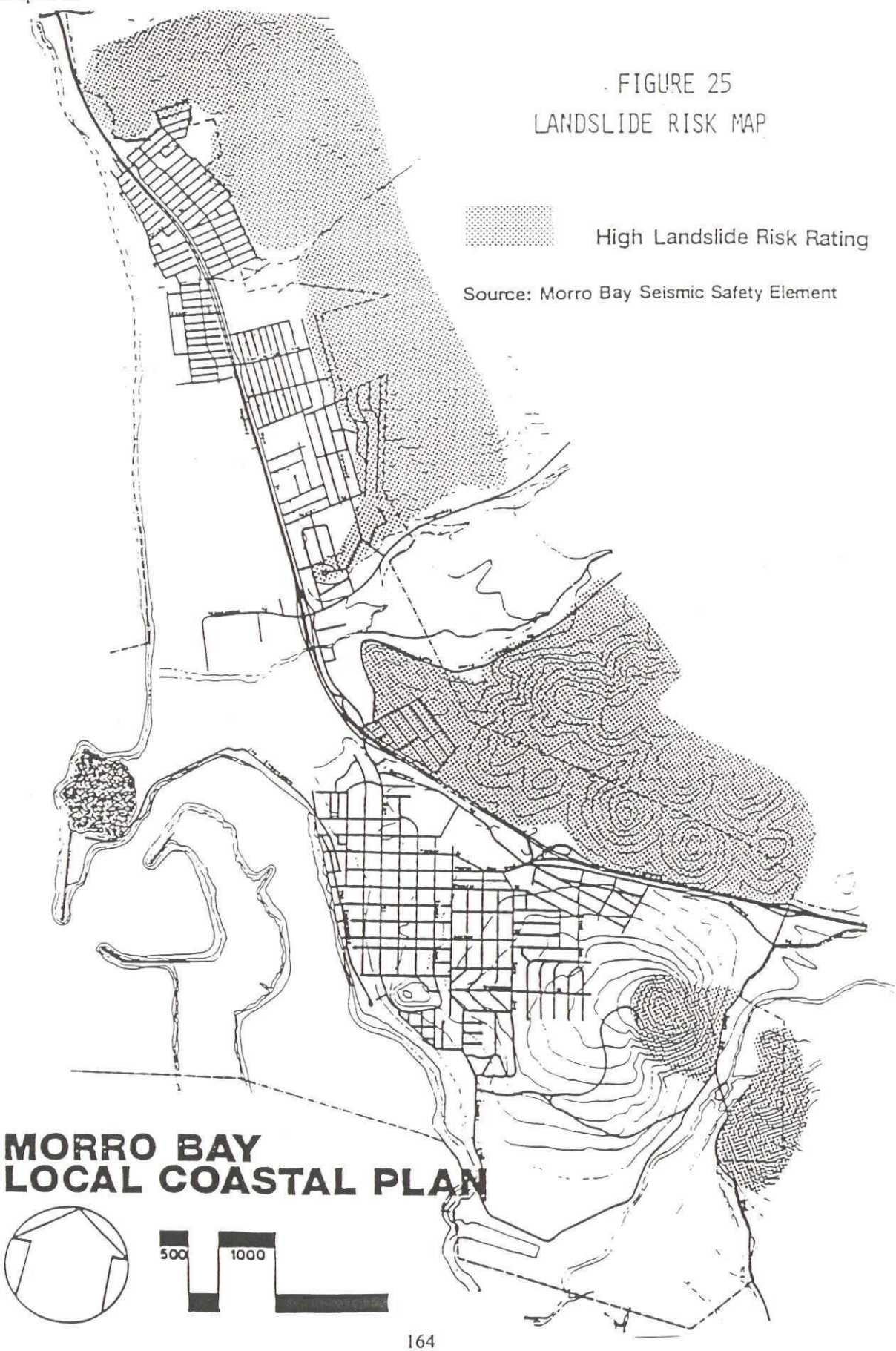
Sub-Zone 3: Those land areas having landslides, adverse water conditions, unstable soils, slopes greater than 30 percent or other apparent geological hazards.

With the exception of Sub-Zone 3, minimum foundation standards have been set for subdivided parcels on a parcel-by-parcel basis. For Sub-Zone 3, a detailed soils and geological report must be provided which identifies the hazards and provides for mitigating measures to assure a stable foundation. The report is required to be prepared by a licensed geologist or civil engineer. In addition, any subdivided lots so designated as having fill also must have a soils report verifying the condition of the fill and the stability of the lot.

FIGURE 25
LANDSLIDE RISK MAP

High Landslide Risk Rating

Source: Morro Bay Seismic Safety Element



Note: The subzone maps and the Central Coast Laboratory reports are available from the City Community Development Department. Because of their scale, the maps cannot be reproduced in this document.

b. Erosion

Disturbance of hillsides from development may also alter natural drainage patterns and vegetative cover, thus increasing runoff and the erosion that results. Development also brings an increase in impermeable surfaces -- such as roofs and driveways that also increase runoff. This runoff then contributes to downstream flooding and is lost for groundwater basin recharge. It also carries sediment and other pollutants into coastal streams and estuaries.

The City's grading ordinance has been ineffective in preventing offsite sedimentation from construction sites. Amendment of the ordinance with specific standards for hillside development and major subdivision is necessary to protect water quality and to meet the intent of the Coastal Act.

An additional concern to the community is the grading of roads ostensibly for agricultural purposes on hillsides immediately adjacent tot he City. This grading creates scenic impacts, increases erosion and may destabilize existing landslides, posing a threat to downslope development.

Due to the sensitivity of these area, the conservation Element (1974) has recommended that the City's Zoning and Subdivision Ordinance be amended to address specific hillside concerns. These include:

(1) hillside density and slope limits;
(2) grading and lope stabilization measures;
(3) open space requirements;
(4) site design; and
(5) visual impacts.

The large amount of eroded sediment being deposited within the Morro Bay Estuary can pose a severe threat to the biological productivity of this sensitive habitat (see Chapter on Environmentally Sensitive Habitat Areas). A study prepared for the county's Local Coastal Plan, Erosion Sources in the Morro Bay Watershed (1979), has identified agricultural practices within the watershed as a major source of sediment.

To ensure water quality protection, the Central Coast Regional Water Quality Control Board has developed standards relating to construction, agriculture and other activities that may cause erosion in the Morro Bay watershed. These standards, "Best Management Practices" are designed to minimize runoff and erosion. Use of these practices by both the City and the County watershed management plan as identified in the study Erosion and Sediment in Central Coast Watersheds (1979) could significantly reduce sedimentation in Morro Bay. This pan could be developed in conjunction with the Water Management Plan recommended for the Chorro and Morro groundwater basins (see Chapters on Agriculture and Public Works).

c. Coastal Erosion

Coastal erosion within the community generally is not a problem with the exceptions of the constant shoaling in the harbor, the accretion of sand in the Coleman Park area and bluff erosion in several areas of the city. The harbor shoaling and the accretion of sand result from the naturally occurring littoral drift and wind pattern for this area.

This sand accumulation poses maintenance problems to the City and threatens to inundate Coleman Park. A dune revegetation program has begun for public ownership parcels with Coastal Conservancy financial assistance.

While not bordering the water, the bluff line running from the PG&E Power Plan to Morro Bay State Park is being eroded in some areas. This is due to the sandy nature of the soil making up the bluff. Another bluff line in the community is found along Beachcomber Drive behind Atascadero State Beach.

The Coastal Act requires bluff-top development to be sited and designed to assure structural stability while minimizing alteration of natural land forms. Since the fluff line along Beachcomber Drive is in Atascadero State Beach, the State Department of Parks and Recreation should ensure new development will not alter the existing topography nor contribute to bluff erosion. Special attention should also be paid to access trails down the bluff face to the beach so they do not contribute to bluff erosion. These measures may include revegetation, posting or development of stairways. The City shall also ensure runoff from the road does not add to the erosion. Although the bluff line along Beachcomber Drive is within the jurisdiction of State Parks and Recreation, the City will have the responsibility to review and approve all development proposed by State Parks upon LCP certification. Appropriate policies must be included to guide State Parks and other development consistent with the Coastal Act.

Because most of the existing bluff top fronting the Tidelands Park and Embarcadero has been developed and the visual character which this bluff brings to the waterfront area has been established, setbacks will be based on the site specific standards necessary to ensure structural stability. Alteration of the bluff face and the slope stabilizing vegetation will not be allowed.

However, for commercial development in the Embarcadero that will serve as a connecting link between the waterfront and downtown, development that steps down the bluff face may occur. This must be accomplished without major alteration to the bluff face, through retaining walls may be used.

4. Wildland Fire Hazards

The dry vegetation throughout much of the year that exists in the hills east of Morro Bay, together with the dry climate and topography of this area, greatly enhances the potential of major brush fire.

Fires in these areas can have serious impacts on downstream development and water supplies. When vegetation is burned off, erosion becomes a critical problem, especially during the rainy season. Consequently, mudslides and landslides could threaten downhill development.

It is also important that fires be prevented in hillside areas since the foothills are of major importance in protecting the watershed. The vegetation in these area show down overland flow which reduces erosion and allows greater groundwater recharge. Otherwise, the water is lost as runoff to the ocean and may greatly contribute to erosion, sedimentation and flooding downstream.

Wildland fires have not historically been a serious problem in the Morro Bay region due to a relatively low use of the hillside areas. Nevertheless, proper management of watershed areas is necessary to protect downstream land uses.

5. Urban Fire Hazards

Due to the concentration of people and property in the City, the potential for fire increases as do the chances for the fire spreading. Urban fire risk is felt to be a factor of both the structural types and fuel potential in the community as well as the City's capacity to respond to fires.

Based on these and other factors, communities are rated by the Insurance Service Office on a scale of 1 to 10 (with 1 being the lowest risk) for their fire hazard. These ratings are then reflected in the Fire Insurance premiums which homeowners pay. For the urbanized portions of the City, the ration is a class 5 (median) and the rural section go as low as Class 9 (high risk).

The City's adopted Safety Element (1976) contains policies that address both wildland and urban fire hazards and will be adopted by reference into the LCP-Land Use Plan.

6. Navy Jet Fuel Storage Area

This facility occupies approximately 12 acres in the northern portion of the community. The facility is surrounded by residential development and undeveloped hills. At this time, the Navy does not anticipate expansion of this facility nor phasing out the operation.

Aviation fuel is brought to the facility by ocean tankers and is temporarily stored then transferred to air basis in the Central Valley. Currently, all receiving and shipping of fuel is through underground pipelines. A real potential problem may arise if the volume of fuel through the pipelines cannot be adequately transferred without the use of truck tankers. The impact of increased truck traffic in the area would become a hazard due to the narrow system of streets, exposing lives to increased potential of fuel spills and having trucks impact State Highway One without adequate traffic control in the form of signals. Policies addressing this facility are found in Chapter VII, Energy/Industrial Development.

D. HAZARDS POLICIES

Policy 9.01 All new development located within areas subject to natural hazards from geologic, flood and fire conditions, shall be located so as to minimize risks to life and property.

Policy 9.02 All new development shall ensure structural stability while not creating nor contributing to erosion or geologic instability or destruction of the site or surrounding area.

Policy 9.03 All development, including construction, excavation and grading, except for flood control projects and agricultural uses shall be prohibited in the 100-year floodplain areas unless off-setting improvements in accordance with the HUD regulations are required. Development within flood plain areas shall not cause further stream channelization, alignment modifications or less of riparian habitat values consistent with Section 30236 of the coastal Act. Permitted development shall be consistent with all applicable resource protection policies contained in the Coastal Act and in the City Land Use Plan.

The Land Use Plan Map shall designate the flood prone lands at the western limits of the Morro and Chorro Valleys for agricultural uses.

Development in the flood prone areas within the City shall include finished floor elevations two feet about the 100 year flood elevation. The heights of permitted development shall be compatible with the character of the surrounding area and not conflict with scenic and visual qualities.

Policy 9.04 Soils reports prepared by a licensed civil engineer with expertise in soils, and geology and reports prepared by a certified engineering geologist shall be required prior to acceptance for filing of development applications in the following areas:

a. Zone F, subzones 2 and 3;

b. all areas having fill material on the property;

c. where there are known or suspected geologic, soils, or hydrologic problems in the immediate vicinity;

d. In addition, soils and/or geology reports may be required whenever in the judgment of the Chief Building Official, or City Engineer such studies are needed.

The geology and soils reports shall identify and evaluate any hazards present including faults under or near the site, and shall provide for mitigating measures to assure a stable foundation. These reports shall contain statements that the proposed project will not destabilize adjacent or nearby land or improvements or create a public hazard or nuisance. Areas identified in the geology reports as having potentially active land slides or gross instability shall be retained in open space. The soils report shall make recommendations as to the need for any temporary shoring during the construction phase.

Whenever geology and/or soils reports are required, a detailed and accurate topographical and land use map shall be required. Such maps shall be prepared by a licensed professional surveyor and shall show topographical contours at 1' intervals over the entire site and for a distance of not less than 50' outside of the perimeter of the site. The topographical map shall show all existing improvements or structures in the area, individual trees of 6" diameter or greater at four (4) feet in height on the property and within 50 feet of its perimeter, and existing site drainage and watercourses. This map shall be available to the preparers of the geology and soils reports prior to completion of those reports.

Whenever geology and/or soils reports are required, grading, foundation, retaining wall and structural plans shall be designed and prepared by a licensed civil or structural engineer. Grading and excavation plans shall show the elevations of the corners of all proposed structures. The Chief Building Official may require independent peer review of any of the above reports and maps with the cost of such review being borne by the applicant. Whenever geology and/or soils reports are required, sediment and erosion control plans shall also be required.

Prior to issuance of any building permit where geology and soils reports are required, a bond shall be posted with the City in the amount of 150% of the estimated cost of restoring the site to a stable, non-hazardous condition in the event that construction plans are not completed. A bond shall also be required for sedimentary and erosion control devices required by the City.

The Chief Building Official may require independent special inspections to review grading, fill, retaining wall, foundations or structural work, or erosion controls, with the cost of such special inspections being borne by the applicant. Requirements for any such special inspections shall be noted on the approved plans.

Upon completion of engineered foundations for projects where geology and soils reports were required, the responsible civil or structural engineer shall certify in writing to the City that the foundation was constructed in conformance with the approval structural design.

In addition to the requirements above, all grading and building plans shall conform to relevant sections of the Uniform Building Code, CAL OSHA requirements, and any grading ordinance that may be adopted by the City of Morro Bay.

Policy 9.05 Plans for development shall minimize cut and fill operations. Plans showing excessive cutting and filling shall be modified or denied if it is determined that the development could be carried out with less alteration of the natural terrain.

Policy 9.06 All development shall be designed to fit the site topography, soils, geology, hydrology, and any other existing conditions and be oriented so that grading and other site preparation is kept to an absolute minimum. To accomplish this, structures shall be built to existing natural grade whenever possible. Natural features, landforms, and native vegetation, such as trees, shall be preserved to the maximum extent feasible. Areas of the site which are not suited to development because of known soil, geologic, flood, erosion or other hazards shall remain in project open space.

Policy 9.07 For permitted grading operations on hillsides, the smallest practical areas of land shall be exposed at any one time during development, and the length of exposure shall be kept to the shortest practicable amount of time. Where a proposed grading operation has the potential for causing significant erosion or sedimentation of water bodies, the grading shall be commenced and concluded during the dry season of April 1 to October 31 of each year. Grading permits shall include requirements for sediment catch basins, revegetation within a specified period of time and other slope stabilization measures. All measures for capturing sediments and stabilizing slopes including revegetation shall be in place before the beginning of the rainy season, and shall be implemented in conjunction with the initial grading operations.

Policy 9.08 Sediment basins (including debris basins, desilting basins, or silt traps) shall be installed on the project site in conjunction with the initial grading operations and maintained through the development process to remove sediment from runoff waters. Sediment basins shall be in place prior to the commencement of the winter rainy season defined in Policy 9.07. All sediment shall be retained on site unless removed to an appropriate dumping location approved by the City consistent with relevant policies of the coastal Act and the Morro Bay Local Coastal Program.

Policy 9.09 Temporary vegetation, seeding, mulching, or other suitable stabilization methods shall be used to protect soils subject to erosion that have been disturbed during grading or development. All cut and fill slopes shall be stabilized immediately with planting or native grasses and shrubs, appropriate nonnative plants, or with accepted landscaping practices.

Policy 9.10 In permitted development, drainage devices shall be required in order to conduct surface water to storm drains or suitable watercourses to prevent erosion. Drainage devices shall be designed to accommodate increased runoff resulting from modified soil and surface conditions as a result of development. Water runoff shall be retained on-site whenever possible on whenever there is the capability to facilitate groundwater discharge.

Policy 9.11 Degradation of the water quality of groundwater basins, nearby streams, or wetlands shall not result from development of the site. Pollutants, such as chemicals, fuels, lubricants, raw sewage, and other harmful waste, shall not be discharged into or alongside coastal streams or wetlands either during or after construction.

Policy 9.12 To protect the sensitive Morro Bay Estuary, the City shall require all development including any interim agricultural uses to follow the Best Management Practices of the Regional Water Quality Board within the City limits and will urge the County to adopt the use of Best Management Practices for all land uses within the Morro Bay watershed. These Best Management Practices, as determined by the Regional Water Quality Control Board, are designed to minimize runoff and erosion.

Policy 9.13 The City shall also urge the county and other appropriate public agencies to develop a Watershed Management Plan to review all land uses within the watershed for potential impacts on water quality and quantity.

Policy 9.14 All development along bluffs shall be adequately set back to ensure protection of the development for its economic life and development shall not require alteration of the existing bluff land form or beach. New development shall assure stability and structural integrity, and neither create nor contribute significantly to erosion or geologic instability by accomplishing the following:

(1) Bluff-top setback shall be determined from a site-specific geology report prepared by a registered geologic engineer. The report shall set forth recommendations for building setbacks which shall ensure structural stability and integrity without altering bluff land form or necessitating the construction of protective devices such as seawalls for the life of the development (75-100 years).

(2) The face of the bluff and vegetation or fill material stabilizing the slope shall not be altered.

Policy 9.15 All new development on bluff tops shall be required to install drainage systems to carry runoff inland to the nearest public street. In areas where the topography prevents such conveyance, because additional filling or grading would create greater adverse environmental or visual impacts, private bluff drainage seaward should be permitted if the drainage system is sized to accommodate drainage from adjacent parcels and the system is designed to minimize visual impacts utilizing natural coloring, natural land forms, and vegetative planting to hide the system.

Policy 9.16 Development shall not be permitted on the bluff face except for the above drainage systems and for engineered staircases or accessways to provide public beach access and pipelines for scientific research or coastal-dependent industry. To the maximum extent feasible, these structures shall be designed to minimize alteration of the bluff and beach.

Policy 9.17 In the Embarcadero area between Surf Street and Anchor Street, development may be stepped down the bluff face. However, the development shall not require the construction of protective devices or retaining walls that would alter natural landforms or impede public access.

Policy 9.18 Channelizations, dams, or other substantial alterations of rivers and streams shall incorporate the best mitigation measures feasible, and be limited to (1) necessary water supply projects, (2) flood control projects where no other method for protecting existing structures in the flood plain is feasible and where such protection is necessary for public safety or to protect existing development, or (3) development where the primary function is the improvement of fish and wildlife habitat.