5 NATURAL HAZARDS

Ensuring the safety of community members, through protection from hazards, is an essential service of public agencies and a critical priority for maintaining community health. The purpose of the Natural Hazards chapter is to establish goals and policies to mitigate the potential impacts from natural and man-made hazards that pose a threat to public health and safety.

5.1 COASTAL ACT FRAMEWORK

The Coastal Act seeks to ensure that new development minimizes risks to life and property, does not create unstable site conditions, does not create or contribute significantly to erosion, and does not require new protective devices along the shoreline (Section 30253). The same Coastal Act policy also states that new development must not require new protective devices to be built along the shoreline, reinforcing the requirement of Section 30235 that construction that alters the natural shoreline may only be permitted in specific cases, and when designed to mitigate adverse impacts on the local shoreline and sand supply. Meanwhile, Sections 30212 and 30214 specify that public access to the shoreline is to be consistent with public safety, including with regard to geologic site characteristics. Policies relevant to this chapter are below. Chapter 2 contains the full text of each Coastal Act policy.

Coastal Act Policies

Article 2: Public Access

- **Section 30212** New development projects
- **Section 30214** Implementation of public access policies; legislative intent

Article 4: Marine Environment

- **Section 30235** Construction altering natural shoreline
- **Section 30236** Water supply and flood control

Article 6: Development

- **Section 30253** Minimization of adverse impacts

5.2 SEISMIC AND GEOLOGIC HAZARDS

The Planning Area lies within the geologically complex region of California known as the Coast Range geomorphic province. Much of the Coast Range province is composed of marine sedimentary deposits and volcanic rocks that form northwest trending mountain ridges and valleys, running subparallel to the San Andreas Fault Zone. West of the San Andreas Fault lies the Salinian Block, a granitic core that extends from the southern end of the province to north of the Farallon Islands.

Coastal Bluffs

Pacifica's Coastal Zone prominently features coastal bluffs. A bluff is a high bank or bold headland with a broad, precipitous, sometimes rounded cliff face overlooking a plain or body of water. A coastal bluff is a bluff overlooking a beach or shoreline or that is subject to marine erosion. Many coastal bluffs consist of a gently sloping upper bluff and a steeper lower bluff or sea cliff. The term "coastal bluff" refers to the entire slope between a marine terrace or upland area and the sea. The term "sea cliff" refers to the lower, near vertical portion of a coastal bluff. For purposes of establishing jurisdictional and permit boundaries coastal bluffs include, (1) those bluffs, the toe of which is now or was historically (generally within the last 200 years) subject to marine erosion; and (2) those bluffs, the toe of which is not now or was not historically subject to marine erosion, but the toe of which lies within an area otherwise identified as an Appealable Area.

The Bluff Edge is the upper termination of a bluff, cliff, or seacliff. In cases where the top edge of the bluff is rounded away from the face of the bluff as a result of erosional processes related to the presence of the steep bluff face, the bluff line or edge is defined as that point nearest the bluff beyond which the downward gradient of the surface increases more or less continuously until it reaches the general gradient of the bluff. In a case where there is a steplike feature at the top of the bluff face, the landward edge of the topmost riser shall be taken to be the bluff edge. Bluff edges typically retreat landward due to coastal erosion, landslides, development of gullies, or by grading (cut). In areas where the bluff top or bluff face has been cut or notched by grading, the bluff edge is the landward most position of either the current of historic bluff edge. In areas where fill has been placed near or over the historic bluff edge, the original natural bluff edge, even if buried beneath fill, shall be taken to be the bluff edge.

Seismic Hazards

Earthquakes can cause surface rupture from faulting or seismically induced effects, such as ground shaking and landslides. The challenge is to:

- *Minimize Earthquake-Related Hazards, Liquefaction, and Landslides*. The San Andreas Fault, which traverses the northeast corner of Pacifica, is active and capable of causing a large earthquake. Areas located on or immediately adjacent to the mapped fault traces must be investigated prior to any development to ensure that fault rupture hazards be avoided or minimized.

  Areas located within the alluvial valleys could have a high potential for liquefaction. Site-specific geotechnical investigations can confirm the presence of liquefiable materials and provide foundation design criteria to mitigate the potentially damaging effects of liquefaction.

  The Planning Area also includes slopes that are susceptible to landslides, especially areas with greater than 50 percent inclines. Geotechnical engineering can typically overcome the challenges of development on steep terrain through drainage improvements, anchoring foundations in deeper materials, re-grading slopes, and other methods.

- *Minimize Hazards Related to Winter Storms and Coastal Erosion*. Much of Pacifica's coastline is subject to severe coastal erosion. Short term erosion hazards are generally mitigated through best management practices and use of soft stabilization techniques. In areas that are experiencing active coastal erosion, the most effective mitigation is to relocate development. With sea level rise, there is potential for more serious long-term coastal erosion, which could be a critical challenge within the Planning Area.

Modern seismic activity within the Coast Range continues to be associated with movement along the San Andreas system of faults. Regionally, this fault system is the boundary between large sections, or plates, of the earth's crust known as the North American Plate and Pacific Plate. The Bay Area is considered an area of high seismic activity, with an estimated 63 percent probability of an earthquake of magnitude 6.7 or higher occurring in the region over the next 30 years.[1]

The ***San Andreas Fault*** is the principal strike-slip boundary between the Pacific plate to the west and the North American plate to the east. Its main trace trends northwest through the Santa Cruz Mountains and the eastern side of the San Francisco Peninsula. Between Pacifica and San Mateo, Crystal Springs Reservoir and San Andreas Lake clearly mark the rupture zone.

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[1] United States Geological Survey (USGS) Working Group on California Earthquake Probabilities (WG07). Fact Sheet 2008-3027, Forecasting California's Earthquakes – What Can We Expect in the Next 30 Years?,http://pubs.usgs.gov/fs/2008/3027/fs2008-3027.pdf. 2008.

The ***Hayward Fault*** trends to the northwest within the East Bay, extending from San Pablo Bay in Richmond, 60 miles south to San Jose. Although large earthquakes on the Hayward Fault have been rare since 1868, a large earthquake could occur on the Hayward fault over the planning period.

The ***Calaveras Fault***, located in the eastern San Francisco Bay region, trends along the eastern side of the East Bay Hills, west of San Ramon Valley, down into the western Diablo Range, and eventually joining the San Andreas Fault Zone south of Hollister. The Calaveras Fault has been the source of numerous moderate magnitude earthquakes but the probability of a large earthquake is much lower than on the San Andreas or Hayward faults.

Fault Rupture

Fault rupture is the surface displacement of the earth's surface due to the movement along a fault associated with an earthquake. Ground displacement is generally experienced on or within the immediate vicinity of the mapped fault trace. The Alquist-Priolo Earthquake Fault Zoning Act of 1972 established the requirement to regulate development within Earthquake Fault zones associated with active faults. Development is feasible but requires detailed geologic and seismic evaluations by certified professionals prior to approval of a building permit.

An Alquist-Priolo fault hazard zone associated with the San Andreas Fault grazes the northeast corner of Pacifica's Coastal Zone, as shown in **Figure 5-1**, applying to a small amount of housing in the Fairmont West neighborhood.

Ground Shaking

Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material. The composition of underlying soils, even those relatively distant from faults, can intensify ground shaking. The strongest ground shaking anticipated to occur in Pacifica would come from the San Andreas Fault, and could cause strong to very violent ground shaking.

Liquefaction

Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits. Four kinds of ground failure commonly result from liquefaction: lateral spread, flow failure, ground oscillation, and loss of bearing strength. Liquefaction and associated failures could damage foundations, roads, underground cables and pipelines, and disrupt utility service. The depth to groundwater influences the potential for liquefaction, in that sediments need to be saturated to have a potential for liquefaction.

In the Coastal Zone, areas surrounding some of the alluvial drainages (i.e., San Pedro Creek Valley and Sanchez Creek Valley) contain some areas of very high liquefaction potential. Medium liquefaction potential exists in many low-lying neighborhoods, including West Edgemar-Pacific Manor, West Sharp Park, Rockaway Beach and Quarry, and parts of Pedro Point.[2] The Liquefaction and Fault Lines map (**Figure 5-1**) shows more detail.

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[2] Association of Bay Area Governments (ABAG). Liquefaction Susceptibility http://www.abag.ca.gov/bayarea/eqmaps/liquefac/liquefac.html. 2003.

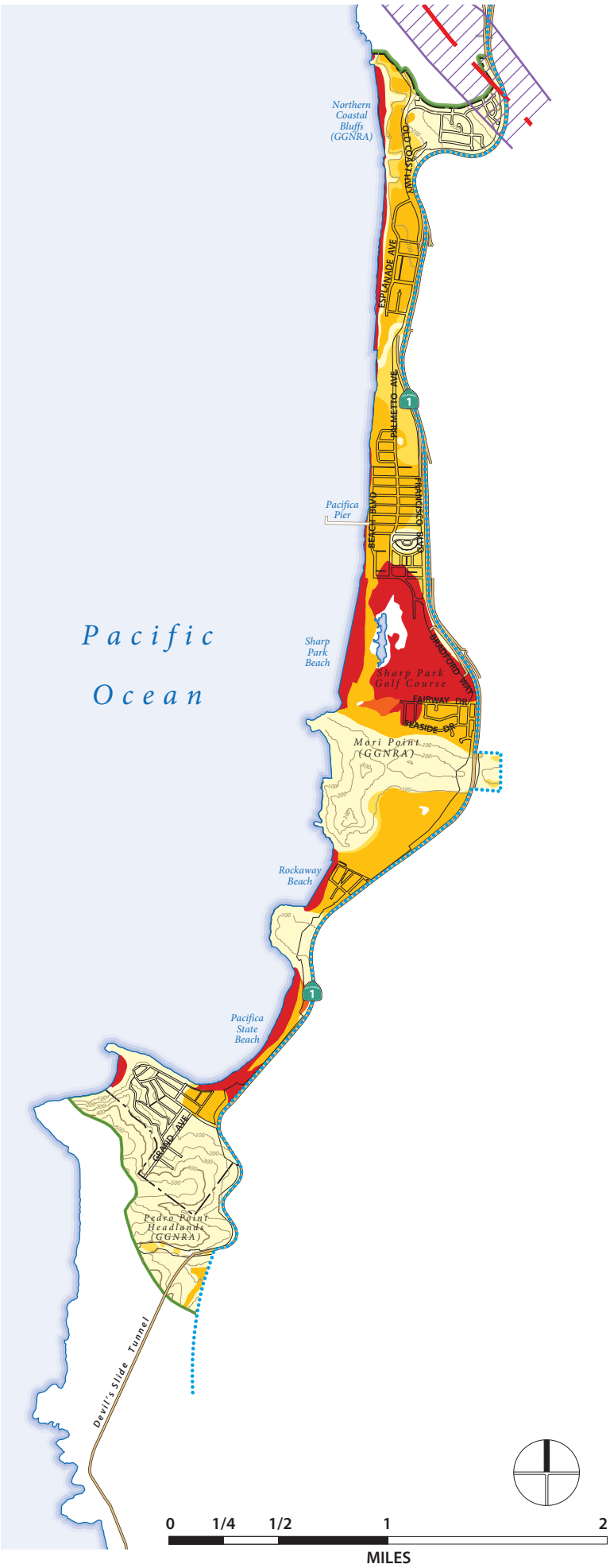

Figure 5-1:

Liquefaction and Fault Lines

Liquifaction Potential

- Very Low
- Low
- Medium
- High
- Very High
- San Andreas Fault
- Alquist-Priolo Zone
- 100 foot contour interval
- 400 foot contour interval
- Coastal Zone
- City Limits
- Planning Area

Source: Association of Bay Area Governments, 2003; US Geological Survey, 2008; ESA. 2009; City of Pacifica, 2008; San Mateo County, 2009; Dyett & Bhatia, 2013.

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Other Hazards

A tsunami is a wave generated by abrupt movement of the seabed, which can occur as an earthquake or after a significant landslide. By contrast, Seiche is a standing wave in an enclosed body of water. Within Pacifica, only Laguna Salada might be subject to seiche, but the potential for significant risk is low.

There are no dams within or above Pacifica, and therefore the city is not at risk from a seismically induced dam failure. However, a seismic event may cause water tanks located in the hills above populated areas to burst and inundate areas below.

Slope Failure and Erosion

Slope Failure

Slope failures, commonly referred to as landslides, include many phenomena that involve the downslope displacement and movement of material, and can be triggered by either static (i.e., gravity) or dynamic (i.e., earthquake) forces. The geology, structure, and amount of groundwater in the slope affect slope failure potential, as do external processes (i.e., climate, topography, slope geometry, and human activity). Slope failure may occur on slopes of 15 percent or less; however, the probability is greater on steeper slopes that exhibit old landslide features such as scarps, slanted vegetation, and transverse ridges. Landslide-susceptible areas are characterized by steep slopes and downslope creep of surface materials, and are more common in zones of active faulting.

Figure 5-2 shows three slope failure threat categories: Mostly Landslides, Few Landslides, and Not Landslide Prone.[3] Mostly Landslide areas consist of mapped landslides, intervening areas typically narrower than 1,500 feet, and narrow borders around landslides; defined by how groups of mapped landslides are clustered. Areas mapped as Few Landslides contain few, if any, large mapped landslides, but locally contain scattered small landslides and questionably identified larger landslides; defined in most of the region by excluding groups of mapped landslides. Steep slopes on Mori Point, Rockaway Headlands, and San Pedro Mountain are identified as likely sites of slope failures, as are small portions of areas in or near development in the Pedro Point and Fairmont neighborhoods. According to the City's Local Hazard Mitigation Plan Annex, 45 acres of residential property and 37 acres of infrastructure are located in areas classified as mostly landslide area in the Planning Area. This includes 15 acres of residential property in the Coastal Zone.

SLOPE FAILURE IN THE COASTAL ZONE

The coastline of San Mateo County includes steep upland areas that are susceptible to slope failures. Most notably, the large coastal slide known as Devil's Slide is located at the southern end of the Planning Area. Devil's Slide has a long history of slope failures and rock slides that occasionally caused closures of Highway 1 before the highway was rerouted through the Devils Slide tunnels.

SUBSIDENCE

Subsidence—the sinking of a portion of the ground surface—can occur from immediate settlement, consolidation, shrinkage of expansive soil, and liquefaction. Subsidence can also be caused by earthquakes or the excess extraction of groundwater.

Portions of Pacifica are underlain by relatively clean, poorly consolidated granular material, such as sand. There are perched layers of groundwater in places, potentially creating the conditions for liquefaction. A1so,

[3] United States Geological Survey (USGS), Open File Report 97-745, San Francisco Bay Landslide Folio, http://pubs.usgs.gov/of/1997/of97-745/. 1997.

where materials are poorly consolidated, there may be ground subsidence or other forms of ground failure. Because the conditions at any particular site control the potential for any type of ground failure, only specific geotechnical investigations, including subsurface testing, can provide a basis for assessing such hazards.

Soil Erosion

Erosion is the wearing away of soil and rock by processes such as mechanical or chemical weathering; mass wasting; and the action of waves, wind, and underground water. Excessive soil erosion can eventually lead to damage of building foundations and roadways.

Pacifica's Coastal Zone includes areas that the USGS has determined to have critical erosion hazards and unstable segments where the sedimentary rocks are susceptible to failure from heavy wave action. A study of the winter storms of 1997–1998 showed that sea cliffs in the Planning Area were particularly impacted and that a number of homes were impacted as a result.[4] In 2009-10, erosion on the northern coast of Pacifica resulted in the evacuation of two apartment buildings on the 300 block of Esplanade Avenue. Coastline segments that have experienced significant coastal erosion are shown in **Figure 5-2**.

Increased Coastal Erosion from Potential Sea Level Rise

The potential for sea level rise and increased coastal erosion has very serious implications for Pacifica. Areas of the Sharp Park Golf Course, the Rockaway Beach district, and the West Linda Mar and West Sharp Park neighborhoods could be inundated. Meanwhile, coastal erosion processes that have caused damage along the high bluffs of Pacifica's northern neighborhoods would very likely increase in magnitude.

Sea level rise resulting from global climate change is projected to cause more extensive erosion of beaches, dunes, bluffs and cliffs. The 2009 Pacific Institute study of the impacts of sea level rise on the California Coast developed erosion models for dune and cliff/bluff backshore environments. Mean lateral erosion of dunes is estimated at 115 to 116 meters by 2025, 119 meters to 128 meters by 2050. Bluffs, meanwhile, are projected to have eroded by 8 meters to 9 meters by 2025, with geology, wave exposure, and bluff toe elevation all playing important roles in producing variation.[5] These models indicate that there could be new risks of erosion along the length of Pacifica's coastline in areas that are not currently exposed to wave action erosion, which could impact all of the coastal neighborhoods and coastal habitats.

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[4] United States Geological Survey (USGS). Coastal Erosion Along the U.S. West Coast During the 1997–98 El Niño:Expectations and Observations, http://coastal.er.usgs.gov/lidar/AGU_fall98/, 2005.

[5] Heberger, M., H. Cooley, P. Herrera, P.H. Gleick, E. Moore of Pacific Institute. The Impacts of Sea Level Rise on the California Coast. A paper from the California Climate Change Center. May 2009.

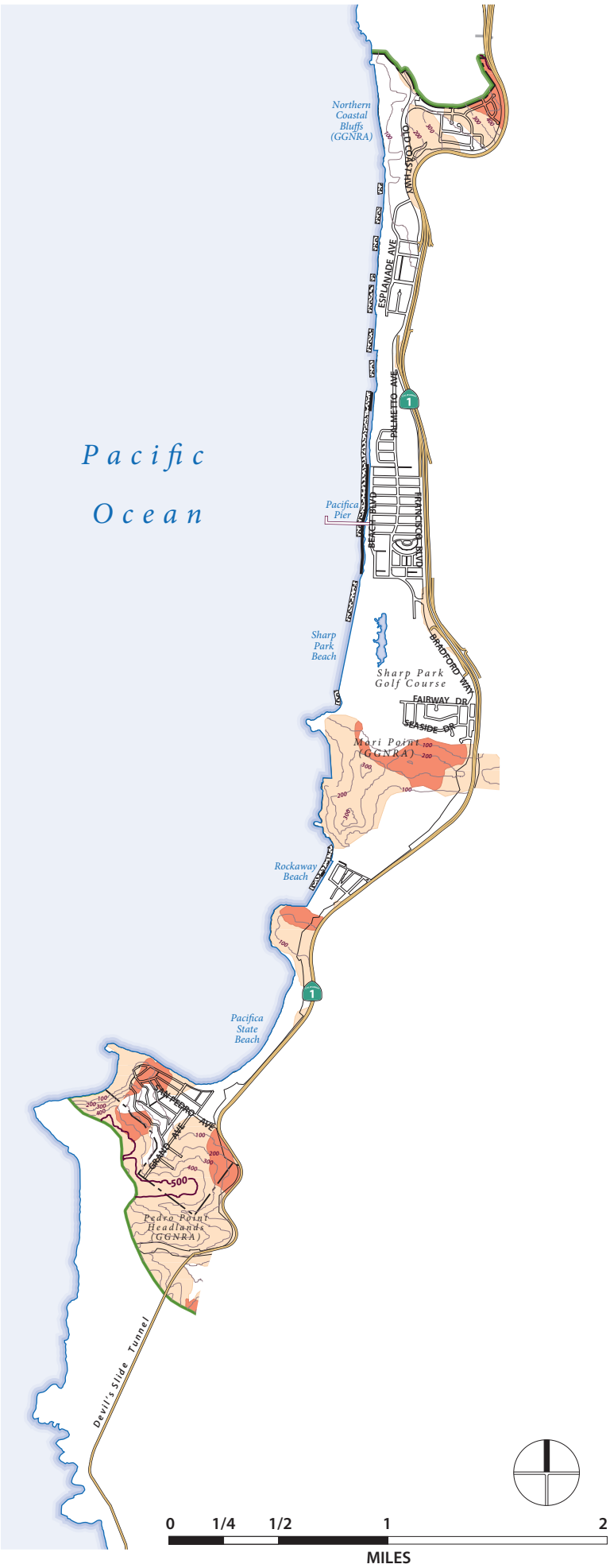

Figure 5-2:

Slope Failure and Coastal Erosion

Slope Failure Threat

- Mostly Landslides
- Few Landslides
- Not Landslide Prone

Shoreline Protective Structures

- Seawall
- Riprap, Other Revetments
- 500 foot Contours
- 100 foot Contours
- Coastal Zone
- City Limits
- Planning Area

Note:
Beach and cliff erosion are typical of much of the Pacifica coastline.

Source: Pacific Institute, 2009; FEMA Revised DFIRM, 2011; US Geological Survey, 1997; ESA, 2009; City of Pacifica, 2008; San Mateo County, 2009; Dyett & Bhatia, 2013.

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Shoreline Protection Programs

In the early 1990s, the City of Pacifica, the California Coastal Conservancy, and the Pacifica Land Trust collaborated to improve steelhead trout habitat and preserve the sandy beach at Pacifica/Linda Mar State Beach, with the removal of vulnerable structures along the shore. The stabilization methods were used to expand and enhance the tidally influenced wetlands at the mouth of San Pedro Creek and restore more than 1900 feet of eroding creek banks. This restoration both enhanced steelhead trout habitat and achieved 100-year flood protection for the nearby community.

To address the remaining flood threat to homes and businesses, the City also removed the most vulnerable structures. In 2002, the City partnered with the Pacifica Land Trust and the California Coastal Conservancy to purchase two homes and their surrounding acreage and delivered 4,000 cubic yards of sand to rebuild dunes and restore four acres of beach and the nearby estuary.

In addition, the City is continuing to maintain and improve the existing seawall and revetment originally constructed in 1962 at Rockaway Beach. Repairs in the past have consisted of retrieval of displaced rip-rap, importation of additional rip-rap and repair of the revetment. Other revetments are placed along the beaches of the planning area and a seawall has been constructed at Beach Boulevard at the terminus of Santa Rosa Avenue. Existing shoreline protection structures are shown on the Slope Failure and Coastal Erosion map (**Figure 5-2**).

Policy Framework

Enforcement of the State's latest building code, as required by law, will provide a base level of mitigation from ground shaking. The City also has a Coastal Zoning Combining District and coastal development regulations in its Zoning Ordinance. These regulations should be updated following adoption of the Local Coastal Land Use Plan, to complete the update of the Local Coastal Program and to reflect updates in State law, to better avoid or mitigate seismic and geologic hazards.

Policies

Guiding Policies

NH-G-1 **Reduce Risk.** Minimize risks of property damage and personal injury posed by geologic and seismic hazards.

IMPLEMENTING POLICIES

NH-I-1 **Hillside Preservation.** Update the Hillside Preservation District on the zoning map to ensure that all steep and sensitive terrain is subject to these regulations.

NH-I-2 **Transfer of Development Rights.** Amend the Transfer of Development Rights (TDR) program to reflect the following changes:

- Apply sending status to undeveloped sites potentially vulnerable to coastal flooding or erosion resulting from sea level rise, when a detailed sea level rise model suitable for local land use planning is available.
- Apply receiving status to sites designated for Mixed Use development in addition to the residential land use categories.

The TDR Program provides a mechanism to relocate potential development from areas where environmental or land use impacts could be severe to other areas more appropriate for development.

NH-I-3 **Fault Zone**. Continue to review projects located in identified fault zones subject to the Alquist-Priolo Earthquake Fault Zone Act. (See the Liquefaction and Fault Zones map, Figure 5-1).

NH-I-4 **Development in Hazardous Areas.** Prohibit development in areas of Mostly Landslides or High or Very High liquefaction risk as shown on the Slope Failure and Coastal Erosion Map (Figure 5-2), or on slopes steeper than 35 percent, unless detailed site investigations ensure that risks can be reduced to acceptable levels and that the structure will be protected for its design life.

NH-I-5 **Real Estate Disclosure.** Require real estate transactions, development approval processes, and property titles to declare known or suspected seismic or geologic hazards on a property, includingAlquist-Priolo Fault Zones and areas suspected of high or very high risk of liquefaction, subsidence, or landslide.

NH-I-6 **Code Enforcement.** Continue to maintain and enforce appropriate standards to ensure that new development is designed to meet current safety standards associated with seismic activity.

NH-I-7 **Seismic Rehabilitation Flagging**. Identify and catalogue structures that may be subject to serious structural damage in the event of a major earthquake, and provide information to property owners on ways to pay for rehabilitation of existing buildings.

NH-I-8 **Restrictions on Mitigation Measures.** Prohibit mitigation measures for potential geotechnical hazards if those measures could adversely affect surrounding property, including the use of public rights-of-way or adversely affect public health, safety, and welfare.

NH-I-9 **Erosion Prevention.** Require erosion prevention of hillside areas by revegetation or other acceptable methods.

NH-I-10 **Geotechnical Studies.** Within the Coastal Zone and hillside areas, continue to require geotechnical site investigation for proposed development on sites located in any of the following areas, prior to allowing site development:

- On slopes greater than 15 percent.
- In areas showing evidence of landslides or landslide potential.
- In areas showing evidence of ground shaking or earth movement
- Within 50 feet of a coastal bluff
- Within sand dune areas.

Geotechnical studies shall identify any geologic hazards affecting the proposed project site, any necessary mitigation measures, and a statement of the site's suitability for the proposed

development and whether or not it will be safe from geologic hazard for its expected life. The study shall identify net developable areas, if any, based on landslide or ground shaking potential or erosion risk. Impacts from the development, such as those resulting from increased water runoff, shall also be determined. Such studies must be signed by a licensed Certified Engineering Geologist or Geotechnical Engineer and are subject to review and approval by City staff and/or contracted employees.

NH-I-11 **Maintain Restrictions on Hazardous Areas.** Continue enforcing the existing Coastal Zone Combing District and Hillside Preservation District regulations that restrict development in hazardous areas where access is impractical and areas prone to hillside and coastal erosion, landslides, seismic shaking, tsunami inundation, or flooding.

NH-I-12 **Soil Study.** Require any geotechnical studies to include study of expansive and creeping soils, as well as analysis of erosion, seismic, tsunami, and other geotechnical hazards and make recommendations, as warranted.

NH-I-13 **Grading and Drainage Plans.** Continue to require a grading and drainage plan for proposed development requiring a coastal development permit and a grading permit. The Plan should demonstrate how the project will maintain natural surface drainage and existing vegetation to the greatest extent feasible, by minimizing alteration of natural topography and removal of existing trees and vegetation; stablilizing cut-and-fill surfaces with native vegetation; restricting the movement of heavy equipment and machinery; and other means. Prohibit development-related grading and vegetation clearance on slopes steeper than 35 percent. Driveways and utilities may be allowed in the case that there is no less environmentally damaging alternative for providing access to the building site.

NH-I-14 **Blufftop Development.** Require that any new development located on coastal bluffs be set back from the bluff edge an adequate distance to ensure safety for the economic life of the development. All new development proposed on or adjacent to a coastal bluff shall require a site stability survey conducted by a licensed Certified Engineering Geologist or Geotechnical Engineer to determine the necessary setback, taking into account bluff retreat projected over the economic life of the development.

NH-I-15 **Water Tank Rupture.** Work with the NCCWD to determine areas potentially affected by flooding from ruptured water tanks in the event of a seismic event and inform property owners.

NH-I-16 **Geologic Hazard Abatement District.** Amend the Municipal Code to include provisions for formation of geologic hazards abatement district for coastal bluffs and hillside areas at risk of landslides in Pacifica to enable cooperative efforts among property owners for protection of coastal bluffs from erosion and improvement and maintenance of drainage and protective infrastructure.

The Geologic Hazard Abatement District (GHAD) is a potentially useful tool to effectively abate a landslide hazard that crosses property boundaries. It is a mechanism that responds to the physical realities of landslides, and allows property owners to cooperate in solving a common problem. It removes much of the stigma of legal liabilities among adjacent landowners and allows them to

cooperate rather than litigate. It also provides for a cost-effective solution, requiring only one geotechnical engineering firm and one plan to solve the problems of several landowners. The City may require the establishment of GHADs as a condition for new development proposed in areas of known bluff erosion or geologic hazard, such as areas identified in Figure 8-2 as "mostly landslides." The City will undertake the following actions to facilitate formation of GHADs:

- *Identify where GHADs are appropriate or necessary;*
- *Advance funds for preparation of a Plan of Control for each proposed GHAD by a Certified Engineering Geologist describing the GHAD's boundaries, the geologic hazards affecting the GHAD, and a plan for the prevention, mitigation, abatement, or control of the hazards, with costs to be reimbursed by the GHADs.*
- *Establish a public education and outreach program to inform property owners of the benefits and responsibilities of participating in a GHAD; and*
- *Provide ongoing support of GHADs, with funding provided by the districts.*

The establishment of a GHAD would not allow development that is otherwise restricted on the basis of hazard risk, bluff erosion or geologic instability.

NH-I-17 **New Development in Coastal Zone.** Continue to enforce provisions of the California Coastal Act requiring new development within the Coastal Zone to:

- Minimize risks to life and property in areas of high geologic, flood, or fire hazard;
- 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 bluffs and cliffs;
- Not accelerate the need for a shoreline structure or increase the likelihood of a future seawall beyond the existing development's expected life; and
- Not violate required setback provisions.

Small improvement projects are exempt, including improvements that would increase height, bulk or floor area by less than ten percent.

NH-I-18 **Seawalls and Shoreline Protection.** Prohibit any new development that would require the use of seawalls or other shoreline alterations for protection either now or in the future. Alterations to the coastline shall be permitted only where necessary to protect existing development or public resources, and must minimize adverse impacts to natural coastal processes. Wherever feasible, shoreline protection shall take the form of non-structural measures, such as setback, redesign, relocation or beach replenishment.

NH-I-19 **Subdivision Limits in Coastal Zone.** Update the Zoning Ordinance to prohibit the division of coastal fronting property that creates hazardous or unbuildable parcels. Only allow new lots to be created if they can be developed without ever requiring shoreline protection for the development.

NH-I-20 **TDR Program in Coastal Zone.** Continue the City's Transfer of Residential Development Rights program to encourage the relocation of existing structures threatened by shoreline erosion, rather than constructing shoreline protective devices.

NH-I-21 **Accessory Structures in Coastal Zone.** Amend the Zoning Ordinance to require new accessory structures within the Coastal Zone to be constructed so they can be easily relocated should they become threatened by erosion.

NH-I-22 **Wave Up-Rush Studies.** Update the Zoning Ordinance to require wave up-rush studies for new development at beach level and in low-lying areas. The study should be completed by a licensed civil engineer with expertise in coastal engineering.

- At a minimum, require wave up-rush studies to evaluate the consequences of a low-probability wave event (1 percent annual probability) with the following beach and water conditions:
    - Seasonally eroded beach with long-term erosion comparable to what could be expected to occur over the life of the proposed development; and
    - High tide combined with the increase in mean sea level expected to occur over the life of the proposed development.
- Require development to be sited to avoid the zone of wave run-up. If complete avoidance is not practical, avoidance should be maximized, and development should be designed, through features such as elevation, to protect against the consequences of unavoidable hazards.

NH-I-23 **Regional Sediment Management.** Participate in regional approaches to protecting, enhancing and restoring coastal beaches and watersheds through the California Coastal Sediment Management Workgroup, with a goal of minimizing coastal erosion.

NH-I-24 **Sea Level Rise Model**. When an adequate model with sufficient local detail is available to project the impacts of sea level rise, take into account potential erosion caused by sea level rise by the year 2050 in the determination of developable area and the assessment of whether coastline-altering structures would be needed in the future to protect new development.

POLICIES FOR SPECIFIC SITES

NH-I-25 **Esplanade.** Establish appropriate zoning for privately-owned, undeveloped land on the west side of Esplanade Avenue to ensure minimal development consistent with the General Plan classification. Require an adequate setback from the bluff to ensure that any proposed development could withstand erosion resulting from a 100-year seismic or storm event, and preserve the view corridor to the ocean along Bill Drake Way.

NH-I-26 **Pedro Point Upper Slopes.** Maintain zoning for the upper slopes of Pedro Point to ensure that any new development is at a density appropriate to the steep slopes.

If any portion of the property is designated as official habitat for California red-legged frog, a biological resources survey must be conducted and development will be required to avoid habitat areas.

5.3 FLOODING

Under Section 30236, flood protection devices that alter rivers or streams must use the best mitigation measures, and are limited to necessary water supply projects or flood control projects where no other method is feasible, and where necessary to protect public safety or existing development. New development is expected to minimize risks to life and property in high flood hazard areas, under Section 30253.

Flooding has been an ongoing issue for low-lying areas of Pacifica, and likely will continue to be a challenge in the future, including possible inundation from a tsunami wave. Strategies to minimize flooding impacts will include limiting development in flood-prone areas and incorporating Federal Emergency Management Agency (FEMA) guidelines and suggested mitigation activities into the City's plans and procedures for managing flood hazards.

Flood Zones

Flood hazards mapped by FEMA to support the development of Flood Insurance Rate Maps (FIRMs) generally identify areas of greater flood risk (100 and 500 year events) in the lower reaches of the main stream channels, and the risk of coastal flooding along the shoreline. Flood zones based on the FIRMs are shown in **Figure 5-3.**

Areas of flood risk include:

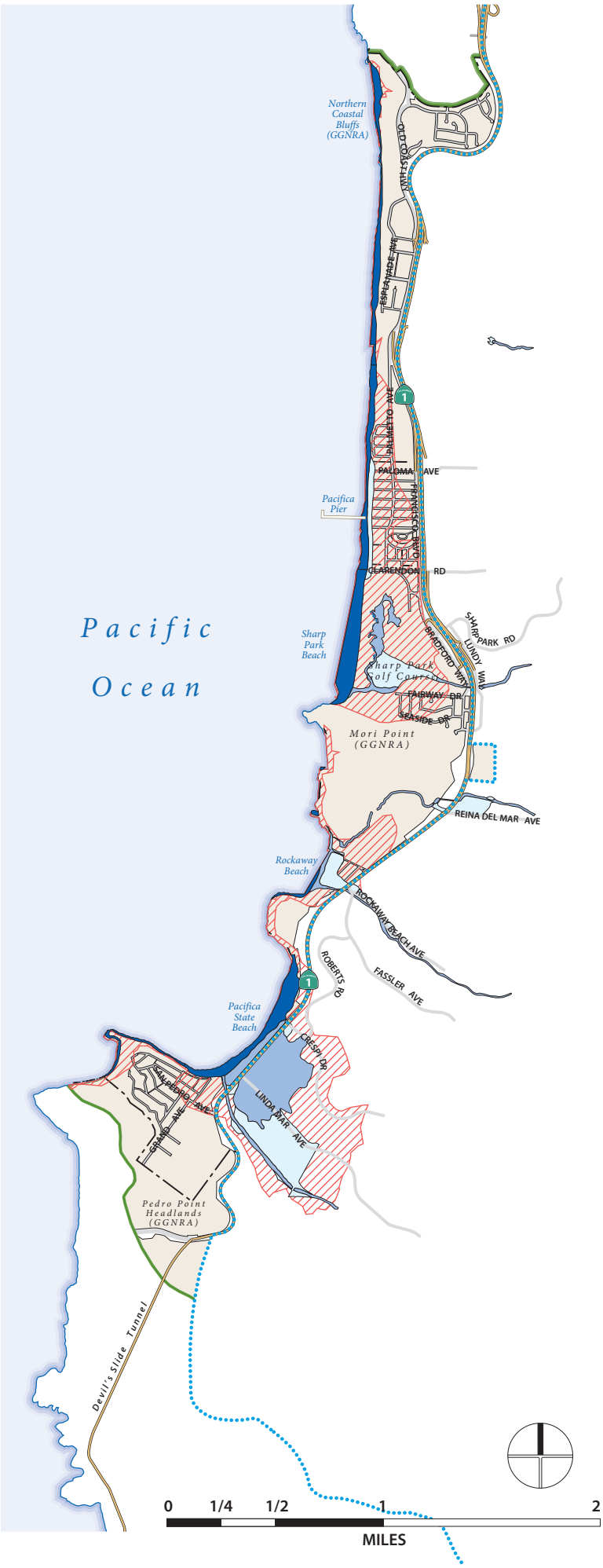
- Broad flood inundation in several parts of Sharp Park Golf Course and the Rockaway Beach district.
- More narrowly confined flood hazards along the creeks; limiting potential flooding in these areas. For example, along Milagra Creek mapped flood hazards are typically within the active channel.

Coastal Flooding

Pacifica can also experience flooding from coastal sources, which occurs as some combination of high tides, large wind-driven waves, storm surge, and/or tsunami wave. Areas with the potential for coastal flooding are the low lying areas along the coast, including the Sharp Park Golf Course/Laguna Salada area and Pacifica State Beach.

The only section of coastline protected by levees is the Sharp Park Golf Course area. However, drainage from Sanchez Creek and Laguna Salada to the ocean can be insufficient to prevent lowland flooding during high tide/high flow events. A seawall/revetment structure protects the area north of the Sharp Park Golf Course, generally along Beach Boulevard, including the Pacifica Pier. This structure has required maintenance to repair areas where beach erosion has undermined it.

Figure 5-3:
Flood Zones



0.2% Annual Chance Flood Zone

1% Annual Chance Flood Zone

1% Annual Chance Coastal Flood Zone

Tsunami Evacuation Area

Coastal Zone

City Limits

Planning Area

Source: Pacific Institute, 2009; FEMA, 2008; ABAG, 2009; US Geological Survey, 2009; ESA, 2009; City of Pacifica, 2008; San Mateo County, 2009; Dyett & Bhatia, 2013.

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Tsunami

A tsunami can occur after an earthquake significant landslide falling into the ocean. Coastal flooding, potentially severe damage, and threats to human health and safety can result from a tsunami. Recorded tsunami runup magnitude is generally lower at Pacifica than other locations from San Francisco to Monterey, likely due to offshore bathymetry and shoreline alterations along the city. Tsunami hazards are generally coincident with the coastal flooding zones: at the Sharp Park Golf Course/Laguna Salada area, Lower Calera Creek, portions of Rockaway Beach, and the residential and commercial area at Linda Mar near the mouth of San Pedro Creek.

Tsunamis can reach Pacifica from several sources, including 'far-field' sources throughout the Pacific Ocean, a substantial earthquake along the Cascadia Subduction Zone in northern California north to Vancouver Island, movement along local fault lines, and local coastal landslides. Travel times, the degree of warning, and the magnitude of the wave will vary depending on the source and initial strength of the tsunami-generating event. Earthquakes along the Cascadia Subduction Zone are likely the most hazardous to Pacifica because of the potential for very large wave generation, and a relatively short travel time (on the order of one to three hours). However, smaller events along local faults could result in a wave that reaches Pacifica with essentially no warning time.

According to the City's Local Hazard Mitigation Plan Annex, there are approximately 900 existing dwelling units within Pacifica's tsunami run-up area.

San Mateo County has an established emergency proposal for tsunamis. As part of this program, the City recently installed a tsunami warning system, consisting of three solar powered alarm towers. One is located in the Sharp Park neighborhood, the second is located in the Rockaway Beach neighborhood, and the third tower stands at Pacifica State Beach. This system links into a San Mateo County alert system that can reach email and cell phones.

Increased Coastal Flooding from Potential Sea Level Rise

Sea level rise resulting from global climate change has the potential to alter the frequency and magnitude of coastal flood events in Pacifica. Estimates of sea level rise vary, so trends and potential increases are typically reported in ranges. Present projections used by the State of California are for between 40 and 55 inches by 2100, depending upon the emission scenario used.[6]

A 2009 report from the Pacific Institute funded by a consortium of California state agencies has developed approximate mapping to indicate potential increases in the 1 percent annual chance of coastal inundation, assuming a 55.1-inch rise in sea level by 2100.[7] This mapping suggests that areas of West Linda Mar, lower Pedro Point, Rockaway Beach, and West Sharp Park neighborhoods, as well as the Sharp Park Golf Course, could be vulnerable to increased coastal flooding.

[6] Sea-Level Rise Task Force of the Coastal and Ocean Working Group of the California Climate Action Team, State of California Sea-Level Rise Interim Guidance Document, October 2010.

[7] Pacific Institute, The Impacts of Sea Level Rise on the California Coast. A paper from the California Climate Change Center. Available online at: http://www.pacinst.org/reports/sea_level_rise/. 2009.

Policies

Guiding Policies

NH-G-2 **Development in Hazardous Areas.** Protect new development in 100-year floodplains and tsunami hazard zones with flood damage prevention programs.

NH-G-3 **Sea Level Rise Adaptation.** Establish policies to minimize the risk to persons and property posed by potential sea level rise.

Implementing Policies

NH-I-27 **Floodplain Management.** Continue to manage floodplains through zoning, development requirements, and ordinances, and take other actions necessary, in order to remain within the National Flood Insurance Program.

NH-I-28 **Flood Map Review.** Periodically review maps prepared by FEMA and the State Department of Water Resources to identify changes in mapping of areas subject to flooding and amend the General Plan or Municipal Code as warranted.

NH-I-29 **NDPES Enforcement.** Enforce NPDES permits, as well as the San Mateo Countywide Water Pollution Prevention Program, to mitigate potential flooding risks.

NH-I-30 **Flood Hazard Reduction.** Continue to enforce Provisions for Flood Hazard Reduction in the Municipal Code.

NH-I-31 **Flood Insurance.** Inform households and businesses located in flood-prone areas about opportunities to purchase federal flood insurance.

NH-I-32 **Flood Control Maintenance.** Regularly maintain flood control structures, including, but not limited to drainage channels, pipes, culverts, and stream beds.

NH-I-33 **Flood Control Structures.** Require flood control devices that alter streams to incorporate best mitigation measures feasible, and only permit them 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.

NH-I-34 **Storm Drainage Impact Assessment.** Require developers to provide an assessment of a project's potential impacts on the local storm drainage system as part of the development review process.

If development is found to have a negative impact on storm drainage, require applicable and effective mitigation measures, such as the creation of permanent or temporary detention or retention basins, provision of additional landscaped areas and green roofs, installation of pump stations, and the use of permeable paving in driveways, walkways and parking areas.

NH-I-35 **No Adverse Impact Approach.** Update the Flood Hazard Reduction regulations to establish a "No Adverse Impact" standard to floodplain and coastal development.

No building permits should be issued for projects that increase the potential for flooding or erosion on and off site, degrade water quality, or increase potential public service costs for things such as emergency personnel and storm-water management, unless such projects are designed and completed in such a way that they will not:

- *pose a threat to public safety; and*
- *substantially increase flood or storm damage risk to public or private property.*

NH-I-36 **Tsunami Evacuation Zone.** For new development in the tsunami evacuation zone, require use of low impact engineering techniques, such as elevating structures above projected water levels, to mitigate impacts to people and structures.

NH-I-37 **Critical Facilities Location.** Site critical public facilities including hospital and healthcare facilities, emergency shelters, police and fire stations, and emergency communications facilities outside of the tsunami evacuation zone and 100-year flood plains.

NH-I-38 **Infrastructure.** Evaluate existing public infrastructure, including the wastewater and stormwater distribution systems, for vulnerability to coastal flooding and erosion and identify areas in need of protection.

NH-I-39 **Sea Level Rise Surveys.** Periodically conduct surveys of sea level rise studies to determine the expected frequency and extent of coastal flooding and the rate of coastal erosion, with a focus on at-risk areas, and propose General Plan amendments, as warranted.

NH-I-40 **Managed Retreat.** Incorporate "managed retreat" strategies into master planning for public land and large projects in the Coastal Zone.

Fire Hazards

New development is expected to minimize risks to life and property in high fire hazard areas (Section 30253). Fire hazards in Pacifica include both urban and wildland fires. Urban fires involve the uncontrolled burning of built structures due to human-made causes; wildland fires affect grassland, forest, and brush (and the structures on them), and can result from either human or natural causes. Pacifica has a substantial risk of wildland fires, with many areas of high and very high threat within the Planning Area. The City's main challenges regarding these hazards are:

- *Actively Managing the Urban-Wildland Interface*. Pacifica's residents enjoy close contact with open ridges and woodlands. This brings with it the risk of proximity to wildland fires. Preparedness is essential, and the North County Fire Authority's fire prevention activities, especially its Vegetation Management Program, are important.
- *Maintaining and Enhancing Evacuation Routes*. It is critical that road capacity exists for local residents, workers, and visitors to evacuate in case of an environmental disaster, including fire.

Urban Fires

Urban fires are fires that begin in a building in urban centers. They are typically localized but have the potential to spread to an adjoining building. The risk of urban fires is highest where single-family homes, multifamily residences and business facilities are clustered close together, increasing the possibility of rapid spread to an adjoining building. The risk to life and property can be reduced by adopting and funding

adequate levels of fire protection and ensuring new buildings are built to include fire resistive features which conform to modern fire and building codes.

Wildland Fires

Wildland fires are fires that start in a wooded or undeveloped area. Their potential for damage is dependent on the extent and type of vegetation, known as surface fuels, as well as weather and wind conditions. Wildland fires occur infrequently but typically cause more damage than urban fires.

About two thirds of Pacifica is undeveloped, and nearly half is protected open space. This undeveloped land is mainly on the rugged ridges that form the City's western edge and descend down to the ocean between Pacifica's valley communities. Coastal scrub is the predominant vegetation type, interspersed with annual grassland. Significant areas of eucalyptus forest and mixed woodland are present in eastern Sharp Park and on Cattle Hill and San Pedro Mountain.

The California Department of Forestry and Fire Protection (CDF) maps areas of significant fire hazards in the state. These areas are identified based on weather, terrain, fuels (e.g., type of ground vegetation), and other factors. According to the CDF:

- A Very High Fire Hazard Severity Zone is designated for much of Pedro Point Headlands, directly adjacent to the Pedro Point neighborhood.
- Pedro Point Headlands has large areas considered to have "high" or "very high" threat of fire.
- Mori Point is classified with a mix of "high" and "moderate" risk areas.
- Nearly all of the urbanized parts of the Planning Area are classified as having a "moderate threat" level for fire.

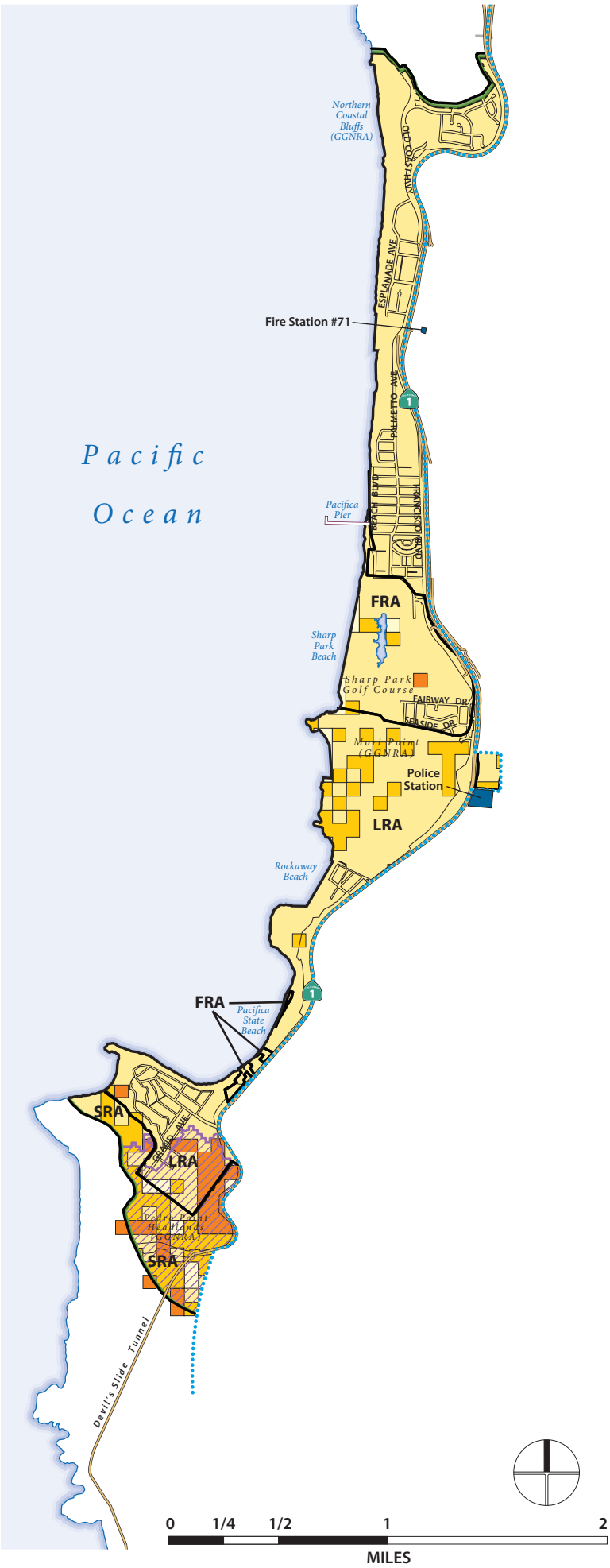
Figure 5-4, Fire Hazards and Public Safety Services, shows these locations.

The CDF also designates land as either a State or Local Responsibility Area (SRA and LRA), based on population density, land use, and land ownership. The City of Pacifica is an LRA while the small areas of the Planning Area outside City limits are in an SRA. Lands in Pacifica owned by the federal government and the County are designated as a Federal Responsibility Area (FRA) within the Pacifica LRA.

Fire and Emergency Services

The cities of Brisbane, Daly City, and Pacifica are contributing members of the North County Fire Authority (NCFA), a Joint Powers Authority established in 2003. The Fire Authority provides both emergency response and non-emergency public safety services to the three cities and their 185,000 people in its service area. Two of the Authority's 10 stations are in Pacifica. Fire Station 71, at 616 Edgemar Avenue, serves the north end of Pacifica, while Fire Station 72, at 1100 Linda Mar Boulevard, serves the south end. Neither is located in the Coastal Zone.

Figure 5-4:
Fire Hazards



Fire Threat Level

- Little or No Threat
- Moderate Threat
- High Threat
- Very High Threat
- Responsibility Area
- **LRA** Local (LRA)
- **SRA** State (SRA)
- **FRA** Federal (FRA)
- Very High Fire Hazard Severity Zone (VHFHSZ)
- Coastal Zone
- City Limits
- Planning Area

Source: California Department of Forestry and Fire Protection, 2004; City of Pacifica, 2008; San Mateo County, 2009; Dyett & Bhatia, 2013.

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Fire and Emergency Response

NCFA has established the following service ratio and response time standards:

- Service ratio standard: one responder per 1,500 population
- Response time standards for fire service: Four-minute travel time to 90 percent of calls for fire service, and eight-minute travel time for all apparatus on-scene for fire calls for service.

Response time standard for Emergency Medical Services (EMS): Under seven-minute travel time (6:59) for first response to 90 percent of calls.

Pacifica's long and narrow geography and its reliance on Highway 1 as the single north-south access route makes the City a challenge for fire response. A 2008 study determined that the Vallemar, West and East Fairway Park, Rockaway Beach, and Rockaway neighborhoods in central Pacifica are beyond four-minute travel distance from northern San Mateo County fire stations, corresponding with the standard response time for first-due fire apparatus. The full assignment response time standard cannot be met in Pacifica from Vallemar south.[8]

NCFA's EMS standard is for 90 percent of calls to be reached in less than seven minutes. This standard is met for 97 percent of calls in the North Zone, including approximately 93 percent of calls in Pacifica.

The Fire Authority needs additional facilities to meet its fire response standards for Vallemar and areas to the south. A third, mid-point station in Pacifica with a truck and engine company has been discussed for some time. The area that currently does not meet first-response time standards has a low density of development, and so it has fewer persons and structures threatened by fire. A new station would be needed if the central part of Pacifica were to experience significant new development, for example at the Quarry site.

Pacifica has an ISO rating of 4. The City's rating is unlikely to be affected by population growth, but population growth will increase existing deficiencies in service delivery.

Fire Prevention

The NCFA's Fire Services Prevention Bureau manages code enforcement, plan review and construction inspection, fire investigations, and public education. A key part of the Bureau's code enforcement activities is the annual safety inspection of every commercial business and multi-family residential property in its service area. The Fire Authority also conducts a Vegetation Management Program, promoting compliance with vegetation standards to reduce the threat of fire in the urban/wildland interface.

Local Hazard Mitigation Plan

The regional Local Hazard Mitigation identifies two mitigation strategies for wildland fires: review development proposals to ensure that they incorporate appropriate fire-mitigation measures, including adequate provisions for evacuation and access by emergency responders, and develop a clear legislative and regulatory framework to manage the wildland-urban interface consistent with best practices.

[8] Emergency Services Consulting, 2008.

State Requirements

In 2005, the California Building Code was amended to require that all new buildings located in any Fire Hazard Severity Zone in SRAs, or any Very High Fire Hazard Severity Zone in LRAs, must use building materials approved for use in wildland/urban interface areas. The code now specifies certain roof coverings, fire resistive wall and ceiling-floor assemblies, wall finish materials, hardware, insulation, and other building materials for use in high fire hazard areas. Also in 2005, Public Resources Code (PRC) 4291 was amended to expand the defensible space clearance requirement around buildings from 30 feet to 100 feet, in any SRA. Building owners must minimize potential fuel around structures, to minimize the risk of loss, and to improve firefighter safety.

Policies

Guiding Policy

NH-G-4 **Fire Prevention.** Protect Pacifica residents and businesses from potential wildland fire hazards.

Implementing Policies

NH-I-41 **Response Time.** Support efforts by North County Fire Authority to meet its response time standards throughout the City.

This effort may include construction of a third fire station in the central part of Pacifica, near the police station or the Quarry site. The City could provide land or shared facilities.

NH-I-42 **Adequate Peakload Water Supply.** Work with the Water District to maintain adequate water supply for firefighting, including capacity for peakload under a reasonable worst case wildland fire scenario, to be determined by the North County Fire Authority.

NH-I-43 **Water Storage Locations.** In evaluating sites for new water storage facilities, place a priority on locations least subject to impacts from seismic activity and landsliding.

NH-I-44 **Development Review.** Continue to review development proposals to ensure that they incorporate appropriate fire-mitigation measures, including adequate provisions for evacuation and access by emergency responders.

NH-I-45 **Plan Review in Fire-Prone Areas.** Continue to request the North County Fire Authority participation in plan review of new buildings in potentially fire-prone areas.

NH-I-46 **Fire Prevention Inspections.** Continue to require a fire prevention inspection of every permitted business and multi-family development covered by the North County Fire Authority.

NH-I-47 **Fire Prevention Education.** Continue educating the public about local fire hazard prevention programs. Work cooperatively with the North County Fire Authority to promote public awareness of fire safety and emergency life support.

NH-I-48 **Vegetation Management.** Promote and support the North County Fire Authority's Vegetation Management Program to reduce urban/wildland interface fire hazards.

NH-I-49 **Multi-Jurisdictional Approach.** Participate in State or regional efforts to develop a clear legislative and regulatory frame-work to manage the wildland-urban interface.

NH-I-50 **Rockaway Quarry Service.** Ensure that any new development at the Rockaway Quarry site is adequately served by public infrastructure, including fire and police services.

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