TOWN OF PORTOLA VALLEY
SAFETY ELEMENT UPDATE

PUBLIC REVIEW DRAFT

October 2022

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SECTION 1. INTRODUCTION

The Safety Element is designed to establish goals, policies, and implementation programs that will protect the Town of Portola Valley from risks associated with earthquakes, floods, fires, landslides, and other environmental hazards identified by the local community. By identifying these hazards and the appropriate related policies, the Safety Element is intended to effectively reduce the potential for life threatening, property damaging, and economically and socially detrimental events. In addition, this element is used as a guide for establishing land use patterns that minimize the exposure of Town residents to excessive natural and human-caused hazards.

WHAT IS A SAFETY ELEMENT?

The Safety Element is one of the State-mandated elements of the General Plan. It presents the Town's overall goals, policies, and implementation actions to facilitate resilience and prosperity. This Safety Element meets the requirements of California Government Code Section 65302 (g). Under State planning law, this Element identifies and discusses the following hazards of concern for the Town:

- Faulting
- Ground Shaking
- Landsliding
- Ground Settlement
- Soil Liquefaction
- Flooding
- Erosion and Sedimentation
- Expansive Soils and Soil Creep
- Wildfire Hazards
- Climate Change Adaptation and Resilience

The Town cannot be made hazard free, but the planning process can be used to minimize exposure to dangerous conditions. This is the concept of acceptable risk, and it is an inherent part of the environmental planning process. Every community must decide what public safety standards are acceptable and the actions needed to maintain those standards. For planning purposes, an acceptable level of risk is one at which a hazard is deemed to be a tolerable exposure to danger, given the expected benefits to be gained. For some types of risk, numerical measures have been defined to identify the threshold of acceptable risk. In the case of seismic or flooding hazards, for example, specific locations may be identified for development mitigation based on their distance from known faults or location within an area of or designated flood zone.

The impacts of climate change pose an increasing and growing challenge to the safety and wellbeing to the residents of Portola Valley. California will continue to experience effects of

climate change in different ways, including increased likelihood of drought, flooding, wildfires, heat waves, severe weather, and sea-level rise. In addition to climate change planning becoming necessary on its own merits, SB 379, requires jurisdictions on or after January 1, 2017 to update their Safety Element to address applicable adaptation and resiliency strategies.

PLANNING PROCESS AND PUBLIC OUTREACH

This Safety Element comprehensively updates the Town's previous Safety Element adopted in 2010. An update of the Safety Element was needed given the land use and regulatory changes that have taken place over the last 12 years, and in response to new State law requiring jurisdictions update their Safety Element in conjunction with their housing element update, which occurs on an eight-year cycle.

The Town's website was updated with information about the importance of the Safety Element update, with links to public meeting information, and draft and final documents, as well as details of the project status.

The Town has held numerous meetings on the Safety Element update in coordination with the Housing Element update including:

TABLE 1: SAFETY ELEMENT UPDATE PUBLIC MEETINGS

Meeting	Date	Topic
Ad Hoc Housing Element Update	January 18, 2022	Housing and Safety Element Timeline Presentation Fire District Process and Key Considerations (with Don Bullard) Wildfire Resilience and Recovery (with Susan Hartman, Town of Paradise)
	February 22, 2022	Woodside Fire Protection District Presentation
Geologic Safety Committee	May 11, 2022	Geologic, Seismic, Flooding Memo
Emergency Preparedness Committee	May 17, 2022	Wildfire Hazards Background and Best Practices Memo and Senate Bill 99 Assessment Memo
Sustainability Committee	May 19, 2022	Climate Change Adaptation and Resilience Memo
Joint Committee Meeting	October 26, 2022	Draft Safety Element update
Community-Wide Meeting	XX	Draft Safety Element update

Town of Portola Valley, 2022.

[NOTE: MORE DETAIL WILL BE ADDED AFTER UPCOMING COMMITTEE MEETING AND COMMUNITY-WIDE MEETING]

SECTION 2. BACKGROUND

REGULATORY SETTING

CALIFORNIA GOVERNMENT CODE 65302(G)(1)

California Government Code Section 65302(g) establishes the legislative framework for California's Safety Elements. This framework consolidates the requirements from relevant federal and state agencies, ensuring that all jurisdictions are compliant with the numerous statutory mandates. These mandates include:

- Protecting against significant risks related to earthquakes, tsunamis, seiches, dam failure, landslides, subsidence, flooding, and fires as applicable.
- Including maps of known seismic and other geologic hazards.
- Addressing evacuation routes, military installations, peak-load water supply requirements, and minimum road widths and clearances around structures as related to fire and geologic hazards, where applicable.
- Identifying areas subject to flooding and wildfires.
- Avoiding locating critical facilities within areas of high risk.
- Assessing the community's vulnerability to climate change.
- Including adaptation and resilience goals, policies, objectives, and implementation measures.

The Safety Element must include mapping of known seismic and other geologic hazards. It must also address evacuation routes, military installations, peak load water supply requirements, and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards.

The Safety Element must also identify information regarding flood hazards, establish a set of comprehensive goals, policies, and objectives for the protection of the community from the unreasonable risks of flooding, and establish a set of feasible implementation measures designed to carry out the goals, policies, and objectives for flood protection. It is recommended that the Safety Element do the same for drought impacts.

The Safety Element must also be reviewed and updated as necessary to address the risk of fire for land classified as state responsibility areas and land classified as very high fire hazard severity zones.

CALIFORNIA GOVERNMENT CODE SECTIONS 8685.9 AND 65302.6

California Government Code Section 8685.9 (also known as Assembly Bill 2140 or AB 2140) limits California's share of disaster relief funds paid out to local governments to 75 percent of

the funds not paid for by federal disaster relief efforts. However, if the jurisdiction has adopted a valid hazard mitigation plan consistent with DMA 2000 and has incorporated the hazard mitigation plan into the jurisdiction's General Plan, the State may cover more than 75 percent of the remaining disaster relief costs. All cities and counties in California must prepare a General Plan, including a Safety Element that addresses various hazard conditions and other public safety issues. The Safety Element may be a standalone chapter or incorporated into another section as the community wishes. California Government Code Section 65302.6 indicates that a community may adopt a Local Hazard Mitigation Plan (LHMP) into its Safety Element as long as the LHMP meets applicable state requirements. This allows communities to use the LHMP to satisfy state requirements for Safety Elements. As the General Plan is an overarching long-term plan for community growth and development, incorporating the LHMP into it creates a stronger mechanism for implementing the LHMP.

In October 2021, the Town of Portola Valley adopted the San Mateo County Multi-Jurisdictional Hazard Mitigation Plan (SMCMJHMP). The adoption of this plan affords the Town opportunities to pursue FEMA hazard mitigation grant funding. As an adopted plan, the SMCMJHMP has been integrated into the Portola Valley Safety Element, which ensures compliance with Government Code 8685.9 (AB 2140). Through this integration, the Town should be eligible for additional disaster assistance from the State.

CALIFORNIA GOVERNMENT CODE 65302 (G) 3 ADOPTED THROUGH SB 1241 (EFFECTIVE 2014/ADOPTED 2012)

California Government Code Section 65302 (g) 3 requires the Safety Element to identify and update mapping, information, and goals and policies to address wildfire hazards. As part of this requirement, any jurisdiction that includes State Responsibility Areas or Very High Fire Hazard Severity Zones in the Local Responsibility Areas (LRA), as defined by the California Board of Forestry and Fire Protection (Board), is required to transmit the updated element to the Board for review and approval.

CALIFORNIA GOVERNMENT CODE 65302 (G) 4 ADOPTED THROUGH SB 379 (EFFECTIVE 2017/ADOPTED 2015)

California Government Code Section 65302 (g) 4 requires the Safety Element to address potential impacts of climate change and develop potential strategies to adapt/mitigate these hazards. Analysis of these potential effects should rely on a jurisdiction's LHMP or an analysis that includes data and analysis from the State of California's Cal-Adapt website.

CALIFORNIA GOVERNMENT CODE 65302 (G) 5 ADOPTED THROUGH SB 99 (EFFECTIVE 2020/ADOPTED 2019)

California Government Code Section 65302 (g) 5 requires the Safety Element to identify evacuation constraints associated with residential developments, specifically focused on areas served by a single roadway.

NATIONAL FLOOD INSURANCE PROGRAM

The National Flood Insurance Program (NFIP) was created in 1968 to help communities adopt more effective floodplain management programs and regulations. The Federal Emergency Management Agency (FEMA) is responsible for implementing the NFIP and approves the floodplain management plans for participating cities and counties.

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT

The Alquist-Priolo Earthquake Fault Zoning Act (California Public Resources Code [PRC], Chapter 7.5, Section 2621-2699.6) was intended to reduce the risks associated with surface faults and requires that the designated State Geologist identify, and map "Earthquake Fault Zones" around known active faults. Per PRC Section 2623 a, cities and counties shall require a geologic report defining and delineating any hazard of surface fault rupture before the approval of a project. If the jurisdiction finds no undue hazard of that kind exists, the geologic report on the hazard may be waived, with the State Geologist's approval. For a list of project types, please refer to PRC Section 2621.6. The Town contains an Alquist-Priolo special study zone due to the presence of the San Andreas Fault.

SEISMIC HAZARDS MAPPING ACT

The Seismic Hazards Mapping Act (California Public Resources Code [PRC], Chapter 7.8, Section 2690-2699.6) created a statewide seismic hazard mapping and technical advisory program in 1990 to help cities and counties more effectively address the effects of geologic and seismic hazards caused by earthquakes. Under PRC 2697, cities and counties shall require a geotechnical report defining and delineating any seismic hazard before approving a project located in a seismic hazard zone. If the jurisdiction finds that no undue hazard of this kind exists based on information resulting from studies conducted on sites near the project and of similar soil composition to the project site, the geotechnical report may be waived. After a report has been approved or a waiver granted, subsequent geotechnical reports shall not be required, provided that new geologic datum, or data, warranting further investigation is not recorded. Each jurisdiction shall submit one copy of each approved geotechnical report, including the mitigation measures to be taken, if any, to the State Geologist within 30 days of its approval of the report. For a list of project types, please refer to PRC Section 2693.

CORTESE LIST

Government Code Section 65962.5 (typically referred to as the "Cortese List") identifies sites that require additional oversight during the local permitting process as well as compliance with the California Environmental Quality Act (CEQA). The list is generally a compilation of properties and businesses that generate, store, and/or have been impacted by the presence of hazardous materials/wastes. Many properties identified on this list may be undergoing corrective action, cleanup, or abandoned and in need of these activities. The Town of Portola Valley regularly refers to these Statewide lists to during the development review process.

SENATE BILL 99 AND ASSEMBLY BILL 747

Senate Bill (SB) 99 requires jurisdictions, upon the next revision of the housing element on or after January 1, 2020, to review and update the Safety Element to include information identifying residential developments in hazard areas that do not have at least two emergency evacuation routes. Assembly Bill (AB) 747 requires jurisdictions to, after January 1, 2022, review and update the Safety Element as necessary to identify evacuation routes and evaluate their capacity, safety, and viability under a range of emergency scenarios. The Town contracted with Fehr & Peers and Atlas Planning to prepare an evacuation analysis on constrained roadways and parcels with limited ingress/egress in accordance with SB 99. The Town also contracted with Fehr & Peers to undertake a separate evacuation study. This study went above and beyond the requirements of AB 747, to identify evacuation routes and evaluate their capacity, safety, and viability under a range of emergency scenarios. The results of both studies have helped inform the policies in this Element. ***[NOTE: ADDITIONAL INFORMATION WILL BE ADDED.]***

SECTION 3. HAZARD TOPICS

SAFETY ELEMENT PURPOSE AND MISSION

While this Safety Element update incorporates new legal requirements, hazard data, climate and wildfire science and best practices, the fundamental purpose and mission of the Element is to ensure the highest degree of safety to Town residents and properties. The goals, policies, and implementation actions described in this element are intended to prevent loss of life, reduce injuries and property damage, and minimize economic and social dislocation that may result from earthquakes, other geologic hazards, fires, and flooding.

Many of the goals and policies included in the element are based on prior versions of the Safety Element with modifications to better address the changing regulatory requirements and real-world conditions within the Town. Proposed goals, policies, and implementation actions serve as guidance for future developments proposed as well as community activities used to reduce or minimize existing and future hazard related issues.

FAULTING

EXISTING CONDITIONS

Portola Valley is bisected by the San Andreas Fault Zone which is made up of a number of individual fault traces along which movement has occurred at some time in the past. Some of the traces of the San Andreas Fault Zone are active; some are of undefined activity; some are deemed to be inactive; and others are poorly defined or are as yet unrecognized and the possibility of their activity is questionable. Experience in California and in other parts of the world where active faulting takes place indicates that future fault movements are most likely to occur along the traces of recent displacements. Ground rupturing, with horizontal displacements of up to 8 to 10 feet, took place along the San Andreas Fault through Portola Valley in the 1906 earthquake. Measurable earth strain and other geologic considerations suggest that similar or greater amounts of displacement may be anticipated in the Portola Valley area in the years ahead. Recurrence intervals for major movements along the Portola Valley segment of the San Andreas Fault are calculated to be approximately 180 years.[1]

Although future fault movement is generally anticipated along only those faults judged to be active, there is always the possibility that movement may occur along traces that are of undefined activity, deemed inactive, poorly defined, as yet unrecognized, or newly

[1] U.S. Geological Survey, The Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) – The Time-Independent Model: U.S. Geological Survey Open-File Report 2013–1165, 97 p., California Geological Survey Special Report 228, and Southern California Earthquake Center Publication 1792, http://pubs.usgs.gov/of/2013/1165/, 2013.

formed.[2,3,4,5] Figures 1 and 2 show the locations of regional and local faults within Portola Valley.

The traces of the San Andreas Fault Zone judged to be active and with significant potential for future displacement are shown with distinctive heavy lines on the Town of Portola Valley's Geologic Map[6] and Ground Movement Potential Map (see Figures 3 and 4). These geologic maps were prepared by the Town, based on the study of aerial photographs, field investigations, and other available geologic studies. These maps portray the various geologic conditions with considerable accuracy and were adopted by the Town Council to serve as guidelines for addressing geologic hazards, with the intention of modifying them as new information becomes available.

Fault traces similar to this source are also shown on the Special Studies Zones Maps of the Mindego Hill and Palo Alto Quadrangles,[7,8] issued by the California Geological Survey in compliance with requirements of the Earthquake Fault Zoning Act.

Studies of the San Andreas Fault in California and other similar faults elsewhere in the world show that dislocations associated with faulting tend to be concentrated along relatively narrow traces. In Portola Valley, however, a pattern of en echelon (overlapping) ground breakage has occurred along some of the San Andreas trace. Also, a belt of disturbed ground several hundred feet wide or more, characterized by secondary fractures and cracks, ground lurching and warping may develop along traces of dislocation. Although deformation of this zone may result in serious structural damage to buildings within it, the risk of structural collapse due solely to permanent ground deformation is considerably less than for sites crossing or immediately adjacent to the principal trace of movement. The Portola Valley municipal code has established special building setbacks along earthquake fault traces to minimize the potential loss of property and life resulting from differential movement along such traces caused by tectonic forces.[9] To that end, the town should adopt and apply the best available information on the potential for ground rupture due to faulting. Land uses should be located where the level of risk from seismic forces is deemed acceptable to the community.

[2] William R. Dickinson, "Fault Lines Mapped by W.R. Dickinson, November 1971."
[3] William R. Dickinson, Reconnaissance of Active Traces of the San Andreas Fault in Woodside, 1973.
[4] William Lettis & Associates, Inc., Seismic Hazard Evaluation, Proposed Portola Valley Town Center, 765 Portola Road, Portola Valley, CA 94028, February 28, 2003.
[5] William Lettis & Associates, Inc., Supplemental Surface-Fault Rupture Hazard Evaluation, Proposed Portola Valley Town Center, 765 Portola Road, Portola Valley, CA 94028, January 29, 2004.
[6] Cotton, Shires and Associates, Inc., "Geologic Map, Town of Portola Valley, San Mateo County, California, June 2017," scale 1" = 500'.
[7] William R. Dickinson, "Fault Lines Mapped by W.R. Dickinson, November 1971."
[8] State of California, Special Studies Zones, Mindego Hill Quadrangle, Official Map, Effective July 1, 1974, scale 1:24,000.
[9] Portola Valley Municipal Code, October 2010. Chapter 18.58.030- Special building setbacks along earthquake faults. April 2022.

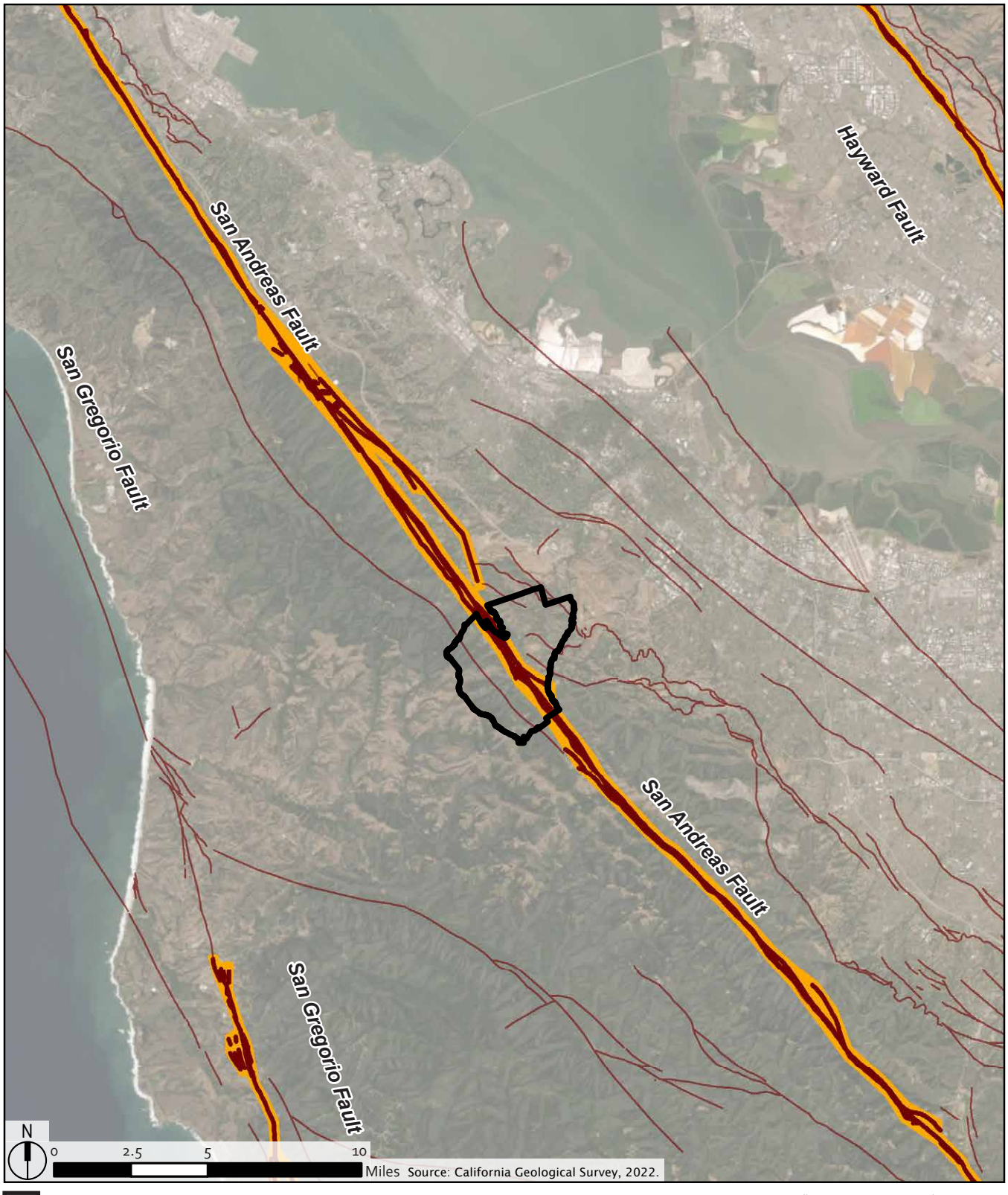


Figure 1
Regional Fault Areas Map

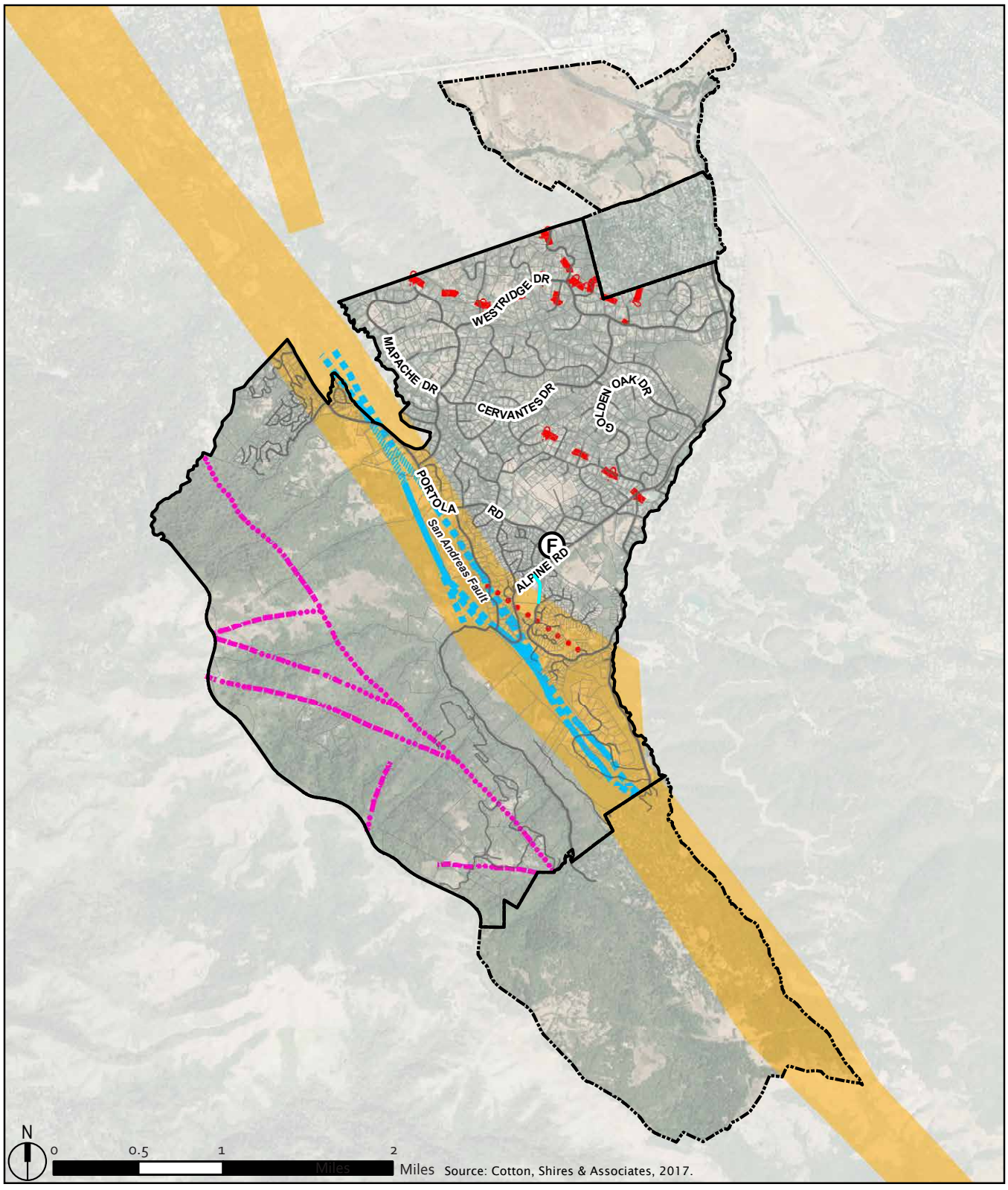
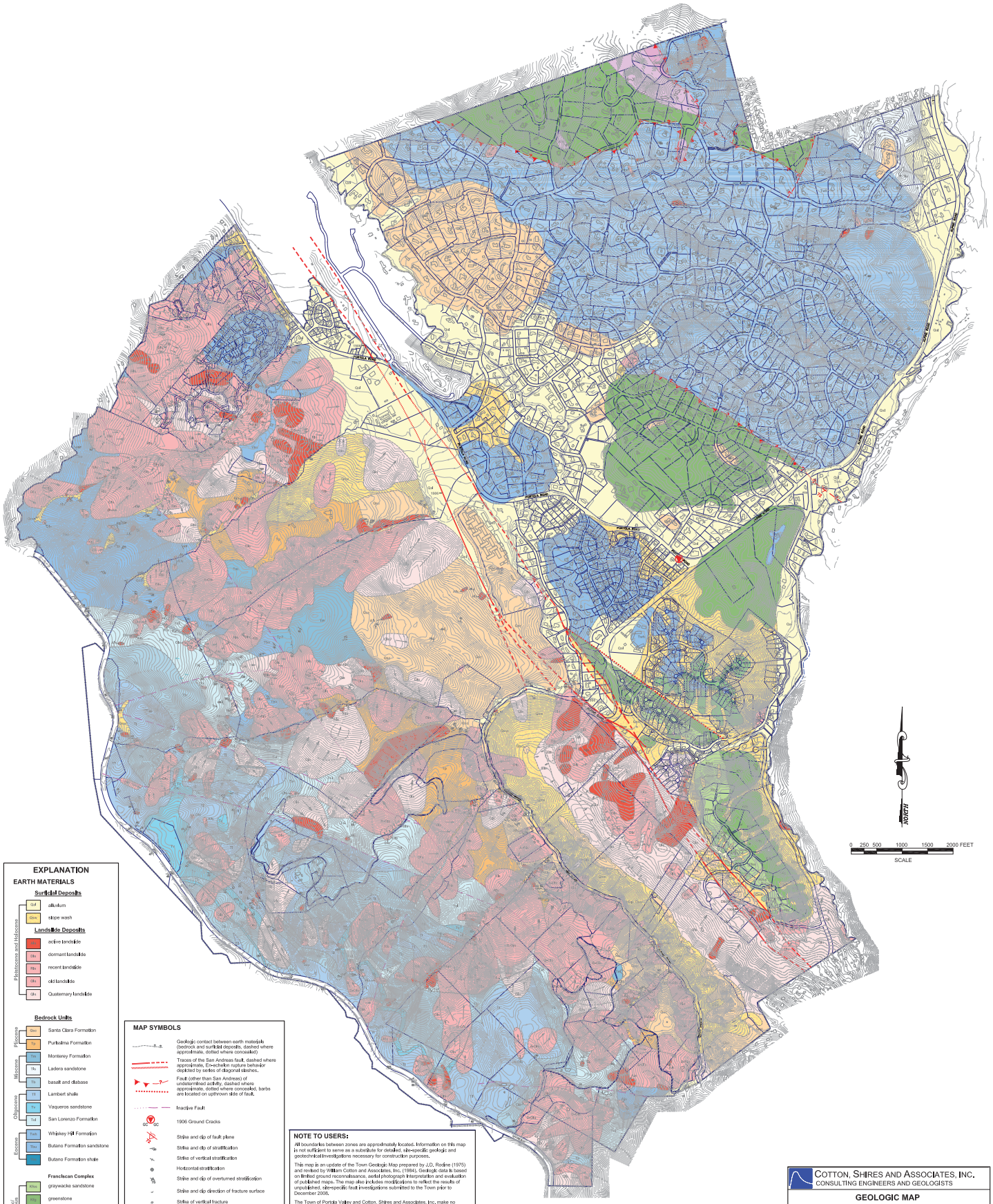


Figure 2
Local Fault Areas Map

GEOLOGIC MAP

Town of Portola Valley, California



EXPLANATION

EARTH MATERIALS

Surficial Deposits

- Qaf — alluvium
- Qsw — slope wash

Landslide Deposits (Pleistocene and Holocene)

- Qls — active landslide
- Qls — dormant landslide
- Qls — recent landslide
- Qls — old landslide
- Qls — Quaternary landslide

Bedrock Units

Pliocene
- Tsc — Santa Clara Formation
- Tp — Purisalma Formation

Miocene
- Tm — Monterey Formation
- Tla — Ladera sandstone
- Tb — basalt and diabase

Oligocene
- Tl — Lambert shale
- Tv — Vaqueros sandstone
- Tsl — San Lorenzo Formation

Eocene
- Tw — Whiskey Hill Formation
- Tbu — Butano Formation sandstone
- Tbu — Butano Formation shale

Franciscan Complex

Jurassic/Cretaceous
- Kfsd — graywacke sandstone
- Kfg — greenstone
- Kfc — chert
- Kfsp — serpentinite
- Kfu — Franciscan Complex undifferentiated

MAP SYMBOLS

- Geologic contact between earth materials (bedrock and surficial deposits, dashed where approximate, dotted where concealed)
- Traces of the San Andreas fault, dashed where approximate, En-echelon rupture behavior depicted by series of diagonal slashes.
- Fault (other than San Andreas) of undetermined activity, dashed where approximate, dotted where concealed, barbs are located on upthrown side of fault.
- Inactive Fault
- 1906 Ground Cracks
- Strike and dip of fault plane
- Strike and dip of stratification
- Strike of vertical stratification
- Horizontal stratification
- Strike and dip of overturned stratification
- Strike and dip direction of fracture surface
- Strike of vertical fracture
- Boundary of landslide deposit, arrows show direction of movement
- Trace of axial plane of syncline
- Trace of axial plane of anticline

NOTE TO USERS:

All boundaries between zones are approximately located. Information on this map is not sufficient to serve as a substitute for detailed, site-specific geologic and geotechnical investigations necessary for construction purposes.

This map is an update of the Town Geologic Map prepared by J.D. Rodine (1975) and revised by William Cotton and Associates, Inc. (1984). Geologic data is based on limited ground reconnaissance, aerial photograph interpretation and evaluation of published maps. The map also includes modifications to reflect the results of unpublished, site-specific fault investigations submitted to the Town prior to December 2008.

The Town of Portola Valley and Cotton, Shires and Associates, Inc. make no representation or warranties regarding the accuracy of the data from which this map was derived. Depicted Town and parcel boundaries are approximate and based on preliminary information. Absence of appropriate symbols (i.e., landslides, faults, etc.) from any part of this map may not be used to prove the absence of these features. Additional explanation and description of units may be found in Geology and Movement Potential within the Town of Portola Valley, California, by J.D. Rodine (1975).
Please see Town website at www.portolavalley.net for latest map revisions.

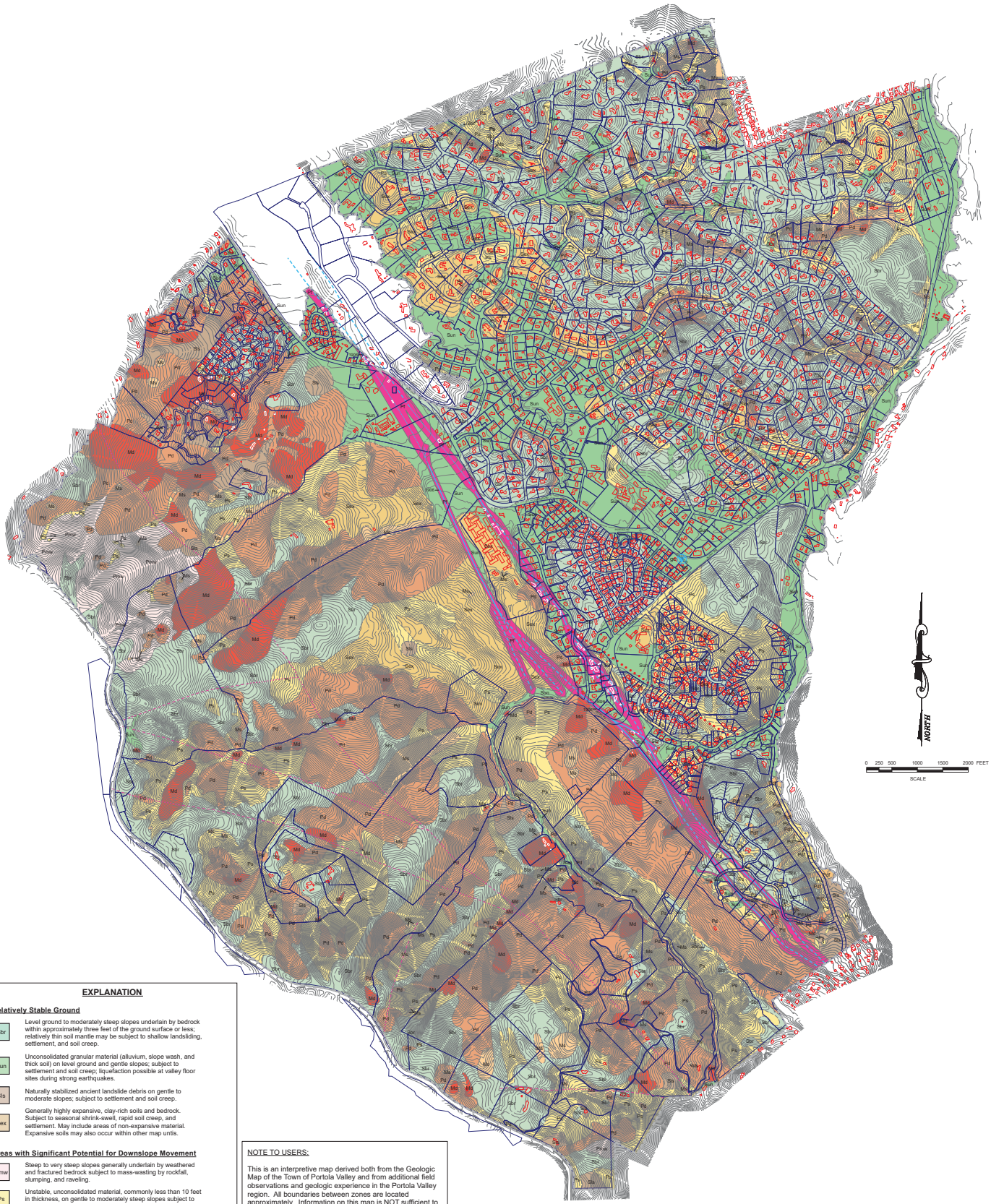
COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GEOLOGIC MAP
Town of Portola Valley
San Mateo County, California

GEO/ENG BY	SCALE	PROJECT NO.
TS	1"=500'	G0088
APPROVED BY	DATE	SHEET NO.
JW	JUNE 2017	1 OF 1

GROUND MOVEMENT POTENTIAL MAP

Town of Portola Valley, California



EXPLANATION

Relatively Stable Ground

- Sbr — Level ground to moderately steep slopes underlain by bedrock within approximately three feet of the ground surface or less; relatively thin soil mantle may be subject to shallow landsliding, settlement, and soil creep.
- Sun — Unconsolidated granular material (alluvium, slope wash, and thick soil) on level ground and gentle slopes; subject to settlement and soil creep; liquefaction possible at valley floor sites during strong earthquakes.
- Sls — Naturally stabilized ancient landslide debris on gentle to moderate slopes; subject to settlement and soil creep.
- Sex — Generally highly expansive, clay-rich soils and bedrock. Subject to seasonal shrink-swell, rapid soil creep, and settlement. May include areas of non-expansive material. Expansive soils may also occur within other map untis.

Areas with Significant Potential for Downslope Movement

- Pmw — Steep to very steep slopes generally underlain by weathered and fractured bedrock subject to mass-wasting by rockfall, slumping, and raveling.
- Ps — Unstable, unconsolidated material, commonly less than 10 feet in thickness, on gentle to moderately steep slopes subject to shallow landsliding, slumping, settlement, and soil creep.
- Pd — Unstable, unconsolidated material, commonly more than 10 feet in thickness, on moderate to steep slopes; subject to deep landsliding.
- Pdf — Debris flows, (shallow, rapidly moving landslides) including recognized source areas, flow paths and depostional runout areas.

Areas with Potential for Primary Ground Rupture from Active Faults

- Pr — Zone of potential primary surface rupture.

Unstable Ground Characterized by Seasonally Active Downslope Movement

- Ms — Moving shallow landslides, commonly less than 10 feet in thickness.
- Md — Moving deep landslides, commonly more than 10 feet in thickness.

NOTE TO USERS:

This is an interpretive map derived both from the Geologic Map of the Town of Portola Valley and from additional field observations and geologic experience in the Portola Valley region. All boundaries between zones are located approximately. Information on this map is NOT sufficient to serve as a substitute for detailed, site-specific geologic and geotechnical investigations necessary for construction. It illustrates the relative stability or movement potential, in the Portola Valley area, of ground in its natural undisturbed state. Works of man may seriously alter the natural stability of ground. Potential impacts of graded cut and fill slope are not addressed movement potential interpretations.

This map is an update of the initial Movement Potential of Undisturbed Ground Map prepared by J.D. Rodine (1975) revised by William Cotton and Associates, Inc. (1984), and revised by Cotton, Shires and Associates, Inc. (2010). For additional information about this map and the Geologic Map of the Town of Portola Valley, see: Geology and and Movement Potential within the Town of Portola Valley, California, February 1975, by J.D. Rodine

Please see Town website at www.portolavalley.net for latest map revisions.

MAP SYMBOLS

- Traces of the San Andreas fault, dashed where approximate. En-echelon rupture behavior depicted by series of diagonal slashes.
- Fault (other than San Andreas) of undetermined activity, dashed where approximate, dotted where concealed, barbs are located on upthrown side of fault.
- Inactive Fault
- gc gc — 1906 Ground Cracks

COTTON, SHIRES AND ASSOCIATES, INC.
CONSULTING ENGINEERS AND GEOLOGISTS

GROUND MOVEMENT POTENTIAL MAP
Town of Portola Valley
San Mateo County, Calfornia

GEO/ENG BY TS	SCALE 1"= 500'	PROJECT NO. G0088
APPROVED BY JW	DATE JUNE 2017	SHEET NO. 1 OF 1

HISTORICAL DATA

The entire San Francisco Bay Area is in a region of active seismicity. The seismicity of the region is primarily related to the San Andreas Fault Zone. The San Andreas Fault Zone is a complex of active faults forming a boundary between the North American and the Pacific plates. Historically, numerous moderate to strong earthquakes have been generated in northern California by several major faults and fault zones in the San Andreas Fault Zone system.

The last significant (greater than magnitude 6.0) seismic event in the San Mateo vicinity was the 6.9 magnitude San Andreas Loma Prieta Earthquake in 1989, which originated 10 miles northeast of Santa Cruz. Other significant local earthquakes include the 1906 earthquake in San Francisco and the 2014 Napa earthquake. Although the 1906 earthquake is most associated with the City of San Francisco, San Mateo County was also greatly affected. San Mateo County is in a region of high seismicity because of the presence of the San Andreas Fault that bisects the county, the Hayward Fault across the bay to the east, and the San Gregorio Fault to the west. The primary seismic hazard for Portola Valley is potential ground shaking from these three large faults.[10]

POLICIES AND IMPLEMENTATION ACTIONS

P-1 Consider all faults shown on the Town's Geologic Map and Ground Movement Potential Map, adopted by Resolution 2746-2017 during the review of development applications. Required setbacks for buildings for human occupancy illustrated on the Ground Movement Potential Map (Figure 3) should be adhered to and reflected in the Town's zoning ordinance.

P-2 At a minimum, new habitable structures shall be designed and built per the most recent California Building Code.

P-3 Qualifying subdivisions, including structures for human occupancy and other critical structures within an Earthquake Fault Zone shown on current maps published by the California Geological Survey,[11] should prepare a site-specific fault investigation report by a certified engineering geologist for Town review and approval. Also, any proposed new living space within a fault setback (consistent with the Pf Zone illustrated on the Town Movement Potential Map) should be supported by a fault investigation. The corresponding report should contain at a minimum the results of subsurface investigations, locations of hazardous faults adjacent to the project site, recommended setback distances of proposed structures from hazardous faults, and additional recommended measures to accommodate warping and distributive deformation associated with faulting (e.g., strengthened foundations, engineering

[10] Tetra Tech, October 2021.Multijurisdictional Local Hazard Mitigation Plan (MJLHMP).
[11] Division of Mines and Geology (now California Geological Survey), Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone's Maps (name changed from Special Studies Zones January 1, 1994), Special Publication 42, Revised 1997, Supplements 1 and 2 added in 1999.

design, flexible utility connections). The recommendations should be incorporated into project design plans.

A-3-1 Design and construct new Town and utility infrastructure (either public or private) that cross active fault traces in a manner which recognizes the hazard of fault movement. Such designs should consider that there is a possibility of up to a 20-foot right-lateral displacement on the Woodside and Trancos traces of the San Andreas Fault.

A-3-2 Equip water, gas, and electric lines that cross active fault traces with shut-off devices and flexibility which utilize the best available technology for quick shut-off consistent with providing reliable service.

A-3-3 Develop a Utilities Resilience Program that examines all existing utility lines that cross active fault traces to determine their ability to survive fault movement and the necessary modifications if they are unable to accommodate fault movement.

A-3-4 Encourage utility companies to institute an orderly program for installing shut-off devices on these lines, starting with the lines that cross the Woodside and Trancos traces and those which serve the most people.

A-3-5 In consultation with Cal Water and WFPD, establish and maintain adequate emergency water supplies in areas served by water lines that cross active fault traces.

P-4 Require above ground crossing of utility lines where it has been determined that continued service and safety cannot be assured for subsurface lines.

P-5 Consider fault traces identified as "Fault other than the San Andreas" in the review of applications for the construction of buildings for human occupancy, site development, land divisions and subdivisions. Require the appropriate geological investigation/report of relevant fault locations and characteristics of proposed development areas before approval of a new development application.

GROUND SHAKING

EXISTING CONDITIONS

Although sparsely populated, the Portola Valley area experienced considerable damage from ground shaking in the 1906 earthquake, which is estimated to have been of a Richter magnitude[12] 8.3, (or Moment magnitude of 7.9) with local intensities ranging from VIII to X, on the Modified Mercalli scale (1956 edition). Moment magnitude, a more recent term used to

[12] Richter magnitude is an instrumentally determined measurement of the energy released by an earthquake at its source. The magnitude scale is logarithmic, hence an increase in one unit of magnitude (e.g., 6 to 7) represents a ten-fold increase in seismic wave amplitude but an approximately 32 times increase in energy released at the source.

describe earthquakes, takes into consideration more than the ground shaking at a location and includes such considerations as the surface area of a rupture.

The most recent addition (third) of the Uniform California Earthquake Rupture Forecast (UCERF3) estimates the magnitude, location, and likelihood of earthquake rupture throughout California. According to this model, which has assessed the probability of earthquakes in the San Francisco Bay Area, there is a 72 percent probability that an earthquake of Richter magnitude 6.7 or greater will strike the region between 2014 and 2044.[13]

The ground effects from seismic shaking in Portola Valley would vary with different underlying rock formations, soil conditions, and the amount of underground water present. Those areas underlain by relatively thick, unconsolidated, water-soaked surficial sediments (such as some recent alluvial deposits) have a greater potential for damaging effects due to ground shaking than do areas of firm bedrock. Table 2[14] below, defines three "geologic categories" in the Portola Valley planning area in which the geologic materials are grouped on the basis of their anticipated response to seismic shaking.

The amount of ground shaking at any location is based on the seismic energy released through the ground. It is prudent to analyze new developments and provide a reasonable level of protection.

TABLE 2: RELATIVE GROUND SHAKING POTENTIAL IN THE PORTOLA VALLEY PLANNING AREA

Increasing Ground Shaking Potential ↑	
	Surficial Materials – generally young, often saturated, unconsolidated deposits of gravel, sand, silt, and clay commonly confined to valley floors (alluvium, slope wash, landslide debris, and artificial fill).
	Near-Bedrock Materials – semi-consolidated to consolidated older deposits of gravel, sand, silt and clay (older alluvium).
	Bedrock Materials – hard, stratified to massive, deposits of sandstone, shale, conglomerate, chert, mafic, igneous rocks and serpentine (generally shown as Stable Bedrock-Sbr-on Movement Potential Map of Portola Valley).

[13] Field, E.H. and 2014 Working Group on California Earthquake Probabilities, 2015. UCERF3: A New Earthquake Forecast for California's complex Fault System: U.S. Geological Survey 2015-3009, 6 p., https://dx.doi.org/10.3133/fs20153009.

[14] See Geologic and Movement Potential Maps of Town of Portola Valley for the location of areas underlain by materials described above.

At any location, new structures must comply with the current California Building Code. Portola Valley and much of California are within the highest seismic risk category in the building code. The code provides differing levels of safety based on building occupancies. In addition, provisions in the code provide detailed requirements for calculating earthquake forces and requiring that buildings be appropriately designed. In Portola Valley, the Building Official is tasked with administering the provisions of the code.

POLICIES AND IMPLEMENTATION ACTIONS

P-6 **Require that all essential (critical) buildings (facilities) be designed and constructed to meet or exceed the current California Building Code requirements.**

A-6-1 Review the structural integrity of all essential services buildings in the own, and strengthen, remove, or replace those that are found to be unable to meet policy P-6 above.

P-7 **Require that new developments/projects be built to the latest siting, design, and construction standards that promote structural integrity and functionality after a seismic event.**

A-7-1 Periodically review methods to enhance current siting, design, and construction standards for ensuring post seismic event structural integrity and functionality. Update Town requirements accordingly.

P-8 **Encourage seismic retrofits for existing homes within the Town. Consistent with the current California Building Code and recommendations from the California Earthquake Authority.**

A-8-1 Identify funding opportunities to assist homeowners with seismic retrofit improvements.

P-9 **Review State building code updates and make any necessary local amendments to address local geologic, topographic, or climatic conditions.**

LANDSLIDING

EXISTING CONDITIONS

Landsliding is the mass-movement of soil and rock downslope along one or more recognizable slip surfaces; the movement may be rapid (as in rock-falls) or very slow (as in earth flows). In the California coast ranges, landsliding is a natural and widespread phenomenon occurring on many slopes underlain by relatively unstable rocks and soils. Initiation of movement of a new landslide or reactivation of an existing one may be caused by either natural processes or human activities. Strength of hillslope materials may be reduced by weathering and decay of rocks and soils, saturation, and strong vibrations. The balance of forces acting on hillslopes, ordinarily in equilibrium, may be upset by addition of weight, removal of lateral support, and seismic accelerations. Excavation, construction, irrigation, and disposal of wastewater in septic drain fields may contribute to these processes. Strong ground motion during earthquakes

may initiate new landslides and reactivate existing ones. Studies following larger earthquakes in California demonstrate that landsliding is commonly the most widespread type of earthquake related ground failure.

The Ground Movement Potential Map (see Figure 4) of the Town classifies landslides with respect to the potential for future movement and town regulations require that these maps be consulted when new development is proposed. In addition, the California Geological Survey (see Figure 5) has mapped areas based on their potential for earthquake-induced landslides, which may require further investigation prior to development.

POLICIES AND IMPLEMENTATION ACTIONS

P-10 Review all proposed developments with respect to the "Geologic Map" and "Ground Movement Potential Map" of the town. Require geologic and soil reports, when deemed necessary by the town geologist, to determine landslide risk/potential for developments.

P-11 Require geologic and soil reports for all new development in areas of identified landslides or other zones of geologic hazard susceptibility, or when deemed necessary by the town geologist.

A-11-1 Continue to file, reference, and index geologic/geotechnical mapping and data within the Town's Geographic Information System.

A-11-2 Require that all geotechnical investigations within the Town be prepared by a Geotechnical Engineer, Civil Engineer with geotechnical expertise, or Certified Engineering Geologist and be peer-reviewed by the Town's on-call geotechnical consultant.

P-12 Locate structures for human habitation and most public utilities so as to minimize disturbances from potential landslides. Give due consideration to mitigating measures, based on geologic and other reports acceptable to the Town, that can be taken to reduce the risk from seismic and non-seismic hazards to an acceptable level (as defined in Table 3 below and related text).

P-13 Where roads or utility lines are proposed to cross landslide areas for reasons of convenience or necessity, they should be permitted only if special design and construction techniques can be employed to assure that acceptable risk levels will be met.

P-14 Maintain policies and regulations that correlate the various land uses permitted by the zoning ordinance with the several categories of landslides shown on the Ground Movement Potential Map which will help assure that any failures of ground due to landslides will not endanger public or private property beyond levels of acceptable risk defined in this element.

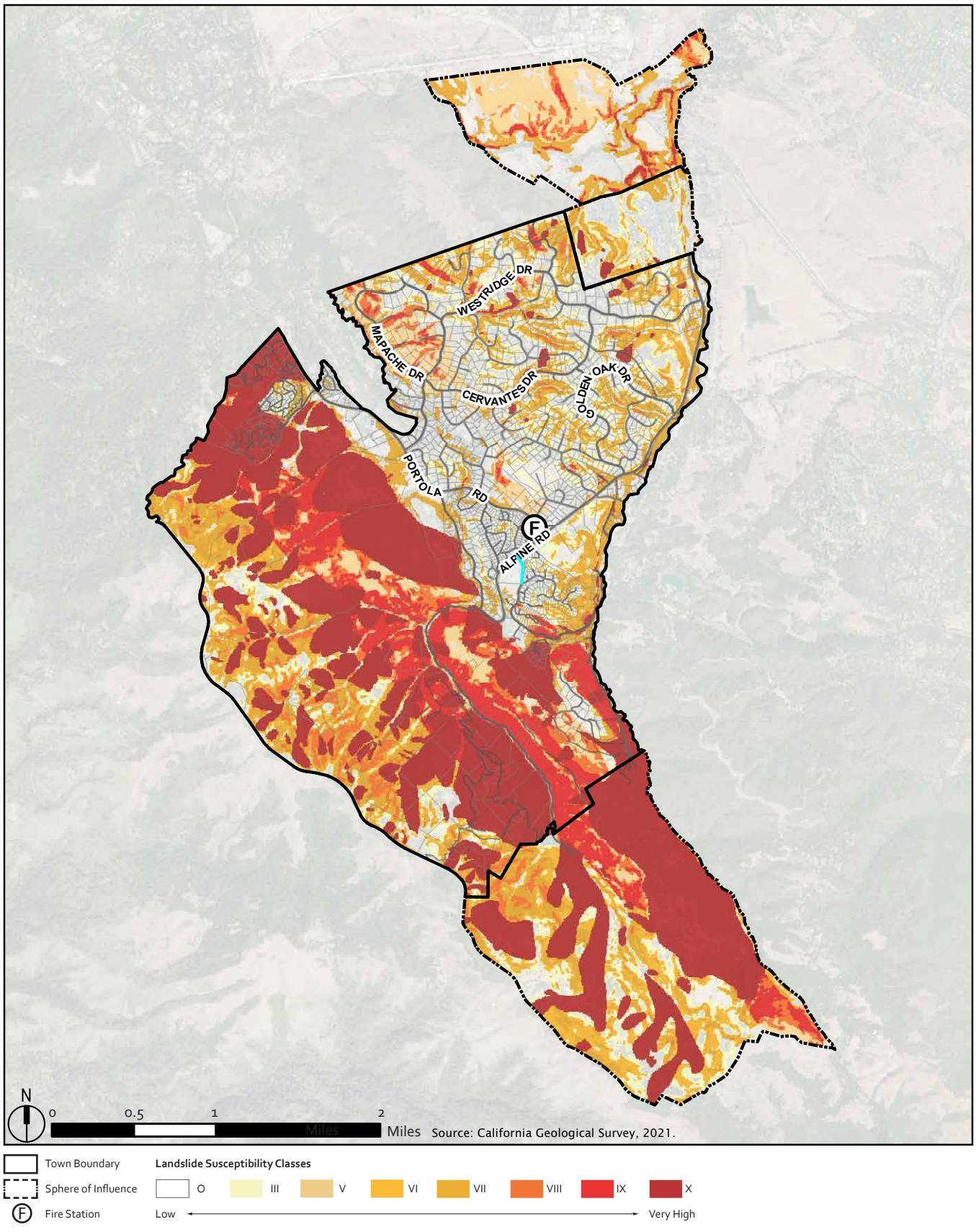


Figure 5
Landslide Susceptibility

TABLE 3: RISK CLASSIFICATION OF STRUCTURES, OCCUPANCIES, AND LAND USES

Class	General Category	General Examples	Acceptable Damage to Facility	Level of Acceptable Risk
1-A	Facilities whose failure might be catastrophic	Nuclear reactors, large dams	None which would result in exposing affected population to death or injury	Near zero
1-B	Facilities whose continuing function is critical	Power plants, power intertie systems	None which would impair safety of facility or disrupt function	Extremely low
2-A	Facilities critically needed for services after disaster	Hospitals, fire stations, telephone exchanges	None which would impair safety of facility or disrupt function	Extremely low
2-B	Critical transportation links	Regional highways, bridges, rail lines, overpasses, tunnels	Minor non-structural; facility should remain operational and safe, or be susceptible to quick restoration of service	Low
2-C	Major local utility lines and facilities	Power substations, gas and water mains	Minor non-structural; facility should remain operational and safe, or be susceptible to quick restoration of service	Low
2-D	Small dams	Small dams	None which would expose "downstream" population to injury	Extremely low
3-A	High occupancy structures	High-rise apartmenets and offices, schools	No structural damage; minor non-structural damage, but structures should remain safe and usable	Low
3-B	Facilities highly desirable for shelter after disaster	Schools, churches, civic buildings	No structural damage; minor non-structural damage, but structures should remain safe and usable	Low
3-C	Local roads, utilities and communication facilities	Local roads, local utility lines	Damage should be susceptible to reasonable rapid repair (or utility shut-off)	Moderate
4-A	Medium occupancy structures	Most commercial and industrial buildings, apartments	Structural integrity must be retained; non-structural damage should not unduly endanger safety of occupants	Low
4-B	Low occupancy structures	Singe-family homes	Structural integrity must be retained; non-structural damage should not unduly endanger safety of occupants	Low
5-A	Open space, with developed sites	Recreation areas, orchards, vineyards	Structural integrity must be retained; non-structural damage should not unduly endanger safety of occupants	Moderate
5-B	Open space, with undeveloped sites	Grazing lands, forests	Not applicable	Moderate

Source: Town of Portola Valley.

P-15 Restrict development projects that will cause hazardous geologic conditions or expose existing developments to an unacceptable level of risk until the causative factors are mitigated.

P-16 When considering development in areas that contain unstable ground, it is preferable to develop on those areas of natural stable terrain and thereby avoid the potential negative environmental impacts from engineered solutions.

GROUND SETTLEMENT

EXISTING CONDITIONS

Ground settlement is the sinking of the surface of the land and is most commonly due to the compaction of unconsolidated granular sediments, soils, and artificial fills. Compaction and settlement of such materials is a natural process that ordinarily takes place slowly and imperceptibly. However, the process can be accelerated by loading imperfectly compacted soils with embankments or buildings, by excessive withdrawal of groundwater, or by ground shaking resulting from earthquakes. Seismically induced ground settlement or "shakedown" may occur very rapidly. Settlement, particularly when aggravated by human or seismic processes, may be unequally distributed over a small area (differential settlement) with damaging effects to foundations of structures resting directly on the settled ground. Ground settlement during earthquakes has been a major source of property damage in many earthquake-prone regions of the world.

Areas within Portola Valley with the highest potential for ground settlement are those shown on the Geologic Map of the town as alluvium, slope wash, and landslide deposits. However, some areas underlain by other geologic units may also be subject to ground settlement. Detailed site investigations are required to determine local settlement potential.

POLICIES AND IMPLEMENTATION ACTIONS

P-17 Address areas of potential settlement within the Town as part of the development process.

A-17-1 Regularly update the Town's Geologic Map that identifies geologic deposits prone to ground settlement.

A-17-2 Require geologic investigations for sites identified with or suspected to contain settlement-prone geologic units.

SOIL LIQUEFACTION

EXISTING CONDITIONS

Soil liquefaction is the phenomenon in which certain water-saturated soils temporarily lose their strength when subjected to intense shaking and flow as a fluid. Soils most susceptible to liquefaction are saturated, well-sorted, poorly compacted, fine sands and silts. Substantial

damage in California and other areas of the world has been caused by soil liquefaction brought about by earthquakes.

Although sufficiently detailed geologic and engineering information to accurately predict sites of soil liquefaction in Portola Valley is not currently available, the possibility of liquefaction in localized areas along the valley floor, underlain by unconsolidated alluvium and a seasonally high water table, is considered to be relatively high. In addition, the California Geological Survey has data showing areas of potential liquefaction and require that prior to development in these areas the possibility of liquefaction be investigated.[15,16] Figure 6 shows potential liquefaction susceptibility in the Portola Valley area.

POLICIES AND IMPLEMENTATION ACTIONS

P-18 Require liquefaction assessment studies for all development projects proposed in areas identified as potentially susceptible to liquefaction, ensuring compliance with current state code.

A-18-1 Require that all new developments/projects must prepare and comply with a Design-Level Geotechnical Investigation Report prepared by a Certified Engineering Geologist, Geotechnical Engineer, or qualified Civil Engineer and with Structural Design Plans as prepared by a Registered Structural Engineer.

FLOODING

EXISTING CONDITIONS

Floods are among the most frequent and costly natural disasters. Floods are usually caused by large amounts of precipitation, either from a period of very intense precipitation or a long period of steady precipitation. In addition to storms, floods can also be caused by very rapid snow melting or from infrastructure failure, such as dam collapses or burst water storage tanks. As part of the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency (FEMA) conducts nationwide flood hazard mapping to identify flood-prone areas and to reduce flood damages. The maps identify the flooded extent that have a 1 percent annual chance of being equaled or exceeded, called the "100-year flood" and a 0.02 percent annual chance of being equaled or exceeded, called the "500-year flood." The flood elevation associated with the 1 percent chance event is referred to as the base flood elevation. Areas predicted to be inundated in a 1 percent chance event are delineated on the Flood Insurance Rate Map and commonly referred to as the "100-year floodplain." Buildings and other structures in the 100-year floodplain must meet certain requirements to receive a floodplain development permit and to qualify for NFIP insurance and federally backed mortgages. The Town of Portola Valley has both 1 percent and 0.2 percent annual chance flood zones as defined by FEMA as shown in Figure 7.

[15] California Geological Survey, Seismic Hazard Zone Report for the Mindego Hill 7.5 – Minute Quadrangle, Santa Clara and San Mateo Counties, California, 2005, Seismic Hazard and Zone Report 109, and Seismic Hazard Zones, Mindego Hill Quadrangle, Official Map, August 11, 2005.
[16] California Geological Survey, Seismic Hazard Zones, Palo Alto Quadrangle, Official Map, October 18, 2006.

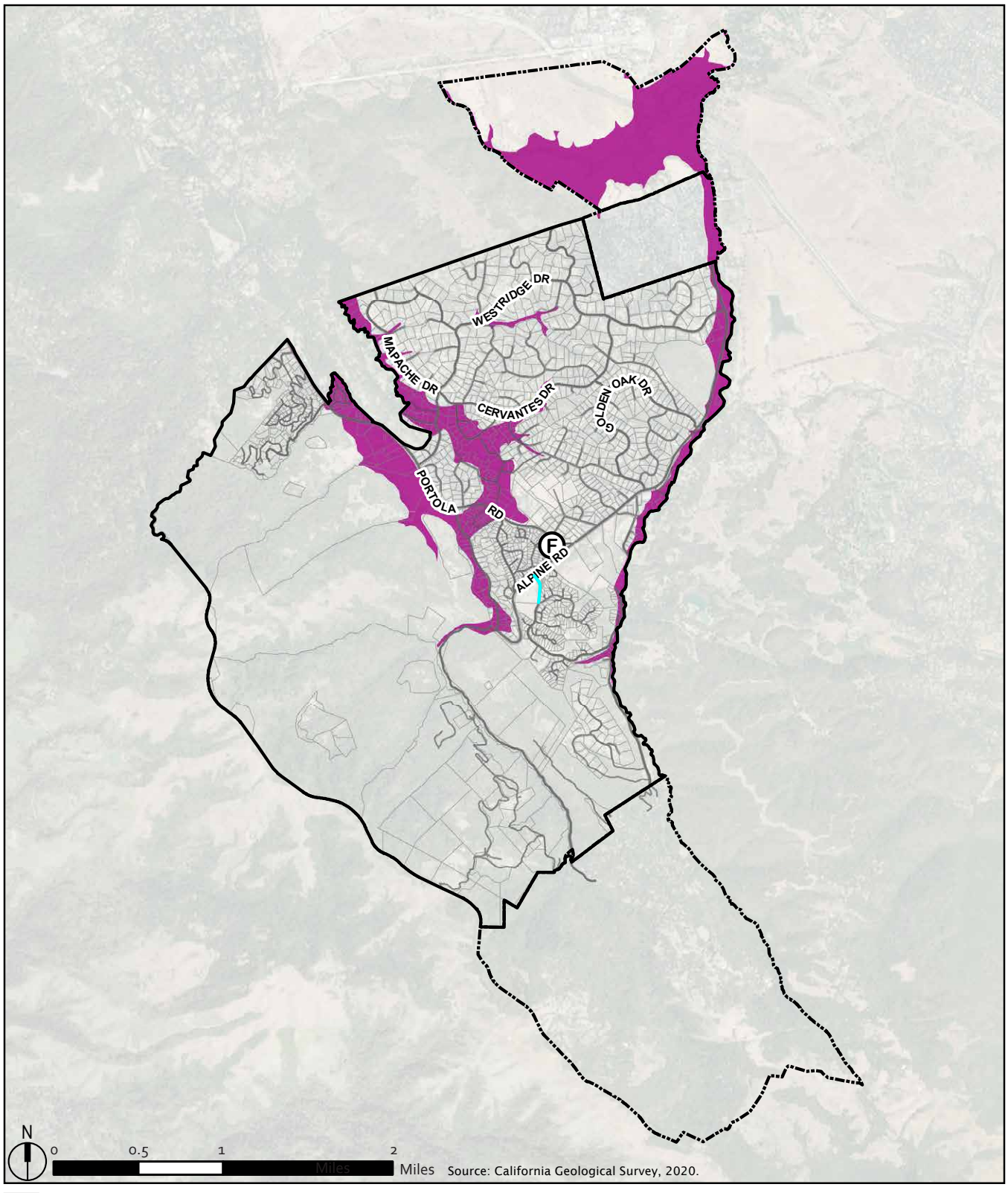


Figure 6
Liquefaction Potential

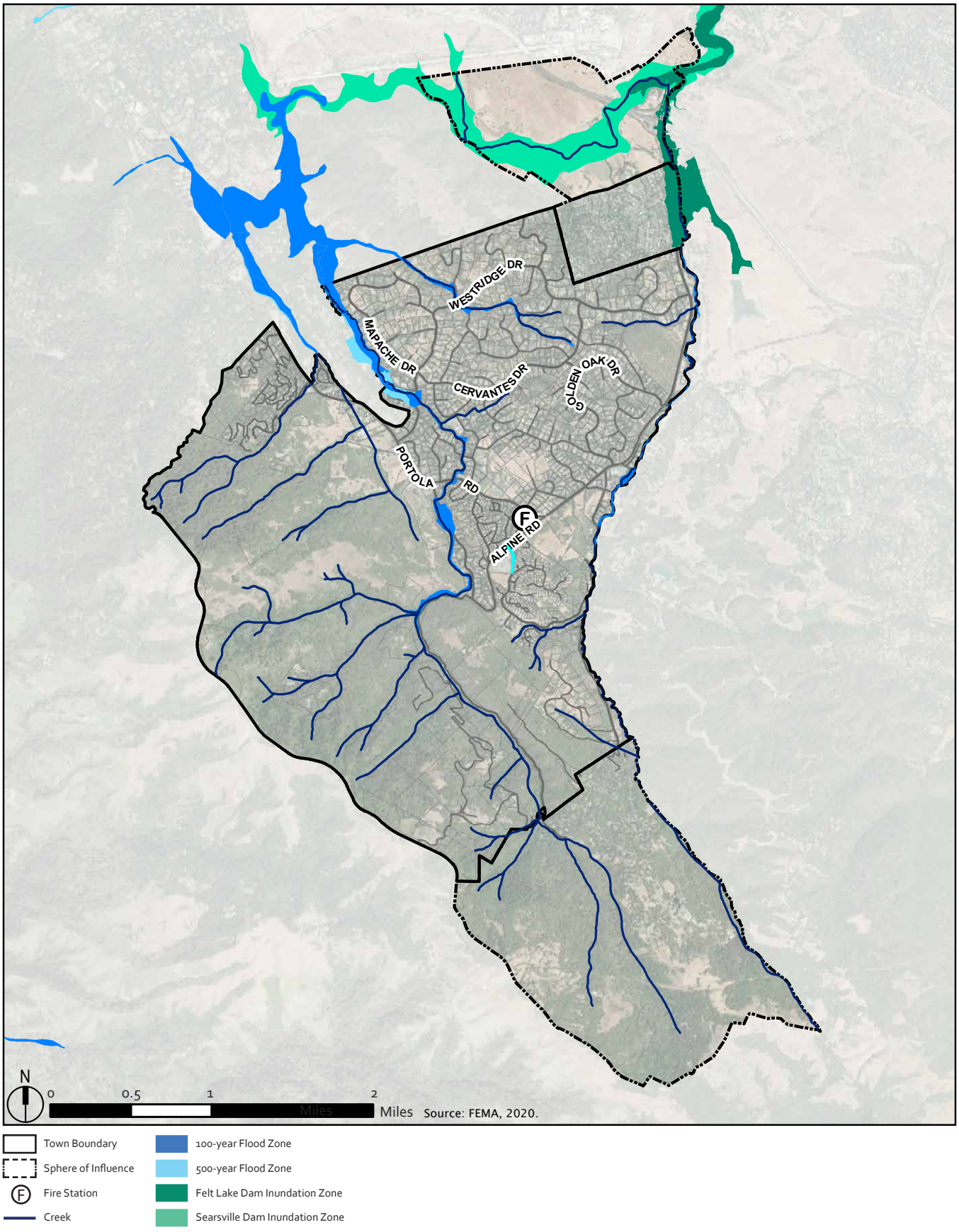


Figure 7
FEMA Flood Map

HISTORICAL DATA

In the past, Portola Valley has experienced flooding in areas adjacent to streams. Most of the flooding events have occurred with severe storm events, which have caused millions of dollars in damage. These areas include portions of the natural floodplains of Corte Madera, Sausal, and Los Trancos creeks, and locations where inadequate or obstructed drainage facilities have been unable to contain peak flows. Hydrologic principles suggest that similar minor flooding will recur sporadically, and that somewhat more extensive flooding may take place during widely spaced intervals. The *Flood Insurance Study for Portola Valley*[17] prepared by the FEMA in 2015 focuses attention on Corte Madera, Sausal, and Los Trancos Creeks. For each stream studied in detail, the boundaries of the 1 percent annual chance and 0.2 percent annual chance floods have been delineated using the flood elevations determined at each cross section. These floodways are to be kept clear of encroachments so that the 1 percent annual chance flood can be carried without any substantial increases in flood heights. Inundation by the 100-year flood is indicated for significant portions of Corte Madera Creek. The *Master Storm Drainage Report for Portola Valley* (1970)[18] cites a number of drainage facilities that were judged to be inadequate to pass 10-to-25-year flood flows or which were subject to obstruction by debris, and which could contribute to local flooding conditions in their vicinity during periods of high runoff.

POLICIES AND IMPLEMENTATION ACTIONS

P-19 Minimize injury, loss of life, property damage, and economic and social disruption caused by flooding and inundation hazards.

A-19-1 Evaluate the Portola Valley Master Storm Drainage Report to identify areas of the Town's drainage system that may require update or modification.

P-20 Review all applications for subdivisions, building permits and other similar applications in the vicinity of major drainage channels with respect to potential flooding.

P-21 Do not erect structures in areas determined to be subject to "100-year floods" in accordance with FEMA requirements, unless appropriate measures will mitigate potential adverse effects on the structures and nearby properties and will not adversely affect natural riparian zones. Minor structures where there is no threat to life and little threat to property may be allowed.

P-22 Rely upon Federally issued Flood Insurance Rate maps to define the "100-year flood" area along the relevant portions of Corte Madera Creek, Sausal Creek, and Los Trancos

[17] Federal Emergency Management Agency, Preliminary Flood Insurance Study, San Mateo County, California and Unincorporated Areas, Volumes 1 and 2, (revised July 16, 2015) and Flood Insurance Rate Maps for Portola Valley (scale 1" = 500').

[18] Jones-Tillson & Associates, "Master Storm Drainage Report for the Town of Portola Valley," unpublished report, Town Hall, Town of Portola Valley, Portola Valley, California, 1970.

Creek unless professionally prepared hydrological reports indicate that the subject site is not within an area that is subjected to "100-year floods."

P-23 Ensure flood plain regulations in the municipal code meet the latest FEMA requirements regarding new construction, redevelopment, and major remodels.

P-24 Replace or improve existing drainage structures such as culverts and pipes deemed to be inadequate to meet acceptable standards. Where possible restore natural systems to convey water.

A-24-1 Develop a drainage improvement program that identifies culverts and pipes that do not meet current standards and/or natural drainages that can benefit from natural systems enhancements.

P-25 Regulate development in drainages, especially in designated 100-Year Flood Zones, according to FEMA regulations.

A-25-1 Do not erect structures which will impede the flow of flood waters in a flood channel.

A-25-2 All development along Los Trancos Creek, Corte Madera Creek, and Sausal Creeks should comply with the Town's Creek Setback Ordinance (18.59).

P-26 Encourage owners of buildings that are in flood-prone areas to take appropriate measures to reduce the likelihood of flood damage to their property.

A-26-1 Control any such measures so as to not increase the flood or erosion hazards to other properties or have adverse impacts on the natural riparian zone.

A-26-2 Investigate and identify potential funding sources to assist property owners in flood hazard retrofits where feasible.

P-27 Maintain appropriate vegetation on the terrain in the Portola Valley planning area to minimize runoff of rainfall consistent with other safety practices.

P-28 Continue participation in the National Flood Insurance Program and encourage all owners of properties located within the 100-year floodplain Zones A and AE, and X (including any repetitive loss properties), to purchase and keep flood insurance for those properties.

P-29 Require all essential and critical facilities in or within 200 feet of 100-Year or 500-Year Flood Zones to develop disaster response and evacuation plans that address the actions that will be taken in the event of flooding.

P-30 Administer setback requirements to ensure adequate room between developed areas and natural creek channels to not impede the flow of water and to limit the extent of development that could be affected by creekbank failure

EROSION AND SEDIMENTATION

EXISTING CONDITIONS

Erosion and sedimentation are on-going natural processes in Portola Valley as they are elsewhere in the world. Factors influencing the rate of erosion at any particular location include climate, weather, rock and soil characteristics, slope, and vegetation. Erosion occurs chiefly on steeper slopes in the upper reaches of drainage basins where runoff velocities are high. Sedimentation, on the other hand, takes place mainly in the lower reaches of drainages where stream gradients and velocities are reduced. No stream gauging or sediment load data are available for the streams in Portola Valley, but it is apparent that the highest erosion potential is found on the steep slopes descending from Skyline Boulevard to the valley floor. Moderately high erosion potential also exists along some short, steep drainages in the eastern part of the town.

Soil maps prepared by Natural Resources Conservation Service dated 1991 and 2008[19, 20] provide a generalized view of the distribution of principal soil associations in the Portola Valley area and the relative erodibility of the soil groups. These maps assign a high erosion hazard to the soils on the steep slopes west of the valley floor and a moderate hazard to the foothill areas to the east.

Throughout much of Portola Valley and the surrounding area, the combination of natural slopes, soil structure and native vegetation contribute to a relatively slow natural erosion rate. On the other hand, where natural conditions are disturbed by grading and site development or poorly controlled animal keeping, erosion can be greatly accelerated and cause damage both to the site where it occurs and downstream where sedimentation of the eroded material takes place.

With the exception of the flood plain of Corte Madera Creek along the Portola Valley-Woodside boundary, few persistent areas of natural sedimentation exist in Portola Valley. Most of the sediment produced by erosion is exported by stream flow beyond the boundaries of the town. Local sedimentation does occur along the main creeks and tributary drainages chiefly where human activities have altered stream flow characteristics. Here, sediment accumulations have partially obstructed a number of culverts and drainage ditches, increasing the hazard of local flooding at these points.

POLICIES AND IMPLEMENTATION ACTIONS

P-31 Maintain natural slopes and preserve existing vegetation, especially in hillside areas.

[19] NRCS, Soil Survey of San Mateo County, Eastern Part, and San Francisco County, California, 1991. (USDA Soil Conservation Service now NRCS.)
[20] NRCS, Custom Soil Resource Report for San Mateo Area, California; San Mateo County, Eastern Part, and San Francisco County, California; and Santa Clara Area, California, 2008.

A-31-1 When change in natural grade or removal of existing vegetation is required, employ remedial measures to provide appropriate vegetative cover to control storm water runoff.

A-31-2 Give special attention to minimizing erosion problems resulting from the keeping of animals. In specific applications, these policies will be tempered by the need for fire safety.

P-32 Enforce hillside protection measures that control runoff and erosion.

P-33 Require drought-resistant vegetation with deep root systems where appropriate in new developments and major remodels to reduce over-irrigation in areas of the Town prone to slope instability.

P-34 Continue to administer the provisions of the subdivision ordinance concerning landscaping and erosion control and the provisions of the site development ordinance concerning grading, giving special attention to the protective measures that are appropriate prior to the advent of seasonal rains.

EXPANSIVE SOILS AND SOIL CREEP

EXISTING CONDITIONS

Expansive soils may be encountered anywhere within the Portola Valley area, but they occur most frequently in areas shown on the Town's Ground Movement Potential Map as expansive soils and bedrock. Some soils and bedrock materials in the Portola Valley area swell when they become wet and shrink when they dry as a result of water absorption by certain clay minerals.

Repeated expansion and contraction of soils on slopes results in slow creep of the soil layer in a downslope direction. The expansion and contraction may be caused merely by bulk absorption and loss of water or freezing and thawing, but soils containing truly expansive clays are subject to pronounced soil creep. Soil creep may exert large enough lateral forces on building foundations to produce significant distortions of the structure or damage to the foundation if unanticipated in the foundation design. Individual site investigations and laboratory testing are required to identify expansive soil conditions.

POLICIES AND IMPLEMENTATION ACTIONS

P-35 In areas where information available to town officials indicates the probability of expansive soils or soil creep, soils reports should be submitted in connection with all applications for development. In those instances where expansive or creep-prone soils are reported, measures necessary to mitigate the probable effects of this hazard should be required.

P-36 Subdivisions, structures, or other developments must prepare and comply with a Design-Level Geotechnical Investigation Report prepared by a Certified Engineering Geologist, Geotechnical Engineer, or Qualified Civil Engineer and with Structural

Design Plans as prepared by a Registered Structural Engineer. The report should consider field test results and observations regarding the nature, distribution, and strength of existing soils, and provide recommendations for appropriate grading practices and project design. The recommendations should be incorporated into project design plans.

WILDFIRE HAZARDS

Given its combination of complex terrain, Mediterranean climate, and ample natural ignition sources from productive natural plant communities, portions of California are very fire prone. High hazard wildfire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, accumulation of vegetation, topography, and high winds. Throughout California, communities are increasingly concerned about wildfire safety as increased development in the areas adjacent to wildlands and subsequent fire suppression practices have affected the natural cycle of the ecosystem which have evolved with frequent wildfires.

Portola Valley is characterized by steep canyons and gullies, with dense vegetation, including thick brush and trees, interspersed throughout its residential neighborhoods. The town is bounded to the south, east, and west by open space land uses: Windy Hill Open Space Preserve, Pearson-Arastradero Preserve, and Thornwood Open Space Preserve, respectively. The broken nature of the topography creates difficult-to-access areas where vegetation management is difficult to accomplish; in addition, east-west oriented canyons create funnels for strong autumn winds, which tend to blow from the east or west and amplify wildfire hazards.[21]

The summer/fall climate in San Mateo County is Mediterranean and characterized by warm, dry temperatures accompanied by wind. The topography, fuel conditions, and climate combine to make Portola Valley and surrounding areas at risk for wildfire. Historic weather data suggests that the greatest wildfire threat may be driven by eastern winds, which are typically drier and less common; therefore, areas where the topography aligns with the dominant fire-season winds (east-west oriented canyons) face a higher likelihood of extreme wildfire behavior.[22]

HISTORICAL DATA

According to the 2021 SMCMJHMP and the California Department of Forestry and Fire Protection (Cal Fire), San Mateo County has a high probability of experiencing a wildfire in any given year. However, since the 1950's, only two wildfires have caused sufficient damage, triggering a State or federal disaster declaration: in 1956 near Montara, and in 2020 across the Santa Cruz County border (the CZU Lightning Complex). According to Cal Fire, two wildfires have occurred within the Portola Valley area (see Table 4 below).

[21] Deer Creek Resources, 2022. Portola Valley Wildfire Memo.
[22] Deer Creek Resources, 2022. Portola Valley Wildfire Memo.

TABLE 4: PORTOLA VALLEY HISTORIC WILDFIRES

Year	Name	Location	Acres Burned
2017	SKEGGS	South of Teague Hill Open Space	36
1962	LEIB	North of Bull Run Creek and west of Farm Road	1,328

Source: Cal Fire, 2021. Fire Perimeters through 2021 [GIS]. Retrieved from https://frap.fire.ca.gov/mapping/gis-data/.

CLIMATE CHANGE CONCERNS

Increased temperatures, and decreased precipitation rates, also affect how dry the soil composition and vegetative debris can be in a given area. According to Cal Adapt, the Keetch-Byram Drought Index (KBDI), provides an estimate of average number of days that dry materials may pose an increased risk to wildfire. KBDI is a cumulative value that increases on dry and warm days and decreases during rainy periods. In California, KBDI is anticipated to increase from the end of the wet season (spring) into the dry season (summer & fall). On average Portola Valley has an observed 30-year average of 22 days a year where the KDBI is over 600, which indicates severe drought, extreme wildfire risk, and increased wildfire occurrence. By midcentury, it is projected that 55-63 days may exceed this threshold, and by the end of the century 65-95 days.[23] This is an important factor to consider as it can exacerbate wildfire hazard potential in an area already susceptible to fire.

Based on the anticipated changes in temperature and precipitation in Portola Valley, increases in wildfire vulnerability is expected. According to Cal Adapt, from 1961 to 1990 approximately 106.4 to 116.0 acres of Portola Valley burned on average annually. By mid-century, this annual average area burned is expected to increase to approximately 217.6 to 233.7 acres, and 226.6 to 234.0 acres by the end of the century.[24]

REGULATORY SETTING

In the event of a fire emergency, the Portola Valley planning area is served by the Woodside Fire Protection District (WFPD), Cal Fire, and Stanford University. Northern and eastern portions of the planning area are also served by the Menlo Park Fire Protection District and the Palo Alto Fire Department. WFPD Station #8 serves Portola Valley. All of these fire protection services fight both structural and wildland fires, although the equipment operated by Cal Fire is designed to be most effective against grass, brush, and forest fires, rather than structural fires carrying less water than urban fire engines, and capable of off-road driving.

The Town established both an Emergency Preparedness Committee and Wildfire Preparedness Committee, which coordinate efforts with the WFPD and San Mateo County Office of Emergency Services. Since its establishment in 2019, the Wildfire Preparedness Committee has taken the lead on recommending a variety of wildfire mitigation measures related to home hardening, vegetation management, communications, evacuation, and

[23] Local Climate Change Snapshot for Portola Valley, CA. https://cal-adapt.org/tools/local-climate-change-snapshot
[24] Local Climate Change Snapshot for Portola Valley, CA. https://cal-adapt.org/tools/local-climate-change-snapshot

insurance-related issues to the Town Council. The Committee continues to meet and provide the Council with recommendations.[25]

Domestic water is supplied to Portola Valley by the California Water Services Company (Cal Water). Bear Gulch District, which also serves the communities of Atherton, Woodside, parts of Menlo Park, parts of unincorporated Redwood City, and adjacent unincorporated portions of San Mateo County, including West Menlo Park, Ladera, North Fair Oaks, and Menlo Oaks. The Bear Gulch District considers fire flow needs when determining level of service. The current basic criterion for judging the adequacy of water supply for firefighting purposes is the 2019 California Fire Code (Title 24, Part 9) which requires 1,000 gallons per minute for a period of 1 hour, with a residual pressure of 20-lbs/sq. in. for structures under 3,600 sq. ft.

The Town of Portola Valley implements ordinances and standards to minimize fire hazards. The WFPD's ordinances and standards cover topics such as location of fire hydrants and provision of sprinklers and roadway widths and provide the basis for the rural fire prevention capital facilities standards specified in the Town's Safety Element. The Town has ratified the WFPD Fire Code, which adopts by reference the 2019 California Fire Code (California Code of Regulations, Title 24, Part 9) as amended by the changes, additions, and deletions set forth in the ordinance adopting the WFPD Fire Code. In addition, these codes and standards are updated on a regular basis to incorporate new information, mapping, and understanding of the conditions within Portola Valley. These periodic updates include new mapping and risk assessments to better address the unique fire conditions within the Town and surrounding areas.

Portola Valley Municipal Code

The Town of Portola Valley has adopted Chapter 7A (development in Wildland Urban Interface [WUI] areas) of the Building Code and it is applicable to all properties in town regardless of location. The Town adopted the Wildfire Preparedness Committee's recommended Building Code amendments on December 8, 2021. These amendments require additional "home hardening" measures including use of noncombustible exterior materials and construction for new construction and applicable remodels. As described in the following "State and Local Responsibility Areas" section, properties located within Cal Fire designated Very High Fire Hazard Severity Zones (VHFHSZ) are subject to more stringent requirements (Chapter 7A of the California Building Code) for buildings and property maintenance. Chapter 7A dictates the use of fire-resistant exterior materials and adherence to various design requirements. As of 2021, all properties in Portola Valley are required to adhere to Chapter 7A requirements regardless of location within a VHFHSZ.

[25] Wildfire Preparedness Committee, 2022. Available at: https://www.portolavalley.net/government/town-committees/wildfire-preparedness-committee, bottom of page under "Recommendations and Materials," accessed on August 8, 2022.

San Mateo Multi-Jurisdictional Local Hazard Mitigation Plan (2021)

LHMPs are required by the Federal Disaster Mitigation Act of 2000 (Public Law 106-390). Having an approved LHMP is needed in order for a local jurisdiction to qualify for certain federal disaster assistance and hazard mitigation funding. LHMPs are required to be updated every five years to remain eligible for these potential funding sources. The adopted SMCMJHMP includes an Annex for the Town of Portola Valley. The adoption of this annex ensures the Town is eligible to pursue FEMA hazard mitigation grant funding opportunities to help mitigate future natural hazards.

LHMP and Safety Element requirements are very similar, however both documents serve very different purposes. The LHMP focuses on understanding risks within a community and specific actions to reduce those risks, while the Safety Element provides a broader framework for the protection of life and property from hazard conditions affecting the community. AB 2140 (2006) encourages (but does not require) a jurisdiction to incorporate the LHMP by reference into the Safety Element. Recent legislation, Senate Bill (SB) 379 (2015) and SB 1035 (2018), have linked required updates of the Safety Element to updates of the LHMP and housing element.

Santa Cruz County – San Mateo County Community Wildfire Protection Plan (2018)

A Community Wildfire Protection Plan (CWPP) is a planning and funding prioritization tool authorized by the Federal Healthy Forests and Restoration Act of 2003 as an incentive for communities to engage in comprehensive forest and fire hazard planning and help define and prioritize local needs. CWPPs are generally updated every five years but can be updated at any time if new priorities emerge or major changes occur in the built or vegetated landscape.

The Santa Cruz County – San Mateo County CWPP was collaboratively developed through interested parties including Federal, State, City, Town, and County agencies in the two-county region. The purpose of this plan is to identify the risks and hazards associated with wildland fires in the WUI areas of San Mateo and Santa Cruz Counties. The CWPP is not a legal document and does not satisfy any regulatory permitting processes, but identifies recommendations aimed at preventing and reducing both infrastructure and ecosystem damage associated with wildland fires.

STATE AND LOCAL RESPONSIBILITY AREAS

Cal Fire is required by law to map areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. These designations, referred to as Fire Hazard Severity Zones (FHSZ), mandate how people construct buildings and protect property to reduce risk associated with wildfires. There are three zones, based on increasing fire hazard severity: medium, high, and very high. The maps were last updated in 2007-2010. At that time, Cal Fire was only required to map Very High Fire Hazard Severity Zone (VHFHSZ) located in local responsibility areas.

As shown in Figure 8, the Woodside Highlands neighborhood, and the Thornewood Open Space Preserve to the west of Portola Valley are located in a VHFHSZ. The town areas within the VHFHSZ contain a mix of undeveloped open space, single-family residential, and commercial uses. According to the multijurisdictional LHMP (MJLHMP), there are 146 buildings and approximately 427 people in Portola Valley's VHFHSZ.

Under State law, the areas designated VHFHSZ are subject to more stringent requirements (Chapter 7A of the California Building Code) for buildings and property maintenance. Chapter 7A dictates the use of fire-resistant exterior materials and adherence to various design requirements. While the Town did not officially adopt the Cal Fire VHFHSZ map when it was released, as of 2021 all properties are required to adhere to Chapter 7A requirements regardless of location within a VHFHSZ (see Figure 9).

Cal Fire is currently updating the criteria for how the FHSZ maps are developed and will be publishing all Fire Hazard Severity Zones (FHSZs), including very high, high, and moderate FHSZs, for the Local Responsibility Area (LRA). While not yet available, Portola Valley can identify potential future policies and programs to address the anticipated larger fire hazard areas likely to be identified in the Cal Fire and WFPD FHSZ Maps. The anticipated expansion of such maps underscores the need to continue to adopt town-wide defensible space, Wildland Urban Interface (WUI) building code, and elevated local home hardening regulations.

Building upon Cal Fire's FHSZ maps, local knowledge of wildfire hazard, landscape and vegetation, housing stock, and infrastructure can also be used to develop a wildfire overlay zone for corresponding policies.

MORITZ MAP

In previous versions of the Safety Element, the Town has used a Fuel Hazards Map prepared by Moritz Arboricultural Consulting in 2008 to, according to the currently adopted Safety Element, "provide guidance for reducing the fire threat from vegetation throughout the Town." (see Figure 10 for Moritz Map). The map identified eleven vegetation associations and assigned a rating of potential fire behavior and level of risk to each association. While the map is not as up to date as when it was prepared in 2009, it can still provide insight into the existing vegetative conditions within the Town and should be used to assist with decision making on development projects until new mapping is available (including both new Cal Fire maps and WFPD hazard and fuels work expected to be completed in 2022). In conjunction with Cal Fire and WFPD mapping, the Moritz Map should be used to determine potential concerns for new developments, redevelopments, and major modifications to structures within the Town.

VHFHSZ CONSTRAINTS AND CONCERNS WITHIN PORTOLA VALLEY

Location within the VHFHSZ in the Local Responsibility Area requires new development to comply with defensible space, Building Code Chapter 7A requirements as well as make findings before approving new subdivisions. The Town's local regulations extend these requirements to all properties in town, regardless of location in a VHFHSZ. Effective July 1, 2021, new development in the VHFHSZ in the Local Responsibility Area are also required to

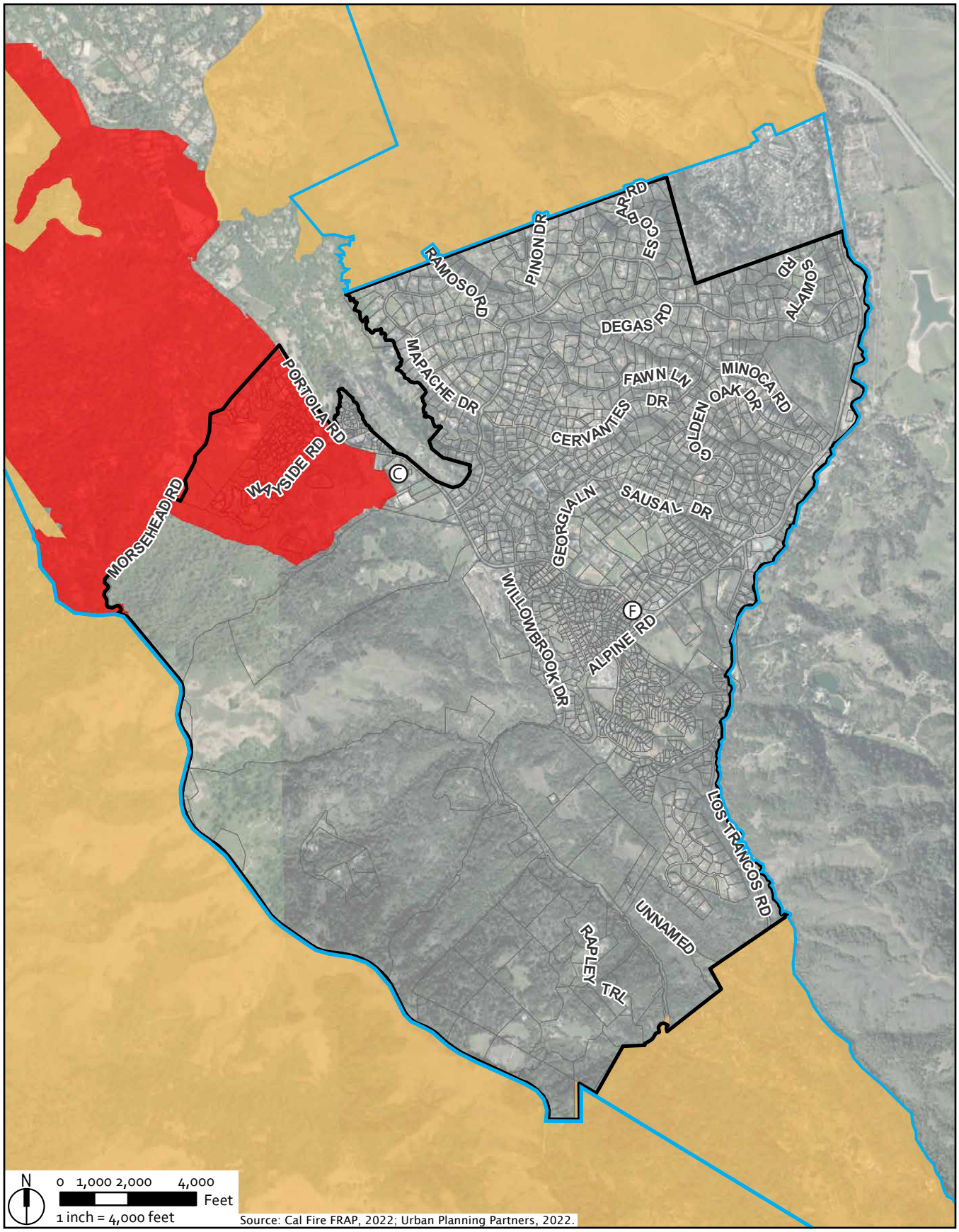


Figure 8
Portola Valley VHFHSZ and FHSZs
Portola Valley Safety Element
Public Review Draft

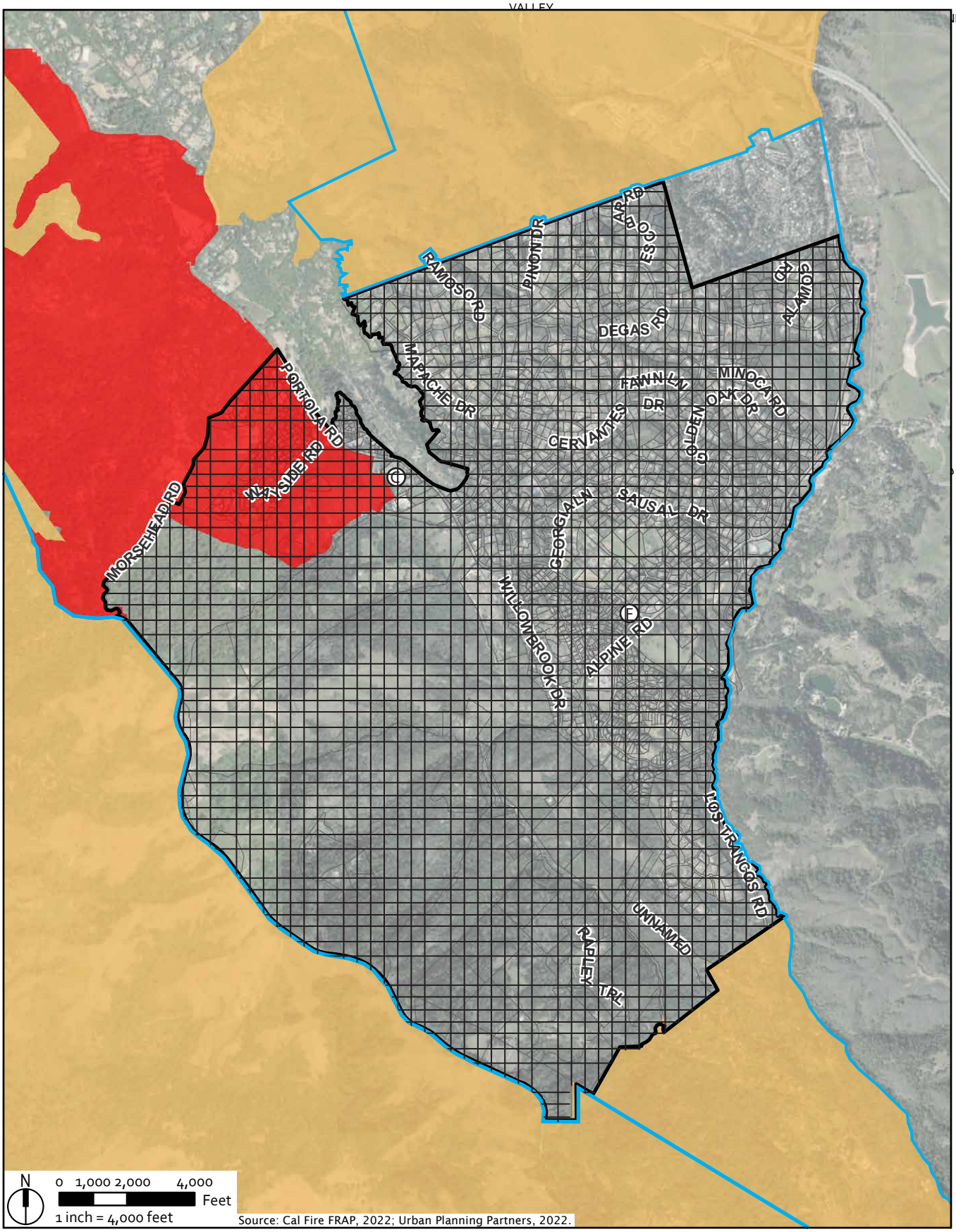
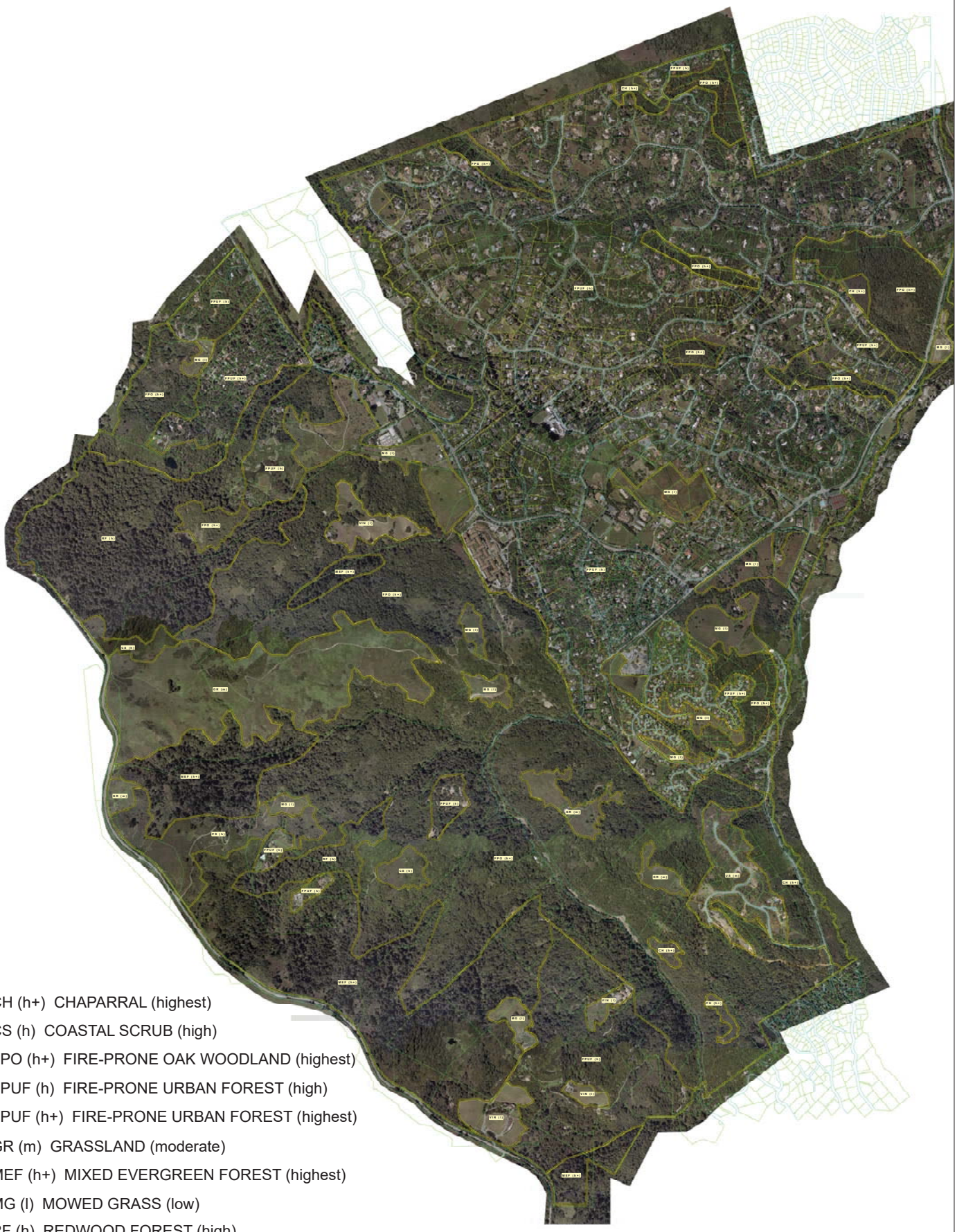


Figure 9
Chapter 7A Applicability Map
Portola Valley Safety Element
Public Review Draft



CH (h+) CHAPARRAL (highest)

CS (h) COASTAL SCRUB (high)

FPO (h+) FIRE-PRONE OAK WOODLAND (highest)

FPUF (h) FIRE-PRONE URBAN FOREST (high)

FPUF (h+) FIRE-PRONE URBAN FOREST (highest)

GR (m) GRASSLAND (moderate)

MEF (h+) MIXED EVERGREEN FOREST (highest)

MG (l) MOWED GRASS (low)

RF (h) REDWOOD FOREST (high)

US (m) URBAN SAVANNAH (moderate)

VIN (l) VINEYARD (low)

0 1,200 2,400

Feet

N

Basemap: Town of Portola Valley
Vegetation Data Source: Moritz Arboricultural Consulting
Map: TRA Environmental Sciences, Inc.
October 2008

comply with the California Fire Safe Regulations. Areas located within the VHFHSZ include approximately 170 parcels in the northwestern portion of the Town. Uses within this area are primarily residential. Many of the parcels located within this area have limited access due to narrow steep roadways and single ingress/egress conditions. These constrained roadways rely on the accessibility of Portola Road, which is an identified evacuation route.

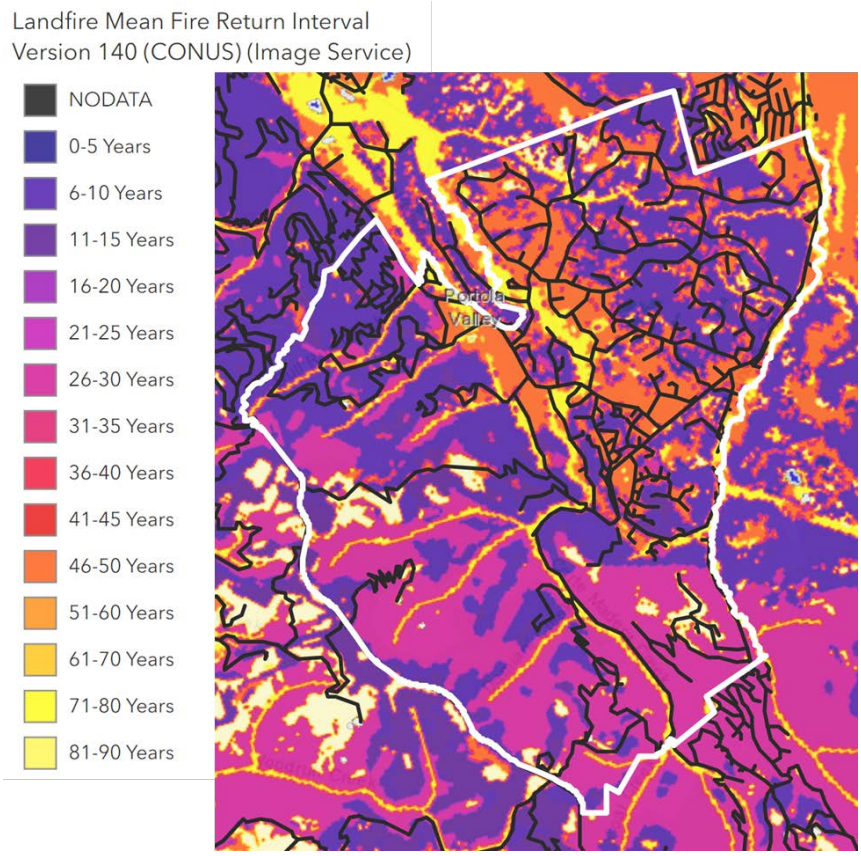
Additional development in these areas would require upgrades to circulation infrastructure, to allow emergency equipment and personnel access without constriction, and to ensure that evacuation standards are met. This could include, but not be limited to, additional access roads to provide multiple points of ingress and egress to the area, widening of roads to accommodate emergency response equipment and provide additional capacity. In conjunction with this, upgrades or expansion of utilities, especially water, may be required to meet fire flow requirements and daily demands, depending on the current infrastructure capacity in these areas.

USGS LANDFIRE DATA

The Landscape Fire and Resource Management Planning Tools or LANDFIRE, is a shared mapping and modeling program used by the U.S. Department of Agriculture Forest Service and the U.S. Department of the Interior. This tool provides consistent, comprehensive, geospatial data and databases that describe vegetation, wildland fuel, and fire regimes across California and the rest of the nation. Fire regimes are characterized by a variety of factors including vegetation composition, fuel structure, climate and weather patterns, and topography. As fire regimes are highly dependent on the landscape and ecosystem in which they occur, there is no standard classification for fire regimes. At a minimum, a fire regime is based upon the impact to the vegetation (severity), and when and how often fires occur in a given area known as the fire interval. Fire severity is the impact of fire on the ecosystem, and a fire interval is the number of years between fires in a given area.

LANDFIRE mapping of Fire Return Intervals (see Figure 11) for Portola Valley varies from (0-5 years) to (71-80 years) depending upon the location in the Town. The areas of greatest concern within the identified VHFHSZ are predominantly characterized by low fire intervals between (0-5 years) and (6-10 years). Based on this data, we can expect that these areas have the types of conditions (topography, vegetation, etc.) to burn frequently. Arid climate and natural fuel sources make Portola Valley a susceptible location for fires to occur.

FIGURE 11: FIRE RETURN INTERVALS



Source: LANDFIRE, 2016.

POLICIES AND IMPLEMENTATION ACTIONS

New Development

P-37 Promote new development outside of the Very High Fire Hazard Severity Zone. If development is proposed in the Very High Fire Hazard Severity Zone, require fire safe design and compliance with fire safe regulations contained in Title 14 of the California Code of Regulations. If vegetation management hazard mitigations are required as a condition of building permit approval, the developer shall sign a maintenance agreement or provide a funding source for future maintenance of the required mitigations.

A-37-1 Require developers to assign all "fuel modification" requirements on common land to the association or other common owner groups responsible upon development completion and occupancy.

P-38 Prior to the approval of any subdivision of lands in a Very High Fire Hazard Severity Zone, the Planning Commission should review the results of a study that includes at least the following topics:

- A description of the risk and the factors contributing to the risk.

- Actions that should be taken to reduce the risk to an acceptable level.
- The costs and means of providing fire protection to the subdivision.
- The costs and means of providing ongoing vegetation management for the subdivision.
- An indication of who pays for the costs involved, and who receives the benefits.
- If a proposed building site requires access to adjoining parcels to maintain 100 feet of defensible space from the primary structure, an easement or other legal agreement for access should be required as permitted by law.

P-39 Ensure new public/critical facilities (schools, hospitals, fire stations, etc.), are not located in High and Very High Fire Hazard Severity Zones, to the greatest extent feasible. If located in these areas, ensure full compliance with fire safe regulations and adequate fire response and evacuation capabilities.

P-40 Continue to require new development to incorporate design measures that enhance fire protection in High and Very High Fire Hazard Severity Zones. This shall include but is not limited to incorporation of fire-resistant structural design, use of fire-resistant landscaping, and fuel modification around the perimeter of structures.

P-41 Require fire protection plans for new development and major remodels in areas designated as High and Very High Fire Severity Hazard Zones by the California Department of Forestry and Fire Protection or equivalent hazard designation in Local Responsibility Areas.

P-42 Require vegetation management plans in all new developments and major remodels.

Vegetation Management

P-43 Provide adequate clearance around structures to prevent spread of fire by direct exposure and to assure adequate access in times of emergency and for the suppression of fire.

P-44 Vegetation management conducted by homeowners should remove the most hazardous plant materials while leaving adequate vegetation to reduce risks of erosion, habitat loss, and reduce the potential for invasive species introduction.

A-44-1 Conduct three-dimensional mapping of understory vegetation in a format which is compatible with predictive wildfire spread models in collaboration with WFPD.

A-44-2 Explore the feasibility of other vegetation management strategies, including:

a. Elimination of use of fire-hazardous plants.

b. Use of non-prolific landscaping species.

c. Requiring project proponents in hillside areas to evaluate and upgrade as necessary fire flows and water supplies to hillside areas.

P-45 Ensure open space brush areas, susceptible to wildfire risk, are adequately maintained in accordance with WFPD and applicable state requirements.

P-46 Encourage the use of fire-resistant vegetation for landscaping, especially in high fire hazard areas.

A-46-1 Provide information on methods for reducing fire hazards through the Town's website and newsletter, including information on clearing of plant debris and combustible materials, use of fire-safe landscaping and defensible space, and modifying buildings to make them fire-resistant.

P-47 Require vegetation clearance and maintenance for all private roads and properties in the high and very high fire hazard severity zones.

P-48 Maintain and adequately fund fuel breaks and other fire defense improvements on public property and require similar measures for private property in compliance with fire safe regulations where possible.

Water Availability/Suppression Needs

P-49 Ensure access to privately owned sources of water, such as swimming pools, in or adjacent to high fire risk areas, for on-site fire protection use, if necessary.

P-50 Ensure that landscaping, lighting, building siting and design, water pressure and peak load water storage capacity, and building construction materials meet current fire safe regulations.

P-51 Prioritize development in areas with sufficient water supply infrastructure and roadway capacity to ensure adequate evacuation and emergency equipment access.

P-52 Maintain and enhance water supply infrastructure to ensure adequate supplies for existing and future daily demands and firefighting suppression requirements.

P-53 Educate residents and property owners on proper water shut off procedures during a hazard incident or evacuation order.

Fire Suppression and Firefighter Safety

P-54 Collaborate with WFPD to promote public awareness of fire hazards and safety measures, including outreach to at-risk populations, and identification of low-risk areas for temporary shelter and refuge during wildfire events

P-55 Ensure adequate fire suppression resources in the local responsibility areas, and coordinate with WFPD and Cal Fire to meet current and future fire suppression needs.

A-55-1 Portola Valley will update the Fire Hazard Severity Zones for Very High, High, and Moderate when hazard and fuels assessments by WFPD and the State complete their updates. The State update recognizes that fire hazard severity is changing and is currently updating maps to reflect changing conditions.

P-56 Identify fire defense zones where firefighters can control wildfires without undue risks to their lives, and areas where firefighter safety prohibits ground attack firefighting.

P-57 Pursue funding for fire prevention and suppression (State grant funds, hazard mitigation funds, etc.).

P-58 Become a Fire Risk Reduction Community through the State Board of Forestry and Fire Protection.

Codes and Regulations

P-59 Building upon CAL FIRE's Fire Hazard Severity Zone maps, use local knowledge of wildfire hazard, landscape, housing, and infrastructure to develop a wildfire overlay or other similar regulatory tool for corresponding policies.

P-60 Require compliance with Chapter 7A requirements of the California Building Code and the Town's Home Hardening Code for all new development and substantial additions.

P-61 Require new developments and major remodels or renovations to comply with the California Building Code, Fire Code, and local ordinances for construction and adequacy of water flow and pressure, ingress/egress, and other measures for fire protection. Require endowments or HOA-type assessments to fund long-term maintenance of wildfire mitigations.

P-62 Require non-combustible roofs and exterior siding in all fire hazard areas.

P-63 Work with WFPD to enforce regulations related to fire resistant construction, sprinkler systems, and early warning fire detection system installation and/or sirens.

P-64 All developments shall comply with the WFPD Fire Code and incorporate recommendations from the Santa Cruz County - San Mateo County Community Wildfire Protection Plan, where applicable.

P-65 New developments in fire-prone hillside areas, shall comply with statewide Fire Safe Regulations (see CCR, Title 14, Sections 1270 et seq.).

A-65-1 Assess structures along slopes to determine if setbacks should be increased to protect structures in wildfire prone areas.

P-66 Expand home hardening throughout the Town to reduce fire hazard vulnerability

A-66-1 Update and expand the home hardening ordinance to existing buildings in high and very high fire hazard severity zone areas.

A-66-2 Develop a program to support residents with home hardening and defensible space actions. The program may include various resources, incentives, and educational components. Programs may include vegetation disposal assistance, home hardening guidance and resources, or support with

development of local resident-focused educational organizations like Firewise Communities.

P-67 Incorporate updated WFPD fire hazard and risk assessment findings into the Safety Element.

P-68 Monitor new State laws that increase minimum building standards and expand the requirements to more areas within the Town, including high and moderate areas.

P-69 Upon the completion of the Structure Separation Experiments being carried out by National Institute of Standards and Technology (NIST), the Insurance Institute for Business and Home Safety, and Cal Fire on structure-to-structure ignition, consider science-backed approaches to addressing narrow setbacks. The Town may wait for State or WFPD guidance, implement findings into local building codes or provide voluntary guidance to residents.

P-70 Develop, monitor, and regularly update a program to educate and inform the public on local and state fire code, and fire safe regulations. Ensure that this program provides the latest information as provided by the Town, County, and the State. Use community-appropriate languages to ensure greater understanding by residents and visitors.

P-71 Support increased enforcement mechanisms and processes by WFPD to incentivize fire risk reduction activities and abatement.

CLIMATE CHANGE ADAPTATION AND RESILIENCE

Climate is the long-term behavior of the atmosphere—typically represented as averages—for a given time of year. This includes average annual temperature, snowpack, or rainfall. Human emissions of carbon dioxide and other greenhouse gas emissions (greenhouse gases) are important drivers of global climate change, and recent changes across the climate system are unprecedented. Greenhouse gases trap heat in the atmosphere, resulting in warming over time. This atmospheric warming leads to other changes in the earth systems, including changing patterns of rainfall and snow, melting of glaciers and ice, and warming of oceans. Human-induced climate change is already resulting in many weather and climate extremes in every region across the globe. Evidence of observed changes includes heatwaves, heavy precipitation, droughts, increased wildfires, and hurricanes.[26]

Likewise, California and Portola Valley are already experiencing the effects of a changing climate. Both gradual climate change (e.g., sea level rise) and climate hazard events (e.g., extreme heat days) expose people, infrastructure, buildings and properties, and ecosystems

[26] Intergovernmental Panel on Climate Change 2021. Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

to a wide range of stress-inducing and hazardous situations. These hazards and their impacts disproportionately affect the most vulnerable populations, including children and elderly adults, low-income populations, renters, immigrants, and BIPOC residents. Many of the climate change projections are compared to a historic time period from 1961-1990. This time period is considered a target for greenhouse gas reduction and provides a community with a threshold that can be established to determine which future climate mitigation and adaptation actions will contribute to reductions in climate change related impacts.

INCREASING TEMPERATURE

During the last century, average surface temperatures in California and the Bay Area rose steadily. Average minimum and maximum temperatures in San Mateo County rose faster than California. Between 1970 and 2006, the average minimum temperature rose by 1.2°F per decade and the average maximum temperature increased by 0.7°F per decade across the region.[27] Several of the warmest years on record, in terms of annual average temperature, have all occurred since 2000, including 2020, 2018, 2015, 2014, and 2009. In Portola Valley, average January temperatures are a maximum of 60°F and a minimum of 37°F. Average July temperatures are a maximum of 88°F and a minimum of 51°F.

Climate change models indicate that temperatures will continue to rise in Portola Valley. Annual average maximum temperatures are projected to increase between 3.2°F and 4.0°F by mid-century (2035-2064) and between 4.2°F and 7.1°F by end of century (2070-2099). The lower temperature bound assumes that greenhouse gas emissions peak by 2040 and decline (medium emissions scenario); the higher temperature bound assumes that global greenhouse gas emissions continue to rise through the 21st century (high emissions scenario).[28]

With climate change, extreme heat events in California and Portola Valley are becoming more frequent, more intense, and longer lasting. Historically (1961-1990), Portola Valley averaged five extreme heat days. The number of extreme heat days is anticipated to increase significantly across the Bay Area region during the next century, but more so for inland areas than coastal cities. In Portola Valley, an extreme heat day is considered a day where the temperature exceeds 90.7°F. By mid-century (2035-2064), the town is expected to have, on average, between 10 to 12 extreme heat days per year, increasing to an average of 13 to 23 extreme heat days per year by the end of century (2070-2099).[29]

In addition to extreme heat days, warm nights are also a concern. Historically (from 1961-1990) Portola Valley has experienced approximately four warm nights where the temperature exceeds 55.1°F. According to Cal-Adapt, by mid-century Portola Valley is projected to experience 35-46 warm nights and 49-89 warm nights by the end of century. Increases in

[27] Cordero, E.C., W. Kessomkiat, J. Abatzoglou, and S.A. Mauget. 2011. The identification of distinct patterns in California temperature trends. Climatic change 108:357– 382.

[28] Cal-Adapt, 2018. Local Climate Change Snapshot for Portola Valley. Retrieved from https://cal-adapt.org/tools/local-climate-change-snapshot.

[29] Cal-Adapt, 2018. Extreme Heat Days & Warm Nights. Retrieved from: https://cal-adapt.org/tools/extreme-heat/

warm nights may exert greater strain on electrical infrastructure and older air conditioning units on homes.

Extreme heat days and heat waves can negatively impact human health. While the human body has cooling mechanisms that help auto-regulate body temperature within 1 or 2 degrees of 98.6 degrees, heat stress can cause fatigue, headaches, dizziness, nausea, and confusion. The combination of heat and high humidity is particularly lethal; it can result in heat stroke, which can lead to death, even among healthy people.[30]

CHANGING PRECIPITATION PATTERNS

Dry, mild summers and moist, cool winters characterize San Mateo County's overall climate. Temperatures are strongly influenced by large saltwater bodies on the east (San Francisco Bay) and west (Pacific Ocean) and the Santa Cruz Mountains. This combination of features has resulted in a variety of microclimates throughout the County with hill and ridgetop areas, valley floors and coastal areas each experiencing different temperatures and precipitation patterns.

The Coastside area experiences a marine climate, characterized by cool, foggy summers and relatively wet winters. Fog, the result of condensation over the ocean near the coast, provides moisture and cool air for the coastal terraces. These elements are largely responsible for the emergence of the Coastside region as an agricultural area, featuring several specialty crops. Bayside climates are generally warm and sunny, particularly in the summer months when hot air from the valleys moving to the east warms the prevailing cool ocean breezes.

The majority of annual precipitation in San Mateo County occurs from December through March. During this wet season, precipitation levels average from 3.00 to 4.5 inches per month. One of the key influences upon precipitation is elevation. The Bayside generally receives less precipitation than the same elevation on the Coastside, because the Santa Cruz Mountain Range acts as a rain shield causing moisture-laden air moving in from the Coastside to condense and deposit much of its moisture in the form of rain or fog as it reaches the higher, colder mountains.[31]

Weather in Portola Valley is usually mild during most of the year. Summers are dry and can be hot; winter temperatures rarely dip much below freezing. Based on Cal-Adapt, the average annual observed 30-year average precipitation is 32.9 inches.[32] Based on the historic record from 1961-1990, Portola Valley experiences average annual precipitation between 30 and 32 inches. Based on Cal-Adapt projections are anticipated to slightly increase to 33.0 to 33.7 inches by midcentury, and 33.8 to 34.9 inches by the end of the century.

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[30] 2. Brink, S., 2013. How 100 Degrees Does a Number on You." National Geographic. Retrieved from https://news.nationalgeographic.com/news/2013/07/130716-heat-wave-dehydration-stroke-summer-sweat/.

[31] San Mateo County Multijurisdictional Local Hazard Mitigation Plan, 2021.

[32] Annual Averages for Portola Valley. Retrieved from https://cal-adapt.org/tools/annual-averages/#lat=37.3702&lng=-122.2218&boundary=place&climvar=Temperature.

Cal-Adapt provides maximum daily precipitation projections, which based on the observed historical 30-year average, Portola can expect rain events that produce up to 2.29 inches. By mid-century, this projection is anticipated to increase by 2.47 to 2.51 inches and 2.54 to 2.76 inches by the end of the century. This increase in the maximum daily precipitation amount may be due to more intense rainstorms resulting from climate change.[33]

DROUGHT

Drought is a normal part of the climate cycle. Droughts are generally considered a slow-moving hazard, which can cause significant damage, causing losses similar to those from hurricanes, tornadoes and other faster-moving disasters. Droughts can significantly impact agricultural resources; affect water supplies, energy production, public health, wildlife; and can exacerbate wildfire risks. Measuring drought typically involves the use of drought-oriented indexes like the Standardized Precipitation-Evapotranspiration Index (SPEI). SPEI is a multi-scalar drought index that can be used to detect, monitor, and analyze droughts. The tool measures drought severity according to its intensity and duration and can identify the onset and end of drought episodes. A value equaling (-1) implies the drought is at least moderate in intensity, with more negative values representing more severe droughts. The data is represented as days where this threshold of (-1) is met or surpassed and indicates that there is a water deficit. According to Cal Adapt, the observed historical 30-year average SPEI for Portola Valley is 0.2 months annually. This number is expected to increase to between 2.2 to 2.8 months by midcentury, and as high as 3.0 to 5.5 months by the end of the century. Longer durations of time with the SPEI below -1 can lead to drier soils and vegetation/fuels, which increases the potential for wildfire hazards. For additional details regarding wildfire and drought relationships see the Wildfire Hazards section.

Policies and Implementation Actions

P-72 **Prioritize the needs of vulnerable populations affected disproportionately by hazards and disasters.**

P-73 **Engage vulnerable populations in identifying potential hazards and program responses and priorities.**

A-73-1 Use Community Emergency Response Team (CERT) resources to assist with identification, outreach, and engagement of vulnerable populations.

P-74 **Collaborate with local and regional agencies on hazard mitigation and emergency management projects and programs.**

P-75 **Ensure infrastructure can accommodate changing conditions and effects associated with climate changes.**

[33] Local Climate Change Snapshot for Portola Valley, 2021. Retrieved from https://cal-adapt.org/tools/local-climate-change-snapshot.

A-75-1 Look to Best Practices to develop and maintain resilient infrastructure standards.

P-76 Require capital projects in high hazard areas to adhere to higher standards to reduce future potential hazard vulnerability.

A-76-1 Develop risk assessment guidance and resilience strategies.

A-76-2 As part of the capital planning and budgeting process evaluate and determine if capital projects located within high hazard areas need to adhere to risk assessment guidance and identify appropriate resilience strategies.

P-77 Strengthen emergency management capacity and coordination with the San Mateo County Department of Emergency Management and the Woodside Fire Protection District (WFPD).

A-77-1 Regularly assess emergency management needs and identify resources to prepare for current and future hazard events.

A-77-2 Incorporate the likelihood of climate change impacts into Town emergency response planning and training.

A-77-3 Incorporate locations and operations responsibility for establishing cooling centers for extreme heat events as part of the next update of the Town's Emergency Operations Plan.

A-77-4 Incorporate the projected impacts of climate change, including extreme heat, drought, flooding, wildfire, and storm events, in the Multijurisdictional Local Hazard Mitigation Plan, the Housing Element, Sustainability Element, Emergency Operations Plan, and other comprehensive planning efforts.

P-78 Continue to promote the Community Emergency Response Team (CERT) program to strengthen community cohesion and emergency preparedness through community engagement efforts.

A-78-1 Coordinate with Town sponsored advisory bodies/committees and neighboring communities to ensure effective coordination with the Safety Element.

P-79 Prepare the Town for post-disaster recovery through proactive planning.

A-79-1 Develop a post disaster recovery framework.

P-80 Require floodproofing for new development in flood hazard zones.

A-80-1 Identify areas of a parcel subject to flooding by type of flooding, including inundation, creek, and groundwater and by the potential depth of flooding.

A-80-2 Encourage increased freeboard above current 100-year base flood elevation requirements.

A-80-3 Locate mechanical equipment, such as boilers, chillers, and air handlers for ventilation in appropriate locations to ensure operation during flooding.

P-81 Monitor drought conditions and enact appropriate measure to reduce water demand in coordination with local and regional water providers.

A-81-1 Continue to collaborate with Town advisory bodies/ committees, in conjunction with Town's water service provider, to identify opportunities for water conservation and efficiencies.

P-82 Continue to work with San Mateo County Flood and Sea Level Rise Resiliency District on developing and implementing adaptation options for San Francisquito Creek.

A-82-1 Restore creek ecologies and create transitional habitat zones to build resilience and ecosystem services.

A-82-2 Continue to identify opportunities to reduce down-stream flooding from town wastewater.

P-83 Identify the major sources of greenhouse gas emissions in the Town and opportunities to reduce them.

A-83-1 Develop a climate action plan that identifies the most impactful measures for reducing greenhouse gas emissions in the Town.

A-83-2 Work with Town advisory bodies/ committees, utility providers and regional partners to identify and develop programs and incentives that support these measures.

P-84 Address climate change impacts and develop adaptation strategies that focus on fire prevention and protection, flooding and severe storms, extreme heat events, public health, and the health and adaptability of natural systems.

A-84-1 Develop a climate adaptation plan for the Town.

P-85 Ensure that the community can respond to future extreme heat events.

A-85-1 Explore upgrades to electrical and HVAC equipment within Town facilities to ensure greater resilience during extreme heat, wildfire smoke events, and public safety power shutoff events.

EMERGENCY MANAGEMENT

Portola Valley proactively addresses emergency management needs through the Emergency Operations Plan (EOP). The EOP supports the Town's response to disasters, including but not limited to earthquakes, floods, wildfires, severe weather, and other natural or human-caused hazards. The EOP anticipates the Town would experience casualties, significant property damage, and utility service interruptions following a major Bay Area earthquake. The potentially catastrophic effects of an earthquake on the San Andreas Fault would more than likely exceed the response capabilities of both the Town and the County.

The EOP primarily outlines the general authority, organization, and response actions for staff to undertake when disasters happen. Key goals/ functions for this plan include:

- Identifies who is in charge during disaster response and clarifies who does what.
- Lists the necessary jobs for disaster response and what each person is to do.
- Ensures survivability and availability of government services, or the continuity of government.
- Helps to understand the Town's emergency organization.
- Provides guidance for disaster education and training.

In addition to the EOP, the Town has identified key evacuation routes and constraints that may affect evacuation events within Portola Valley. Since evacuation is a key concern for Town staff and residents, several key policies have been developed to assist with evacuation capabilities. These policies are based on the analysis and recommendations contained within the *2022 Portola Valley Wildfire Traffic Evacuation Capacity Study*.

Emergency Access/Evacuation

P-86 Prepare and implement a Portola Valley Evacuation Plan

A-86-1 Work with public safety stakeholders and Town committees on the development of a Town-wide Evacuation Plan for adoption by the Town Council

A-86-2 Implement the Town of Portola Valley Evacuation Plan including all recommendations to support more effective evacuation

A-86-3 Explore the identification and construction of new evacuation rights of way throughout the Town

A-86-4 Study neighborhood level evacuation needs and recommendations to be adopted by Town Council.

P-87 Conduct early hazard condition notifications to all residents and conduct early evacuation warnings for high-risk areas or areas where constrained conditions require lengthy evacuation.

P-88 Require new developments, redevelopments, and major remodels to enhance the Town's evacuation network and facilities and comply with the Town's Evacuation Assessment.

A-88-1 Enhance existing town programs to further reduce fire hazards along public roads and rights of way. Vegetation management should focus on thinning low branches and dense trees to the maximum extent possible within the public right of way.

P-89 Ensure street naming and numbering systems adequately identify properties, to avoid potential confusion for emergency response vehicles

P-90 Require all new developments and redevelopments within the high and very high fire hazard severity zones, to provide a minimum of two points of access by means of publicly accessible roads that can be used for emergency vehicle response and evacuation purposes.

A-90-1 Design and maintain all private roads to permit unrestricted access for all emergency equipment and personnel.

A-90-2 Identify the feasibility of constructing additional emergency access improvements for existing developments that do not meet minimum road standards for emergency equipment, such as:

a. Additional vehicle pullouts at key hillside locations.
b. Limiting or restricting on-street parking at key hillside locations.
c. Potential for construction of new or improved emergency access routes.
d. Roadside clearance improvements.
e. Creation of easements and emergency access roads for areas with constrained parcels.

A-90-3 Establish mitigations for properties in High and Very High Fire Hazard Safety Zones with restricted and single points of access including parking restrictions and investigating the feasibility of establishing special assessment districts to improve road capacity, and adequate water supply.

P-91 Promote efficient and effective evacuation preparedness, where households rely on the following:

Use of a single car for evacuation purposes, where feasible

Coordinate with neighbors and tenants to expedite evacuation proceedings, and

Partnering with community groups/organizations to help residents that need assistance

P-92 Enhance information gathering and sharing resources to support future evacuation events.

P-93 Continue supporting County Department of Emergency Management meetings with Town staff, stakeholders, and institutions to support the development and integration of school and private institution evacuation plans into Town efforts.