FUEL HAZARD ASSESSMENT STUDY

TOWN OF PORTOLA VALLEY

October 2008

Prepared by Moritz Arboricultural Consulting

Preface

This study was commissioned by the town to provide fundamental information with respect to the types of vegetation in the town and the relative potential fire hazards posed by each type. The report is intended to have four fundamental applications, as follows:

First, it will form an important part of the new Safety Element to be developed by the town as a part of the town's General Plan. This will help fulfill a requirement of the state planning law.

Second, it will provide a basis for the establishment of programs and measures by the town and the Woodside Fire Protection District in assisting in the protection of all properties in the town.

Third, it will allow residents to locate their properties with respect to the several vegetation categories with different degrees of fire hazard and to begin to take prudent precautions on their properties.

Fourth, it will provide an outline of fuel reduction measures along the major roads in the town, most of which will be a responsibility of the town.

Residents and town officials are encouraged to read the study and view the illustrative map. These should provide a good background on the fire hazards posed by the vegetation in the town.

Residents will likely be most interested in the section "Specific Fire Hazard Mitigation Strategies by Fuel Type" starting on page 10. Here, the reader will find detailed mitigation strategies that they can consider applying to their property. As noted in the report, property owners are encouraged to call on assistance from the Fire Marshal's office of the Woodside Protection District.

Residents may also find Appendix II, "Implementation of the Portola Valley Fuel Hazard Assessment Study," starting on page 20, as a good starting point when considering overall approaches to providing vegetation fire safety on their properties.

The town and the Woodside Fire Protection District will want in particular to consider the recommendations in the section "Fire Response and Evacuation Routes" starting on page 16. This section includes recommended general standards and more specific recommendations for eight main roads in the town. A next step that the town and the fire protection district will consider will be a more detailed application of the standards. The standards are general guidelines and their application will need to take into consideration the practical realities of conditions in the various parts of the town.

George Mader, Town Planner

Portola Valley Fuel Hazard Assessment
Town of Portola Valley

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CONTENTS ***Page***

INTRODUCTION

The goals of this fuel hazard assessment for the Town of Portola Valley are to assist the town and its residents to (1) develop a landscape that has a reasonable level of fire safety for citizens and emergency responders and (2) create a sustainable, aesthetic, and environmentally balanced response to fire threat, taking into account the natural values of the area (e.g., residential use and enjoyment, biodiversity, maintenance of native species, and more).

The project addresses potential fire behavior and offers strategies for fire hazard mitigation in the Town. The following areas are highest in priority for treatment:

- Major emergency access/egress routes
- Areas adjacent to structures/residences
- Areas with potential for severe fire behavior

The values at risk include homes, businesses, government and public infrastructure, the local economy, residents, emergency responders, and aesthetics.

This assessment includes mapping of vegetation fuels and ranking of fuels as to fire behavior, i.e., ability to suppress or fight a fire. Based on the fuel assessment, general and specific strategies are presented to facilitate both public and private actions that can be taken to reduce fire risk. In particular, this assessment has been developed to assist the town in its work on future revisions to the safety element of the general plan.

METHODOLOGY

A fuel hazard assessment of Portola Valley was conducted using color aerial photography (dated 2005), ground reconnaissance (August and September 2007), and published references on fire behavior. This assessment is presented on the "Fuel Hazard Map" dated July 17, 2008. For each mapped unit (or polygon, 5-acre minimum) a ranking of fire behavior potential (highest, high, moderate, and low) was developed using general fuel models created by the Northern Forest Fire Laboratory (USDA Forest Service: NFFL) as modified by Moritz Arboricultural Consulting (MAC) to account for stage of fuel development and regional conditions. In addition, the USDA Forest Service National Fire Danger Rating System (a system of nine fuel models) was used as a reference.

Of the fuel types identified by MAC as occurring in Portola Valley, six are not precisely defined in the national models and required developmental stage modifications for ranking. Consideration was also given to potential changes in fire behavior caused by sudden oak death (SOD)

A follow-up field review of the fuel and fire behavior severity map and methodology was conducted with Woodside fire officials in March 2008. Comments received during this meeting were incorporated into the final fire hazard map and the hazard evaluations presented in this report.

GENERAL DESCRIPTIONS OF VEGETATION FUELS

General vegetation fuel types and rankings as to potential fire behavior for Portola Valley are:

"highest" (h+) includes a shrub type (chaparral) and three forest types (fire-prone oak woodland, mixed evergreen forest, fire-prone urban forest)

"high" (h) includes two forest types (fire-prone urban forest and redwood forest) and one shrub type (coastal scrub);

"moderate (m) includes urban savannah and grassland;

"low" (l) includes mowed grass and vineyard.

There are eleven plant communities/habitats within the borders of Portola Valley as mapped by TRA Environmental Services (TRA). MAC also identified eleven vegetation fuel types in both wildland and urban areas. Eight of the MAC fuel types correspond directly to TRA plant community/habitat types, and two are mapped in a related category. For example, where TRA mapped grassland, MAC divided it into mowed grass and grassland because these distinctions affect the fire hazard.

The comparison of the TRA and MAC types are listed below with corresponding potential fire behavior ratings assigned by MAC. The sequence of plant communities listed under MAC ranges from those with the highest fire potential to those with the lowest potential.

MAC:	**TRA:**
Chaparral (h+)	Chaparral
Fire-Prone Oak Woodland (h+)	Oak Woodland
Mixed Evergreen Forest (h+)	Mixed Evergreen Forest
Fire-Prone Urban Forest [heavy undergrowth] (h+)	Urban Forest/Garden
Fire-Prone Urban Forest (h)	Urban Forest/Garden
Redwood Forest (h)	Redwood Forest
Urban Savannah [grass carries fire] (m)	Oak Savannah
Grassland (m)	Grassland
Mowed Grass (l)	Grassland
Vineyard (l)	Vineyard
N/A	Aquatic Feature

The vegetation fuel types are generally described below in terms of dominant species and general percent cover in the overstory and understory. The prevalence and trends of invasion of exotic species is noted, as are any shifts in species which can be expected over time without manipulation (i.e., shift from oak to bay or oak to Douglas-fir, or shift from grass to coyote bush, etc.). The locations of the fuel types are shown on the July 17, 2008 "Fuel Hazards Map," that is part of this report.

CH – CHAPARRAL (HIGHEST HAZARD) consists of dense evergreen and deciduous shrubs that can reach 10 feet tall and supports a sparse understory of herbaceous plants and litter. Dominant shrubs in this type include chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos glauca*, *A. tomentosa*), California-lilac (*Ceanothus cuneatus*, *C. oliganthus* var. *sorediatus*), redberry (*Rhamnus crocea* ssp. *crocea*), scrub oak (*Quercus berberidifolia*), coffeeberry (*Rhamnus californica*), and holly-leafed cherry (*Prunus ilicifolia* ssp. *ilicifolia*). This type is notorious for exhibiting extreme fire behavior.

FPO - FIRE-PRONE OAK WOODLAND (HIGHEST HAZARD) consists of the native oak woodland dominated by a dense canopy of coast live oak (*Quercus agrifolia*), California bay (*Umbellularia californica*), California buckeye (*Aesculus californica*), and Pacific madrone (*Arbutus menziesii*). The dense understory of this woodland consists of poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), and other shrubs that create fairly contiguous ladder fuels from the forest floor to the tree canopy. The combination of dense understory vegetation, ladder fuels, and disease caused by sudden oak death (*Phytophthora ramorum*) makes this type extremely flammable and prone to crown fires.

MEF - MIXED EVERGREEN FOREST (HIGHEST HAZARD) supports a mixture trees including coast live oak (*Quercus agrifolia*), tan oak (*Lithocarpus densiflora*), Pacific madrone, black oak (*Quercus kellogii*), with minor components of bigleaf maple (*Acer macrophyllum*), coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*). The shrub layer is minimal but includes: tree reproduction, western sword fern (*Polystichum munitum*), California hazel (*Corylus cornuta* var. *californica*), poison oak and various brooms in limited areas. This mixture of trees and shrubs has a great potential for creating severe fire behavior.

FPUF - FIRE-PRONE URBAN FOREST (HIGHEST AND HIGH HAZARD) includes residential areas that are moderate to densely landscaped with fire-prone ornamentals such as juniper (*Juniperus* spp.), pine (*Pinus* spp.), acacia (*Acacia* spp.), and eucalyptus (*Eucalyptus* spp.). Also present in these areas may be sparse to dense remnants of the native trees and shrubs such as coast live oak, Pacific madrone, and poison oak. This forest type is also strongly affected by sudden oak death. Areas with dense understory vegetation were ranked as having the highest hazard.

CS – COASTAL SCRUB (HIGH HAZARD) supports low shrubs, typically 3 to 6 feet tall that are densely arranged with scattered openings supporting non-native annual grasses. Dominant plants in this type include coyote brush (*Baccharis pilularis*), poison oak (*Toxicodendron diversiloba*), California-lilac (*Ceanothus thyrsiflorus*), California bee plant (*Scrophularia californica*), blackberry (*Rubus ursinus*), toyon (*Heteromeles arbutifolia*), and sagebrush (*Artemisia californica*). Fire behavior in coastal scrub is strongly affected by the live fuel moisture in the coyote bush.

RF - REDWOOD FOREST (HIGH HAZARD) consists of a dense overstory of young-growth coast redwood (*Sequoia sempervirens*), tan oak (*Lithocarpus densiflorus*), big-leaf maple (*Acer macrophyllum*), salal (*Gaultheria shallon*), sword fern, Douglas-fir,and California bay (*Umbellularia californica*). Associated understory shrubs include California hazel, wood rose (*Rosa gymnocarpa*), and thimbleberry (*Rubus parviflorus*). Redwood forest is surprisingly flammable. The thick duff layer is especially receptive to fire brands and redwood bark ignites easily. Tan oak is highly susceptible to sudden oak

death; dead leaves retained on these mid-canopy trees exacerbate the fire hazard by creating ladder fuels.

US - URBAN SAVANNAH (MODERATE HAZARD) consists of residential areas where grass occupies greater than 50 percent of the overall landscape. Areas along roadways and near homes are typically densely landscaped with ornamental trees, shrubs, irrigated flowerbeds, and lawns. Other than the overstory canopy [typically valley oak (*Quercus lobata*) or coast live oak (*Quercus agrifolia*)] the grassland species dominate this plant community (See Grassland). While there may be some areas of down and dead overstory materials, grass usually is the fuel that carries the fire. Crowning and torching of the overstory are highly unlikely. Thus, fire behavior in grassy areas is determined by whether the grass has been mowed or not.

GR – GRASSLAND (MODERATE HAZARD) includes unmanaged, introduced annual grasses and native forbs including: oatgrass, annual agoseris (*Agoseris heterophylla*), ripgut grass (*Bromus diandrus*), soft chess (*Bromus horeaceus*), barley (*Hordeum murinum* ssp. *leporinum*), foxtail barley (*H. jubatum*), Italian ryegrass (*Lolium multiflorum*), needlegrass (*Nasella pulchra*), and California fescue (*Festuca californica*). When dry, this flashy fuel supports fires with high rates of spread under windy conditions.

MG - MOWED GRASS (LOW HAZARD) includes grazed and mowed introduced annual grasses and both exotic and native forbs, including: oatgrass, annual agoseris (*Agoseris heterophylla*), ripgut grass (*Bromus diandrus*), soft chess (*Bromus hordeaceus*), barley (*Hordeum murinum* ssp. *leporinum*), foxtail barley (*H. jubatum*) Italian ryegrass (*Lolium multiflorum*), needlegrass (*Nasella pulchra*), and California fescue (*Festuca californica*). Rates of fire spread are greatly reduced by grazing or the alteration of the fuel arrangement as a result of mowing; a fire in this type may self extinguish.

VIN – VINEYARD (LOW HAZARD) consists of rows of irrigated grapes (*Vitis* sp.) vines with an exceptionally sparse to barren soil surface. Associated fences are often lined with showy shrubs such as lavender or rose. Fires typically do not burn this vegetation type.

FUEL BEHAVIOR SEVERITY RANKING

The following table ranks the Vegetation Fuel Types in terms of their Fire Behavior. The Fire Behavior Ranking was calculated by Moritz Arboricultural Consulting based on an evaluation of the information in columns (2) – (4).

Vegetation Fuel Type	NFFL Model	Developmental Stage	Flame Length)	Fire Behavior Ranking (current study)
(1)	(2)	(3)	(4)	(5)
Chaparral	4	High	45	Highest – h+
Fire-Prone Oak Woodland	7	Extreme	20+	Highest – h+
Mixed Evergreen Forest	10	Extreme	20+	Highest – h+
Fire-Prone Urban Forest	7	Extreme	20+	Highest – h+
Fire-Prone Urban Forest	7	High	13	High – h
Coastal Scrub	5	High	18	High – h
Redwood Forest	9	Extreme	14	High – h
Urban (Oak) Savannah	3	Low	7	Moderate – m
Grassland (tall grass)	3	Low	7	Moderate - m
Mowed Grass	1	Moderate	5	Low – l

Explanation of columns:
(1) Vegetation Fuel Type by MAC,
(2) NFFL Fuel Model Number,
(3) Fuel Model Stage of Development (eg. old Douglas fir forest has a different structure and fire behavior than Douglas fir reproduction),
(4) expected flame length (fire intensity) for a given model and its stage of development,
(5) expected difficulty to suppress by MAC.

GENERAL FIRE HAZARD MITIGATION STRATEGIES

The following are general strategies that the town and others at risk can employ to reduce fire threat and "Behavior Ranking:"

Strategy: Select fire resistant plants
Actions:

- Select species with low surface to volume ratios (i.e., southern magnolia vs. pine, rhododendron vs. Australian tea, English laurel vs. cypress screen)**.** As an example, for a given weight, southern magnolia leaves have less total surface areas than pine needles.
- Select broadleaf vs. needle-leaf species
- Select clean looking species with stout branches and twigs (non-twiggy)
- Select species listed as pest and disease resistant
- Select deciduous trees and shrubs with supple, moist foliage
- Select species with out volatile oils in their leaves (use the smell test). Sap is water-like and does not have a strong oil odor

Strategy: Reduce fuel volumes
Actions:

- remove deadwood from trees and shrubs
- thin forest stands that produce great amounts of litter and debris
- create shrub/grass mosaics from continuous shrub masses
- remove shrubs beneath and around existing and emerging trees
- select low-growing shrubs and ground covers as replacement plants
- remove/reduce lofty, loosely compacted litter accumulations, especially large debris such as branches and replace with compact, small particle mulch to prevent invasion of noxious weeds and elevate live fuel moisture

Strategy: Reduce fuel flammability
Actions:

- mow grass when it is 50% cured (by June 1st)
- replace annual grass with plants that do not cure (dry out)
- remove deadwood in trees and shrubs
- establish an irrigated landscape in carefully selected areas close to the home (along foundations, under windows, under overhangs, and around decks and other structures)
- remove sick, dying and dead shrubs and trees

Strategy: Establish/maintain fuel discontinuity
Actions:

- remove/reduce "ladder" fuels (grass to brush to trees)
- create shrub/grass mosaics from continuous masses by installing hardscape
- remove shrubs from beneath and around existing and emerging trees
- thin thickets of small trees and tree reproduction from large tree understories
- create low fuel zone near structural vulnerabilities such as windows, decks, large overhangs,

Strategy: Reduce the possibility of fire traveling through tree crown
Actions:

- Separate overlapping tree and large shrub canopies
- Thin fire-prone tree canopies (oak, bay, eucalyptus, pines, redwood and Douglas fir) to open canopy structure (no more than 30% foliar reduction)
- Prune out low hanging fire-available branches and twigs up to 3 inches in diameter to a minimum of 10 feet above ground under any portion of the canopy or to an elevation 10 feet above the highest ground elevation
- Perform fuel volume reduction actions mentioned above

SPECIFIC FIRE HAZARD MITIGATION STRATEGIES BY FUEL TYPE

The following mitigation strategies are specific to the vegetation fuel type.

Chaparral – H+

Dominant shrubs in this type include chemise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos glauca, A. tomentosa*), California lilac (*Ceanothus cuneatus, C. oliganthus var. sorediatus*), redberry (Rhamnus crocea ssp. crocea), scrub oak (*Quercus dumosa*), coffeeberry (*Rhamnus californica ssp. californica*), and holly-leaved cherry (*Prunus ilicifolia*), but may have up to 35% fir or hardwood reproduction.

Chaparral - Fire Hazard: This type is notorious for exhibiting extreme fire behavior. This is one of the serious fire hazardous types due to the heavy horizontal fuel continuity and abundant fine material, almost 100% available to a potential fire. The sclerophyllus species typically have very low fuel moisture and are therefore more flammable. Also, the densely, twiggy and foliated species found in this fuel type, i.e. chemise, tend to be more flammable. The expected fire behavior of this type under severe fire weather may be extreme. Fire in this fuel type displays high to extreme rates of spread with high intensities in strong winds. It can generate a blizzard of fire brands and this fuel bed is very receptive to spot fire ignitions.

Maintenance: Maintenance actions in this fuel type are affordable, effective and necessary for the health, vigor and survivability of the shrubs. Fire safe maintenance is critical to safety and includes the following actions:

- You may wish to favor a particular native species on site or convert to a new or more fire resistant type such as perennial grass. However, all of the chamise should be removed.
- Thin brush or brush islands up to 10.0 feet tall to a spacing of 2 X the height, on center. Always favor fire resistant species.
- Raise (trim up) the crowns by 1/3 the height in defensible space zones and along roads.
- Remove deadwood subcanopies.
- Clear all grass, cured herbs and flammable debris from under the shrub canopies.
- Remove dead shrubs near homes, drives, and roads.
- Remove structurally unstable trees within falling distance of homes, drives and roads.
- Clean up down and dead debris.

Fire-prone Oak Woodland (Pyrophytic Hardwood) - H+

Oak woodland with associated hardwoods, heavy undergrowth or down and/or dead ground fuels. This type consists of a canopy of coast live oak, tan oak, black oak, madrone and bay. It may have a minor component conifers and/or exotics. It has dense undergrowth of, coffeeberry, poison oak, hardwood reproduction, excessive fir reproduction and or exotic brush. This is a hazardous fuel type. It may have an unhealthy over-story/canopy and, as a consequence, excessive down and dead debris.

Fire-prone oak woodland hazard: The fire hazard of this fuel type is among the highest in the area. Under high to extreme fire weather conditions the fire rate of spread is rapid and intensity is very high to extreme. Crowning, branding and

spotting is common. Sudden Oak Death may be a significant factor in the flammablility of this type.

Maintenance: Mitigative actions may be most successful in this forest/fuel type. It can be converted from one of the most hazardous types to one of the least fire-prone. Fire safe maintenance of this type includes the following actions:

- Thin out overly dense stands to provide crown separation. Favor fire resistant species (such as oak rather than bay).
- Remove or substantially thin undergrowth. Separate shrubs by a distance of at least two times their height, crown to crown. Any fire prone shrubs should be cut to no more than two feet in height. Keep the undergrowth sparse. When thinning out undergrowth always favor fire resistant plants.
- Raise tree crowns to a minimum of 8.0 feet above grade. All parts of the canopy less than 3 inches in diameter should be no lower than eight feet vertical distance above grade. The canopy line will be horizontal to slope.
- When thinning out undergrowth or planting, favor fire resistant plants.
- Remove dead and diseased trees or branches and foliage prior to the fire season or as they develop.
- Remove bay and conifer reproduction.
- Clean up down and dead debris. Chip materials up to 6 inches and cut larger branches and trunks flat to maximize soil contact.
- Remove heavily SOD infested trees. Consider replacement with SOD resistant native trees (i.e: Interior Live Oak (Q. Wislizenii), Valley Oak (Q. Lobata), etc.).
- Maintain trees in good health. See California Oak Foundation guide.

Mixed Evergreen Forest – H+

This forest type is dominated by mature evergreen hardwoods such as oak, bay and tanoak. It may have a 25 to 35% fir and/or redwood component. It has sparse or no continuous undergrowth. The dominant trees are in good (healthy) condition. There is no significant accumulation of down and dead materials.

Mixed Evergreen Forest - fire hazard: The fire hazard of this fuel type is among the highest. Most fires will be in surface fuels with short flame lengths and slow rates of spread but there is a high potential for torching, crowning and branding where fuel concentrations are heavy. Crown fires may be infrequent but in severe fire weather when crowning does occur fires are hard to suppress. The crowning potential may be minimized through proper management of ground fuels and crown raising. The opportunity to provide ongoing maintenance and improvements in fire resistance is great.

Maintenance: Maintenance actions in this forest/fuel type are affordable and effective. If this type is not maintained and **is** allowed to decline, it will become a very serious fire-prone type, one of the most hazardous types. Fire safe maintenance of this type includes the following actions:

- Thin out overly dense stands to provide crown separation. Favor the more fire resistant species (such as oak and other broadleaf species rather than bay laurel and fir).
- Keep the fire prone undergrowth sparse and low. Separate fire prone shrubs by a distance of at least two times the height, crown to crown.

Any fire prone shrubs should be cut to no more than two feet in height. When thinning out undergrowth always favor fire resistant species.

- Raise tree crowns to a minimum of 10 feet above grade. All parts of the canopy less than 3 inches in diameter should be no lower than 10 feet vertical distance above grade. On slopes the canopy line will be 10 feet above highest point. Raise the crowns of redwoods and firs as high as practical.
- When thinning out undergrowth or planting, favor fire resistant plants.
- Remove deadwood trees thoroughly, particularly firs.
- Remove dead and diseased trees or branches and foliage prior to the fire season or as they develop.
- Remove bay and Fir reproduction.
- Chip down and dead debris.
- Maintain trees in good health. See California **O**ak Foundation for a guide.

Fire Prone Urban Forest (with heavy undergrowth) – H+

This extremely hazardous forest/fuel type is dominated by mature evergreen hardwoods (e.g., coast live oak, bay, tanoak, madrone, etc.) and 25 to 35% mature fir or redwood. It has a heavy undergrowth of tree reproduction, herbs and/or shrubs. Often it has excessive bay or fir reproduction. It typically has excessive down and dead debris due to SOD and/or competition.

Mixed Evergreen Forest with undergrowth - fire hazard: The fire behavior of this fuel type is high. The opportunity to provide improvements in fire resistance is great but at a greater cost than for hardwood forest or park-like mixed evergreen forest. However, once the initial work is done, maintenance will be significantly less over time.

Maintenance: Maintenance actions in this forest/fuel type are affordable and effective. Fire safe maintenance of this type includes the following actions:

- Thin out overly dense stands to provide crown separation. Favor the more fire resistant species (such as oak and bay and fir).
- Clear undergrowth leaving only well spaced, fire resistant plants. Separate other shrubs by a distance of at least two times the height, crown to crown. Any fire prone shrubs retained should be cut to no more than two feet in height. When thinning out undergrowth**,** favor fire resistant species.
- Raise hardwood tree crowns to a minimum of 10 feet above grade. All parts of the canopy less than 3 inches in diameter should be no lower than eight feet vertical distance above grade. On slopes the canopy line will be horizontal with slope. Raise the crowns of fir and redwood as high as practicable leaving no attached deadwood below the live crown.
- When thinning out undergrowth or planting, favor fire resistant plants.
- Remove deadwood trees thoroughly, particularly bays, redwoods and firs.
- Remove dead and diseased trees or branches and foliage prior to the fire season or as they develop.
- Remove fire-prone shrubs, and bay and Fir reproduction.
- Chip down and dead debris, up to six inches diameter and cut up larger branches and trunks down flat to maximize soil contact.
- Maintain trees in good health. See California Oak Foundation guide.

Fire-prone Urban Forest (hardwoods with minor components of conifers) - H

Mixed hardwoods with heavy undergrowth. This type consists of a canopy of tanoak, coast live oak, bay laurel and madrone, with minor components of Douglas-fir, redwood and exotics. It has excessive down and dead material and/or a dense undergrowth of douglas fir reproduction, oak reproduction, hardwood reproduction, bay and tanoak reproduction, ceanothus, manzanita, hazel, and exotics. This is the areas' second-most hazardous fuel type. It may have an unhealthy over-story/canopy.

Fire-Prone Urban Forest Hazard: The fire hazard of this fuel type is among the highest in the area. Under high to extreme fire weather conditions the fire rate of spread is rapid and intensity is very high to extreme. Crowning, branding and spotting is common.

Maintenance: Mitigation may be most successful in this forest/fuel type. It can be converted from one of the most hazardous types to one of the least fire prone. Fire safe maintenance of this type includes the following actions:

- Thin out overly dense stands to provide crown separation. Favor fire resistant species (such as oak or redwood rather than bay and fir).
- Remove or substantially thin undergrowth. Separate shrubs by a distance of at least two times their height, crown to crown. Any fire prone shrubs should be cut to no more than two feet in height. Keep the undergrowth sparse. When thinning out undergrowth always favor fire resistant plants.
- Raise tree crowns to a minimum of 10 feet above grade. All parts of the canopy less than 3 inches in diameter should be no lower than eight feet vertical distance above grade. The canopy line will be horizontal to slope.
- When thinning out undergrowth or planting, favor fire resistant plants.
- Remove dead and diseased trees or branches and foliage prior to the fire season or as they develop.
- Remove invasive shrubs, and bay laurel and **f**ir reproduction.
- Clean up down and dead debris. Chip small materials and cut larger branches and trunks flat to maximize soil contact.
- Maintain trees in good health. See California Oak Foundation guide.

Coastal Scrub - H

This vegetation fuel type is highly invasive in grassland and open hardwood forest in the absence of natural fire. This type is dominated by a "doghair" stand of Ceanothus, coyote bush, coffeeberry, manzanita and possibly fir reproduction, but may have up to 35% fir or hardwood reproduction.

Coastal Scrub - Fire Hazard: This is one of the serious fire hazardous types due to the heavy horizontal fuel continuity and abundant fine material, almost 100% available to a potential fire. The high density of shrubs water stresses the stand. The expected fire behavior of this type is equivalent to heavy chaparral. Fire in this fuel type displays high to extreme rates of spread with high intensities in strong winds. It can generate a blizzard of fire brands and this fuel bed is very receptive to spot fire ignitions.

Maintenance: Maintenance actions in this fuel type are affordable, effective and necessary for the health, vigor and survivability of the shrubs. Fire safe maintenance is critical to safety and includes the following actions:

- First decide on the kind of mature landscape you envision. You may wish to favor a particular native species on site or convert to a new or more fire resistant type.
- Thin brush reproduction up to 10.0 feet tall to a spacing of 2 X the height, on center. Always favor fire resistant species.
- Raise (trim up) the crowns by 1/3 the height.
- Clear all grass, dried herbaceous herbs and flammable debris from under the shrub canopies.
- Remove dead shrubs near homes, drives, and roads.
- Remove structurally unstable trees within falling distance of homes, drives and roads.
- Clean up down and dead debris.

Redwood Forest – H

This forest/fuel type is more than 50% mature coast redwood and occurs on more mesic (cooler, more moist areas with better than average soil development) slopes and in drainages. Where there is no significant sub-canopy of hardwoods, such as tanbark oak (*Lithocarpus densiflora*) and California bay laurel (*Umbellularia californica*), an abundance of dead-and-down debris, and/or heavy layer of vegetation ground fuels (sword fern, huckleberry, poison oak, toyon, tree reproduction or invasive exotics such as brooms), and the understory is park-like the fire hazard tends to be relatively moderate. Where such forest do have excessive down-and-dead, heavy continuous undergrowth or young redwood forest with attached "ladder fuels" (continuous attached branches from low to high, living or dead).

Coast Redwood Forest - fire hazard: The fire hazard of this fuel type is typically low on mesic sites with rich well-developed soils and relatively cool microclimates (north to northeast facing slopes, along canyon/valley bottom lands, seep sites and along streams). Most fires will be low intensity fires in surface fuels with short flame lengths and slow rates of spread. There could be occasional torching if spot fuel ("jackpot") concentrations are heavy. Crown fires are infrequent but when they do occur, particularly on steep slopes under extreme fire weather conditions.

The fire hazard in this fuel type may be moderate where there is a buildup of down and dead debris and/or heavy undergrowth, and they are hard to suppress. Stand replacement fires are more likely occur in this subtype.

The fire hazard in this fuel type may be high in young to juvenile stand development stages where there is ground to top "ladder" fuels, a heavy buildup of down and dead debris and/or heavy undergrowth, and they are very hard to suppress. Stand replacement fires are more likely to occur in this subtype.

The crowning potential may be minimized through proper management of ground fuels, crown raising and occasionally selective stand thinning. The opportunity to provide ongoing maintenance and improvements in fire resistance is high.

Maintenance: Maintenance actions in this forest/fuel type are affordable and effective. Stand thinning, if needed, is more expensive (It can come to $2,000 per tree in the developed residential setting.). In wildland fuel threat mitigation,

with some thinning of mature trees, may pay for itself. Fire safe maintenance of this type includes the following actions:

- Thin out overly dense stands to provide crown separation. Too many stems per acre deplete soil water, available nutrients and healthy growing space.
- Remove basal sprouts.
- Remove unstable, sick, declining and dead trees.
- Limb up trees as high as practical (More than 10 feet above grade).
- Remove diseased, dying, and dead branches, trunk-attached twigs, dead branches and branch stubs.
- Remove Douglas fir, bay laurel, tanbark oak and other flammable tree reproduction (except where redwood regeneration is necessary).
- Clear undergrowth leaving only well spaced, fire resistant plants. Separate other more flammable shrubs by a distance of at least two times the height, crown to crown. Any fire prone shrubs (broom, poison oak), should be removed. When thinning out undergrowth favor fire resistant species.
- Clean up dead and down debris.
- Remove SOD killed trees.

Grassland and Urban (Oak) Savannah – L to M

This fuel type typically presents relatively low levels of fire intensity but can exhibit rapid rates of spread. Also grasses are important ignition fuels that should be treated where ignition is likely to occur (around homes, roads and other developed areas**)**.
Grass should receive particular attention where it serves as a transition fuel to heavier fuel types (grass to brush to trees). Grass should be mowed to no more that 4 inches in height in the Fire Apparatus Clear Zone **(**FACZ**)** and defensible space areas. It should also be mowed or grazed in fuel management zones where it might serve as a transition fuel.

FIRE RESPONSE AND EVACUATION ROUTES:

During a major wildfire, emergency personnel direct evacuees from local streets to the larger collector roads leading to arterial avenues. Portola Valley is served by three arterial roads: Alpine Road, Los Trancos Road, and Portola Road. Collector roads in the area include Westridge Drive, Cervantes Road, Golden Oak Drive, and Indian Crossing leading to Valley Oak Street. In addition Wayside Road serves as a collector. Vegetation fuel management should be undertaken along these roads initially and on an annual basis in order to provide Fuel Modification Zones (FMZ).

Initial Treatment and Annual Maintenance Requirements for FMZ:

Fuel Modification Zones (FMZ) (commonly referred to as Fire Apparatus Clear Zones) should be constructed and maintained along all roads and other emergency access/evacuation routes if so designated by the Woodside Fire Department. The FMZ along the main routes and collector roads should extend a minimum of 20 feet from either side of the paved surface (note this is greater then required by State and local codes but considering potential flame lengths, it is necessary for fire safe access/egress).

Standards to be Applied within each FMZ :

- In a distance extending 10 feet out from the paved road surfaces, brush and shrub species should not exceed three feet in height and be separated by a distance equal to at least twice the height of the brush or shrub.

- Shrubs and shrub islands (shrub islands should not be greater than 15 feet in diameter) in the 10- to 20-foot-zone out from the road pavement edge shall be separated by a distance no less than two times the shrub or shrub island height

- All cured grasses shall be mowed to a maximum of three inches (3") in height prior to June 15th of any given fire season and debris should be removed. This zone should be so maintained throughout the fire season (as declared by local and State agencies), but at least until October 15. Annual and perennial grasses can be retained in the 10 to 20 foot zone, provided the grasses are mowed annually to a maximum three-inch (3") height. Perennial grasses should be favored where irrigation is absent because of their longer green period.

- Individual oak and ornamental trees can be retained adjacent to the roadway provided a minimum 14-foot clearance is maintained above the paved surface.

- All tree canopy fuels less than 3 inches in diameter (100 hour time-lag fuels) within the 0' to 20' foot zone shall be limbed up (crown raised) one third the height of trees less than 30 feet in total height and a minimum of ten feet above grade for all trees 30 feet or greater in height. Any plants constituting a "ladder fuels" shall be removed from below the tree canopy. (Ladder fuels consist of continuous vegetation from the ground to tree crowns.)

- All tree crowns within the FACZ shall be separated by a distance of no less than ten feet (10') above the road surface. As young trees mature, removal of trees may be required to maintain proper separation of tree crowns within this zone.

- Treatments for specific fuel types are discussed under the maintenance provisions for each vegetation type in the previous section**.**

Comments and Recommendations for Specific Routes

Portola Road: This major emergency access/egress route varies greatly in roadside fuel conditions. The north end of the road, on the east side is perhaps the greatest fire threat where a Eucalyptus stand with an Acacia and brush understory could generate high intensity fire and significant torching, crowning and branding. Smoke and branding from this stand could significantly inhibit fire response and evacuation along this critical route. This condition, capable of generating extreme fire behavior, should be abated. Other areas along this road should receive standard FACZ treatment. Fuels should be modified as described in the fuel treatment section above.

Westridge Drive: This major emergency access/egress connecting Portola Valley Road with Alpine Road passes through large areas of high to highest fire behavior potential urban forest. These areas require the full 20 feet of roadside treatment as prescribed in the fuel treatment section.

Cervantes Road: This secondary access route that connects Westridge Dr. with Golden Oak Drive and ultimately out to Alpine Road. The road runs adjacent to some highest fire behavior potential sites and should receive FACZ attention equivalent to Westridge.

Golden Oak Drive: This road borders some significantly fire hazardous topographic conditions, as well as high to highest fire behavior potential vegetation types. The “chimney drainages” running up to this road should receive as much as 30 feet of vegetation fuel treatment. The remainder of this road should receive that standard recommended treatment described above.

Alpine Road: This road has good FACZ management along most of its extent due to commercial development and other roadside treatments. However, the west end of Alpine, west of the intersection of Portola Valley Road present some FACZ challenges that require attention. This western extent of Alpine is a connector with Willowbrook and could play an important access for wildland fire in the Open Space Preserve. Thus, this area should receive the recommended fuel treatment specified above.

Indian Crossing/Valley Oak: These connected roads are the one-way-in/one-way-out emergency access/evacuation route for Portola Valley Ranch. Therefore this road should receive the full 20 feet of roadside treatment recommended above. The Town and Fire Department may whish to also consider an emergency exit connector to Los Trancos Road from Valley Oak.

Los Trancos Road: This road is an important emergency access/egress for the Blue Oaks development and the Los Trancos Woods development. The fuels on the **Santa Clara** County (east) side of the road are particularly problematic due to the creek, the steep topography and the unmanaged wildland. This road also requires the full 20 feet of treatment recommended above.

Wayside Road. It is an extremely substandard road with substandard road width, turn radii and significant vegetation fuel threats along the road. Consequently, this road should have more than the minimum required roadside fuel treatment. At the east end (low end) of the road there is heavy vegetation off to the north and south side, dominated by fire-prone “pyrophytic” hardwoods. Moving up the road on the south side, in the drainage, is a redwood stand with widespread mortality of tanoak due to SOD. This road requires particularly full treatment for fire safe access/egress to the extent possible.

APPENDIX I

FIRE-RESISTANT PLANTS
10/02/08

Select species and varieties that are relatively fire resistant:

1. Plants that are well adapted to the local climatic zones, microclimate, aspect, slope and local environmental conditions.
2. Plants with low fuel volumes: low growing, limited spread and open architecture.
3. Plants with a low surface to volume ratio (a clean open appearance, not twiggy and dense)
4. Plants that are deep-rooted and proficient at acquiring water.
5. Trees and shrubs with watery sap lacking volatile chemicals, fats and oils.
6. Plants lacking an internal canopy of dead material.
7. Plants with relatively more fire resistant foliage:
   Most deciduous trees and shrubs.
   Trees and shrubs with large fleshy leaves.
   Trees and shrubs with foliage lacking volatile chemicals, oils, waxes, etc.

Examples:

Locally Native Trees	Locally Native Shrubs	Non-native Trees
Valley oak (a.k.a. California white oak)	Pacific wax myrtle	Magnolias
Oregon oak	California beaked hazel	Maples
California sycamore	Magnolias	Oaks (most non-native deciduous oaks)
Big leaf maple	Flannel-bush	Fruit & nut trees (almost all)
Oregon ash	Spicebush (sweet shrub)	Sycamores
Red alder	Pacific rhododendron	Alders
White alder	Western redbud	Ashes
Buckeye		Palms (no dead leaves)
Fremont cottonwood		Birches
Black cottonwood		Buckeyes
Willows		Elms and Zelkovas
Hinds black walnut		Beeches
California box elder		Willows
Pacific madrone		Privets
		Plums
		A variety of broadleaf trees with above Characteristics.

APPENDIX II

Implementation of the Portola Valley
Fuel Hazard Assessment Study
(10/02/08)

Residents are encouraged to outline an approach they are going to take to reduce the fire hazard posed by vegetation on their properties. As a first step they should locate their properties on the Fuel Hazard Map to determine the "Vegetation Fuels" on their property. They should review the "Maintenance" recommendations for the types of vegetation on their property. If questions arise with respect to the recommendations, they should seek advice from the Fire Marshall's office of the Woodside Fire Protection District.

In addition, attention should be given to establishing **Shaded Fuel Breaks** and **Fuel Reduction Zones** on each property. A shaded fuel break is a strip of vegetation where the vertical fuel continuity (fire ladder) has been disrupted and the plants maintained so as to resist fire spread, high fire intensity and ignition of a house. In the first 10 feet from buildings vegetation should be irrigated regularly or monthly depending on the plant requirements. The information that follows is intended to provide guidance with respect to these topics. (For a more information, the reader is referred to the state publication "General Guidelines to Implement Performance Based Defensible Space Regulation under Public Resources Code Section 4291.")

Defensible Space is the area within the perimeter of a parcel where basic wildfire protection practices are implemented. The focus of these guidelines is on fuel modification measures, meaning where vegetation is managed and maintained so that it reduces the spread and intensity of encroaching wildfires. Vegetation surrounding homes is fuel for a fire. Experience has shown that fuel reduction around a structure increases the probability of a structure surviving a wildfire. Good defensible space allows firefighters to protect and save homes safely without unacceptable risk to their lives. Fuel reduction through vegetation management is the key fundamental to creating defensible space. **Defensible Space** comprises a **Shaded Fuel Break** next to structures and a **Fuel Reduction Zone** beyond.

A **Shaded Fuel Break** should be established within 30 feet of each building or structure by removing and clearing away all fire prone vegetation, with certain exceptions. Exceptions include: single specimens of trees or other vegetation that is well-pruned and maintained so as to effectively manage fuels and not form a means of rapidly transmitting fire from other nearby vegetation to any building or structure.

A **Fuel Reduction Zone** should be established from 30 to 100 feet away from a building or to the property line, whichever is less, and limited to your land. Adjacent property owners are not required to clear beyond 100 feet from their structure, but are encouraged to do so to create appropriate defensible space on a community-wide basis. Within the **Fuel Reduction Zone**, the following are recommended:

> Dead and dying woody surface fuels and aerial fuels should be removed. Loose surface litter, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches, should be permitted to a height no greater than 3 inches. This guideline is primarily intended to eliminate trees, bushes, shrubs and surface debris

that are completely dead or with substantial amounts of dead branches or leaves/needles that would readily burn.

Downed logs or stumps, when embedded in the soil, may be retained when isolated from other vegetation.

Fuel reduction does not mean cutting down all trees and shrubs, or creating a bare ring of earth across the property. It does mean arranging the trees, shrubs and other fuel sources in a way that makes it difficult for fire to transfer from one fuel source to another.

General Notes:

Properties with greater fire hazards will require more clearing. Clearing requirements will be greater for those lands with steeper terrain, larger and denser fuels, fuels that are highly volatile.

Fuel reduction activities that remove trees may require permits from the Town.

Care should be taken with the use of equipment when creating a defensible space zone. Internal combustion engines must have spark arresters and metal cutting blades should be used with caution to prevent starting fires during periods of high fire danger. A metal blade striking a rock can create a spark and start a fire. This is a common cause of fires during summertime.

Vegetation removal can cause soil disturbance, soil erosion, regrowth of new vegetation, and introduction of non-native invasive plants. Keep soil disturbance to a minimum, especially on steep slopes. Erosion control techniques such as minimizing use of heavy equipment, avoiding stream or gully crossings, use of mobile equipment during dry conditions, and covering exposed disturbed soil areas will help reduce soil erosion and plant regrowth.

In the **Fuel Reduction Zone**, one of the following fuel treatments should be implemented. Combinations of the methods may be acceptable as long as the intent of the guidelines is met.

Separation Between Fuels

Surrounding each structure, minimum clearance between fuels will range from 4 feet to 10 feet in all directions. Clearance should be in both the horizontal and vertical directions. The clearance distance between vegetation will depend on the slope, vegetation size, vegetation type (brush, grass, trees), and other fuel characteristics (fuel compaction, chemical content, etc.). Properties with greater fire hazards will require greater clearing between fuels.

If your property is on steeper slopes or has larger sized vegetation, this justifies greater spacing between individual trees and bushes (see Plant Spacing Guidelines and Case Examples below).

Grass generally should not exceed 4 inches in height. However, grass and other herbs, may be maintained less than 18 inches in height above the ground when isolated from other fuels or where necessary to stabilize the soil and prevent erosion.

Clearance requirements
Horizontal clearance should be maintained between aerial fuels, such as the outside edge of the tree crowns or high brush. Horizontal clearance helps stop the spread of fire from one fuel to the next.

Vertical clearance should be maintained between lower limbs of aerial fuels, and the nearest surface fuels and grass/weeds. Vertical clearance removes “ladder fuels” and helps prevent a fire from moving from the smaller fuels to the taller fuels.

Plant Spacing Guidelines
Guidelines are designed to break the continuity of fuels and can be used as a “rule of thumb.”

Minimum Horizontal Space from the edge of one tree canopy to the edge of the next on slopes greater than 20% should be 10 feet.

Minimum horizontal space between edges of shrubs on slopes greater than 20% should be twice the height of the shrub.

Minimum Vertical Spacing between top of shrub and bottom of lower tree branches should be three times the height of the shrub**.**

Defensible Space with Continuous Tree Canopy
A vegetation removal option is available for those wanting to retain a continuous stand of larger trees with no space between tree canopies while creating defensible space. For this guideline, within the Reduced Fuel Zone, spacing between aerial fuels is not required, such as in a stand of larger trees. In this situation, remove all surface fuels greater than 4 inches in height; remove lower limbs (3” or smaller) of trees (“prune”) to at least 8 feet above ground or up to 1/3 height for small trees). Properties with greater fire hazards, such as steeper slopes or more severe fire danger, will require pruning heights in the upper end of this range. Where there is shrub undergrowth, apply Plant Spacing Guidelines. A minimum clearance of 8 feet should be maintained where there is grass or other ground cover.