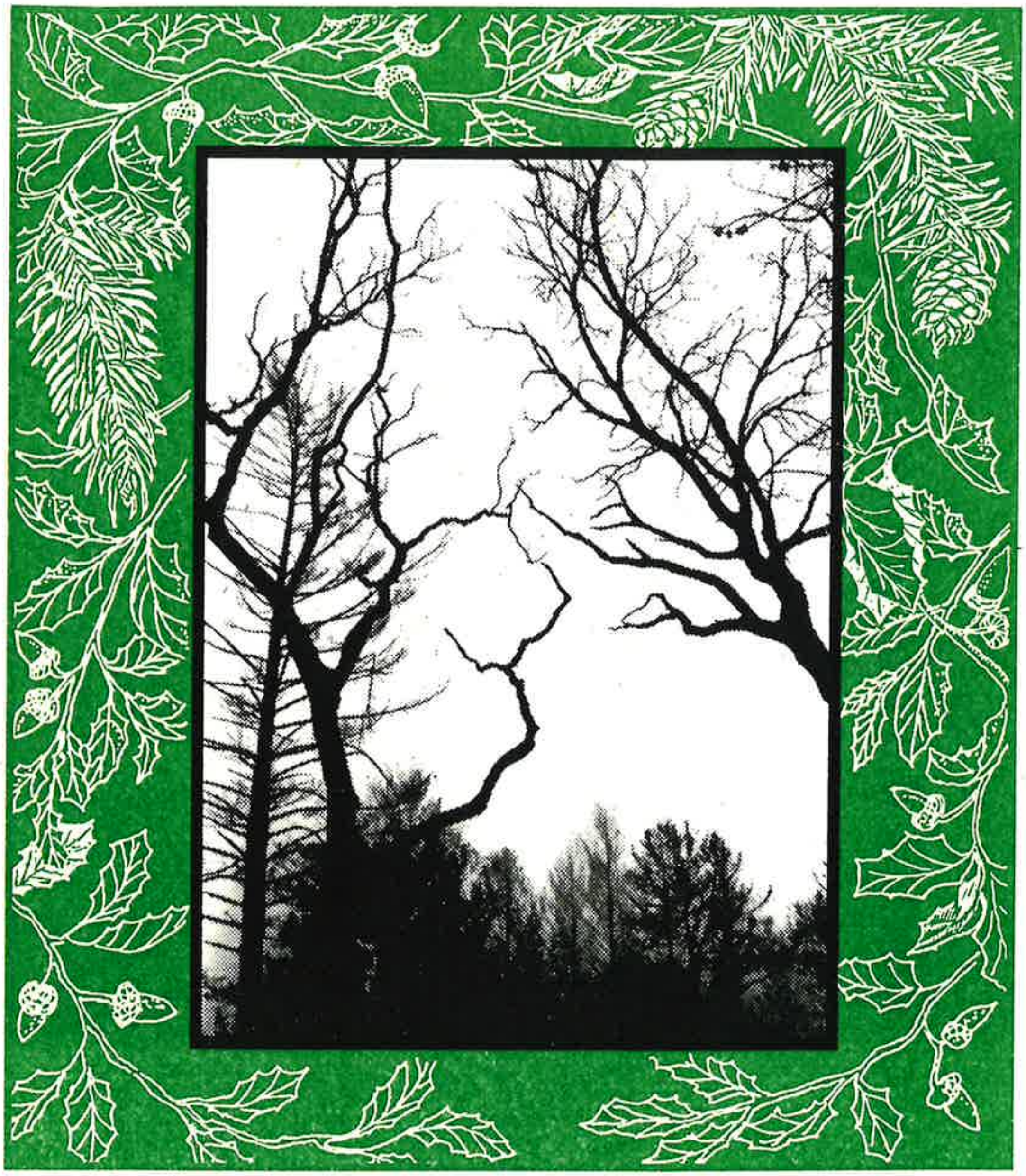
After the Vision Fire

RESTORATION, SAFETY & STEWARDSHIP
FOR THE INVERNESS RIDGE COMMUNITIES



REPORT OF THE PHOENIX TEAM
OF THE ENVIRONMENTAL ACTION COMMITTEE OF WEST MARIN

JUNE 1996

After the Vision Fire

RESTORATION, SAFETY & STEWARDSHIP FOR THE INVERNESS RIDGE COMMUNITIES

Report of the EAC Phoenix Team

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published by

Environmental Action Committee of West Marin

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FOREWORD

***by John Grissim**, Director, EAC*

May, 1996

■ ON BEHALF OF THE 1200 MEMBERS of the Environmental Acton Commiittee of West Marin, I am privileged to present to the West Marin community the Phoenix Report on the Vision Fire. This document is intended as a practical, accessible resource guide for the victims who suffered terrible losses during the disastrous fire that swept across the Inverness Ridge in October, 1995. If it serves that purpose alone, we will be more than pleased.

Yet this report is more than a tool for restoration. Within these pages one may find a quick course in forestry, a primer on wildland fires, an informative set of topographic maps created specifically for this report, strategies for protecting one's home and land, and a blueprint for prudent long-term stewardship tailored to the remarkable land that is West Marin.

EAC is very fortunate to have enlisted the participation of four highly qualified professionals whose commitment to this project went far beyond providing their clients with a report that meets industry standards. For in this instance, the clients are the victims of a disastrous fire, many whom our Phoenix Team know personally, many who have lost everything. The great care and conscientious effort that team members expended in assembing this report demonstrated time and again their deep connection to this community, and their reverence for this land.

One example of that commitment: When the time came to assemble the drafts that each expert had submitted, all agreed to allow their reports to be divided and integrated into a single document that easily enables a fire victim to find in one coherent section the key information about his or her neighborhood. Such a decision was not easy for consultants accustomed to submitting scientifically rigorous stand-alone documents under their sole authorship.

This report, by design, is not linear. Rather, it is a matrix, designed to allow one to go straight to any given geographic area and get information pertinent to that area, in some cases a single street or hillside. One may then read general conclusions and recommendations applicable to the whole area, and/or consult a number of appendices. The emphasis throughout is on clear exposition and no-nonsense practical advice.

Lastly, an observation: Naturalists teach us that disturbances to the regime of an ecosystem — in this case the Inverness Ridge — in the form of fires, landslides, flooding, and tree falls, are important. These upsets stimulate biodiversity, ensure plant succession, and contribute to robust health. In a sense the same may be said of our West Marin community. In recent decades we have together endured severe storms, floods and slides, and, most recently, fire. And each time we have come together to help each other, to grieve, to heal, and to rebuild, each time gaining wisdom and strength. May it be ever thus. ■

ACKNOWLEDGEMENTS

■ THIS REPORT WAS MADE POSSIBLE BY A $25,000 GRANT from the Buck Trust Fund of the Marin Community Foundation, for whose support EAC is most grateful. Art Mills, the foundation's environmental program officer, was especially helpful, as were Peter Martin and Jack Rosevear, whose timely and informed advocacy on behalf of the project is much appreciated.

During our study, homeowners and residents of neighborhoods burned during the Vision Fire gave our research team permission to walk their property, assessing the land. Marin County Creek Naturalist Liz Lewis was accessible and instructive. Stan Rowan, Marin County Fire Chief, and Jim Selfridge, Woodacre Fire Station commander, contributed information to this report about the Vision Fire. Naturalist Jules Evens kindly provided an appendix discussing the fire's impact on wildlife. Penny Livingston, permaculturist, contributed a note on forest soil. Thanks to all.

Photographer Jan Watson of Point Reyes Station furnished the central image on the report's cover, and Nancy Stein created the ink drawing surrounding it. Author and publisher Malcolm Margolin generously gave us permission to reproduce sketches of wildland restoration techniques, from his excellent book *The Earth Manual: How to Work on Wild Land Without Taming It* (Heyday Books 1975), and we borrowed plant illustrations from the Dover Press reproduction of George B. Sudworth's classic (1908) U. S. Forest Service publication, *Forest Trees of the Pacific Slope.*

We thank the Phoenix Report's authors for their conscientious reviews of manuscripts and their unflagging desire to complete a reliable report in a timely fashion. Among many extra efforts volunteered were the color maps generated by Tom Gaman, charts and a graph by Ray Moritz, and conscientious editorial contributions by Laurel Collins and Carol Rice.

Finally, EAC extends special appreciation and heartfelt thanks to the two driving forces behind the production of this report: Phoenix Project coordinator Nancy Stein, and editor/designer Claire Peaslee. Their commitment, craftsmanship, diplomacy, and hard work have been astonishing — and the Phoenix Report reflects it. As a landscape designer, Nancy has worked professionally in the Vision Fire burn area and knows first-hand the need for the information presented here — and she worked tirelessly to assemble it. Editor and graphic designer Claire Peaslee took on the daunting task of organizing a great body of information, weaving the Phoenix Report together (adding wording here and there to achieve seamless transitions), and presenting the end product in an accessible, attractive format. ■

ABOUT THE PHOENIX PROJECT

***by Nancy Stein**, Phoenix Project Coordinator*

■ Most Vision Fire survivors are people who cherished the forest around them. To be able to reside in a place where nature is intact, and humans are part of the equation of balance, is a rare and valuable experience. To live on land that is both remote and natural does imply certain risks, fire being one of them. Many of those who love the forest and live there consider themselves to be stewards of that land.

The Environmental Action Committee of West Marin launched the Phoenix Project in order to provide sound information to those stewards. The initial thrust of the project was a concerted effort, just after the fire, to provide homeowners with information that would aid in making good choices for the recovery of the burned lands. On November 11 and 18, 1995, EAC held seminars for homeowners, where foresters, arborists, fire ecologists, and geomorphologists with considerable fire experience presented slides and discussion. Field trips followed, where homeowners could obtain answers to their specific questions on burned sites.

Reforestation Project

As the experts of the Phoenix Team set out over subsequent months to produce the report you are holding, the Phoenix Project also concentrated on coordinating the donation and planting of trees and shrubs for reforestation in the burn zone.

Volunteer Day. In the spring of 1996, working together with Marin Releaf and the Living Tree Center, EAC assembled 40 volunteers from all over the Bay Area including the West Marin communities to work planting trees in burned neighborhoods. One hundred free trees were given to survivors of the Vision Fire. The trees (spruce, redwood, giant seqouia – beautiful, 20-gallon specimens, reaching as high as ten feet) had been grown as Christmas trees. In a program run by the Living Tree Center, they were donated to Vision Fire survivors by people who had purchased them as living Christmas trees. On On March 15, a beautiful spring day, EAC's volunteers and Phoenix Team worked together with the fire survivors, beginning the rewarding labor of reforesting the burn area.

Free Plants. On May 18, 1996, additional native plants for landscaping were given away. Many thanks to John Littleton of San Anselmo, who collected seed within Marin County over the last few years and grew coast live oak, redwood, buckeye, bay and tan oak trees. (When he began collecting seed, John didn't know where the trees would go: he just decided to grow a forest.) Shrub Growers of Napa, Skylark Nursery of Santa Rosa, and Mostly Natives Nursery of Tomales have also contributed many native plants through the Phoenix Project.

Give a Plant. Residents of local unburned areas are encouraged to donate native plants to residents of the burned area. Plants can be heeled in (placed in soil with their roots protected) in a specially designated area of Toby's Feed Barn. Property owners who are cleaning up their land in an effort to create defensible space can provide valuable reforestation materials to survivors of the fire.

Seeding and Transplants. Students at Tomales High School will grow bishop pine seedlings from seed collected on Inverness Ridge. Students at West Marin School will plant live oak acorns gathered in the fall of 1995 from local trees. Both these programs will be carried out on private property, at the request of owners. Planting will take place in the fall of 1996.

If there are areas of your property that don't seem to be sprouting new trees, EAC will be happy to coordinate a transplant project for you. New seedlings will need water about once a month over the first summer.

For information. For the duration of the Phoenix Project, anyone interested in donating plants or any other aspect of reforestation on Inverness Ridge may contact Nancy Stein, Coordinator, at (415) 663-8851.

Acknowledgements

Thanks to the following organizations for contributing to the Reforestation Project sponsored by the Environmental Action Committee of West Marin.

Chris Giacamini, Toby's Feed Barn, 11250 State Route One, Point Reyes Station CA 94956

Sandra Sellinger, Marin Releaf, P.O. Box 9512, San Rafael CA 94912

Mark Kalish, Living Tree Center, 6000 Locust Avenue, Cotati CA 94931

Sunnyside Nursery, 130 Sir Francis Drake Boulevard, San Anselmo CA 94960

Rich Readimix, P.O. Box 67, Point Reyes Station CA 94956

Stephen Torre, P.O. Box 133, Point Reyes Station CA 94956

Jon Littleton, 27 Tamalpais Avenue, San Anselmo CA 94960

Shrub Growers of Napa, 3260 Redwood Road, Napa CA 94558

Mostly Natives Nursery, 27235 Highway One, Tomales CA 94971

1 :: INTRODUCTION

coast live oak

■ THE POINT REYES PENINSULA IS A SPECIAL PLACE TO LIVE, in part because of the mix and maturity of vegetation, one that for generations residents and visitors alike have lovingly protected. But this protection has some drawbacks, one being the accumulation over time of large amounts of fuel that, when burned, create unnaturally intense fires that can destroy large stands of vegetation and are extremely difficult to fight.

Following a fire that destroys the forest cover, such as the Vision Fire of October 1995, prudent restoration strategies can do much to shape the type, density, and diversity of the future forest and brushland. Indeed, this time of restoration and rebuilding is also a great opportunity. By careful management — especially through landscaping and architectural design — people can not only ensure the return of beautiful surroundings but significantly reduce the threat of future wildfires to their homes. This is especially true for the neighborhoods of the Inverness Ridge, which are characterized by urban development interspersed with fire-prone vegetation on steep hillsides often prone to landslides.

PURPOSE

■ OUR AIM IN THIS REPORT is to provide a guide for restoring the plant communities we love and also for minimizing future threats to property and public safety from the natural recurring processes of wildfire, floods, and landslides. This can be accomplished by incorporating fire-resistant designs into structural architecture, creating defensible space around structures, and understanding how the natural processes of erosion and sedimentation work in different parts of the watershed. Actions that will prevent a recurrence of some of the damage caused by the 1995 Vision Fire are suggested, as are actions that protect the environment from unintended insults.

Organized according to the different vegetation types and neighborhoods within the area of Inverness Ridge affected by Vision Fire, this report proposes strategies for forest restoration, fire hazard management, and watershed awareness with reference to erosion, landslide, and flood hazards.

In arriving at the actions suggested in this Phoenix Report — actions for fire hazard reduction and for shaping the character of vegetation into an appropriate interface between natural and built environments — various considerations were balanced. While fire safety is a primary consideration, aesthetics, wildlife habitat, erosion control and overall livability were considered. All these factors entered into the recommendations that follow. The Phoenix Team has fashioned its recommendations to slow the transmission of fire and moderate its intensity while maintaining a natural, park-like setting.

METHODS

■ PRIOR TO THE CONTAINMENT OF THE VISION FIRE, Environmental Action Committee of West Marin (EAC) recruited four highly qualified professionals — geomorphologist Laurel Collins, forester Tom Gaman, arborist/fire ecologist Ray Moritz, and wildland fire management consultant Carol Rice — to serve on the Phoenix Team. The team's objective: a comprehensive assessment of the Point Reyes communities affected by the burn, together with recommended strategies for restoration, long-term management, and protection. Coordinating the project was Inverness landscape designer and contractor Nancy Stein.

In December 1995, aided by a grant to the EAC from the Marin Community Foundation, the team conducted extensive field reconnaissance and data collection. Using map and parcel information from a variety of sources (Marin County Department of Public Works, National Park Service, and aerial photography), team members walked the study area, and they identified and mapped neighborhood units, burned areas, watersheds, and other significant features. Next, they assessed pre- and post-fire conditions in each neighborhood using the data forms found in Appendix 7. Field conditions were evaluated via comparison with established standards for fire hazards, vegetative classification, and slope stability. The data were then assembled in a geographic information system (GIS) from which the maps used in this report were subsequently generated.

By mid-January, with the data in hand, the team developed a report outline. Each of the core team members prepared sections of the report most closely related to his or her area of expertise. By mid-February the team had prepared the component drafts, and these were reviewed and condensed by the group as a whole in a series of meetings. The final document was edited by Claire Peaslee of Point Reyes Station, and finally reviewed again by the Phoenix Team.

HOW TO USE THIS REPORT

■ CHAPTERS 6 AND 8 OF THE PHOENIX REPORT hold most of the findings and recommendations we produced for residents of neighborhoods within the Vision Fire burn area. See the outline below for a preview of where to find the information you most require. Broad recommendations that apply site-wide are found in Chapter 6 (page 31). Specific recommendations by particular neighborhoods are found in Chapter 8 (page 54). For context and cross-reference, emergency preparedness for all Inverness Ridge communities, including unburned areas, is the subject of Chapter 7 (page 49). Similarly, Chapters 3 through 5 contain specific kinds of information the reader can refer to as needed.

The Phoenix Report is organized as follows.

This introduction explains the contents and development of the report.

We next include a brief chronology of the 1995 Vision Fire.

Chapter 3 presents an overview discussion of the area we assessed.

An insert section follows that contains area maps, generated by geographic information systems, that depict different kinds of information about the study area.

Chapter 4, "Fire Hardening Your Home," contains the Phoenix Team's recommendations for home design and construction to produce more fire-resistant structures.

Chapter 5, "Watershed Awareness," builds a basis for understanding Inverness Ridge topography — especially as related to rainfall runoff — that will help people inhabiting its slopes attend to matters of safety and preparedness. This information is the context for evaluating some of the watershed safety steps we recommend later, in Chapter 7.

In **Chapter 6, "Findings & Recommendations Site-wide,"** we present general findings, as well as recommendations for restoration and fire hazard management, that are applicable throughout the area studied by the Phoenix Team — Inverness Ridge neighborhoods affected by the Vision Fire.

- Our findings initially are organized according to the **four principal vegetation types** that co-mingle in this area of Point Reyes peninsula: 1) Pines with Heavy Undergrowth; 2) Mixed Hardwood with Heavy Undergrowth; 3) Hardwood (including Bay Climax) Forest with Sparse Undergrowth; 4) Coastal Scrub.
- For each vegetation type the report presents a series of **fire-related characteristics**. These are: 1) pre-fire characteristics; 2) fire behavior; 3) fire effects; 4) vegetation response; 5) successional trends; 6) post fire/fuel succession.
- There follows a set of **recommended actions for forest restoration** with a view toward fire hazard management. These are actions intended **over a 30-year period**, in three phases: 1) years 1-2 following the fire; 2) years 3–10; 3) years 11–30.
- Chapter 6 continues with a discussion of **defensible space around structures**, i.e., the area where vegetation is managed to calm fire behavior in order to reduce structure ignition and provide space for firefighters to take defensive action. We list detailed actions in the **four fuel modification zones** relative to any structure: 1) zone 1 — 1-10 feet; 2) zone 2 — 11-30 feet; 3) zone 3 — 30-50 feet; 4) zone 4 — 51-100 feet.
- Within each fuel modification zone, we describe a treatment for each **kind of vegetation**: grass; brush resprouts; brush seedlings; resprouting trees; tree seedlings; standing trees; down and dead material.
- At the end of the chapter, actions specific to a particular vegetation type are spelled out.

In Chapter 7, we summarize and specify some guidelines for all Inverness Ridge communities for planning for emergencies, both future wildfires and the consequences of extreme rainfall runoff.

Chapter 8, "Vision Fire Neighborhoods — Assessments & Recommendations," describes our findings in each of 13 neighborhood units that we surveyed within the burn (see Map 1, map insert section). Only Units 1 through 7 contained structures that were damaged or destroyed.

- We **named the neighborhood units** as follows: Unit 1 – Pine Crest; Unit 2 – Drakes View; Unit 3 – Ridge; Unit 4 – Sunshine; Unit 5 – Saddle; Unit 6 – Sunnyside; Unit 7 – Douglas; Unit 8 – Drakes Summit; Unit 9 – Dream Farm; Unit 10 – Tomales Bay State Park Annex; Unit 11 - Vision Corridor; Unit 12 - Ottingers Hill / Seahaven; Unit 13 - Roberts.
- Under each Neighborhood Unit, we **describe characteristics**: location and slope; watershed; human impacts (i.e., development); prior vegetation/fuel type; critical fire features.
- Under each (as appropriate) we also **list specific recommendations**: defensible space; fire hazard management; geomorphology; forest restoration.

Finally, a number of additional topics and reference / resource lists are included in the Appendices to this report. ■

THE MOUNT VISION FIRE

by Joel Reese

The following account of the Vision Fire was written for this report by Point Reyes Light *reporter Joel Reese who covered the fire and later won the Peninsula Press Club's "Best News Story" award for his article "Wildfire" in the October 5th* Light. *We thank Marin County Fire Department Chief Stan Rowan and Woodacre Station Commander Jim Selfridge for their contributions.*


big leaf maple

■ THE AFTERNOON OF TUESDAY, OCTOBER 3, 1995, had an uneasy feel to it. The air was thick and hot, with temperatures reaching the mid-80's. Humidity was low and still falling, soon to reach the lowest of any day last year. The sky was clear, with only an occasional thin cloud disturbing the azure.

And there was the wind. Gusting at speeds up to 20 mph from the north-northwest, the wind gave the slow afternoon a feeling of hurriedness. Dust whisked down Main Street in Point Reyes Station, while out on the National Seashore the beaches were desolate because of blowing sand.

Gusts also buffeted the hills of West Marin. At these higher elevations, an even more dangerous condition was brewing — chaotic easterly winds so strongly associated with fire season in California.

Winds that blew over the southern slopes of Mount Vision on October 3rd swirled leaves and dirt — as well as embers from a recent campfire. The coals had lain undisturbed in the earth, covered with dirt that had been carefully trampled upon by some campers three days earlier. But the people hadn't anticipated the wind.

Early that afternoon the embers, probably nothing more than tiny orange sparks, flew onto some dry tinder. From there, the gusting air blew them into a small fire, which soon spread as the small flames reached piles of dry branches and grass. The Mount Vision area had not had a fire in 65 years, and the area abounded with a dense accumulation of fuel.

Adding to the already heavy fuel load, the eastern knoll between Mount Vision and Point Reyes Hill is densely forested with bishop pines and bay laurel trees. Fire Commander Tom Tarp, who came down from the Lake/Napa counties area, defined bishop pines as "big, heavy, nasty stuff that drop a lot of things onto the ground, which builds up a lot of fuel." In addition, bay trees defoliate when they get excessively wet, and the extremely rainy winter had produced piles of branches and bark from the bay trees on the knoll.

Inverness contractor Rufus Blunk was the first to spot the fire from a roof near the ridge top where he was working. Ironically, he had heard that the day was an extreme fire danger and was constantly surveying the Inverness Ridge for evidence of a blaze.

"In my subconscious, I was sort of worried about it," he said. "I was thinking, 'Is this the day we're going to have a fire?'"

Blunk said he saw smoke coming off the ridge line at 1:15 p.m. and immediately told his brother to call 911. Then he took the phone: "I told the dispatch to send the air attack immediately, because I knew right away it was going to be very hard to get people there fast enough on the ground. I knew this was a really grave situation. It was really heartbreaking to see it take off, to see the smoke get bigger and then see the flames."

The fire lookout on Mount Barnabe called in the smoke at nearly the same time, 1:27 p.m., but due to the remote location and rugged terrain, it was 1:54 p.m. before the first fire equipment could reach the site.

Marin firefighters came by the truckload to battle the blaze: ten engines, a bulldozer, a helicopter, one air tactical and two air tankers. As the first teams swarmed through the thickets with hand tools and water, the initial grass fire was contained at about two acres. Before all the hot spots were completely extinguished, however, conditions changed for the worse. At about 2:45 p.m., winds from the northeast surfaced; they blew 20 mph and gusted to 30, sending embers into the air. Sparks jumped a lower canyon and reached a dwarf bay forest, where flames reached easily into the canopies of these low trees. From several spot fires that ignited in this fashion, fire raced up to the top of the ridge, beginning its rapid advance southward along two branching corridors.

Marin Fire Chief Stan Rowan later said the wind kept the planes — which came from farther afield and provided the firefighters' only real weapon for reaching the inaccessible flames — from hitting their targets. "One air tanker pilot told us the wind was raising heck with his plane — he said he couldn't hit the spot," Rowan said. "We had four air tankers hitting the fire and they couldn't dent it."

Tomales Bay State Park Ranger Carlos Porrata said the blaze gained unstoppable speed and momentum after jumping the first canyon. "That's where it started getting some really dry material," he said. "As soon as it hit the bishop pines, it was like an explosion."

Propelled by the heavy amount of fuel on the ground, the flames reached the homes on upper Sunnyside Drive in the Paradise Ranch Estates subdivision within three hours. At 4:27 p.m., Marin County Fire Marshal Jack Rosevear called for a mandatory evacuation of the area, leaving many homeowners helpless at the bottom of Drakes View Drive while yellow fire trucks streamed up the steep, serpentine road.

Tuesday night, people who knew their homes were lost mingled vacant-eyed with others who prayed their houses might be spared. A Red Cross shelter at the West Marin School in Point Reyes Station provided a meeting place, and many residents of the fire zone took refuge in the homes of friends. The thick smoke produced a beautiful, haunting red sunset. Throughout the night Inverness Ridge glowed orange with the fire out of control, and the quiet was periodically interrupted by propane tanks exploding into flame.

The huge wildfire raged through the darkness, but the wind regime that originally spurred the blaze may have in fact saved the towns of Inverness and Inverness Park. Instead of the normal evening breeze that blows from the ocean over the land, that night the wind shifted toward the ocean and picked up speed. By 2:00 a.m. Wednesday the wind blew westward at a steady 40 mph with gusts to 60, sending the flames racing into the Seashore and away from the homes.

While the wind shift may have been good news for the two towns, it trapped a team of firefighters in the Limantour Beach parking lot between the ocean and a wall of fire. Members of the crew reported driving through a tunnel of fire on Limantour Road, and when they reached the parking lot they sprayed water on a blaze so hot that it melted the asphalt beneath their feet.

The next day, Tarp noted that, while the wind may have shifted, it didn't die down: "Last night, the fire was burning better at 2:00 a.m. than it was in the afternoon," he said. By that time, the Park Service estimates that 20 homes had been destroyed.

Wednesday, West Marin resembled a war zone as planes and helicopters swarmed through the air over the ridge, dumping thousands of gallons of water and red flame retardant on the hills. More than 2,000 firefighters, from as far as Solano and Butte counties, sprayed water and beat trails for 12- and 16-hour shifts, slept a few hours in local B&B's and at an impromptu encampment set up at the Bear Valley trailhead, then attacked the fire again. The incident command center at Point Reyes National Seashore headquarters set strategies aimed first and foremost at protecting human life and property. Stories of individual stands against the fire were abundant and dramatic.

By 9:00 a.m. Thursday, October 4th, an estimated 40 homes were already lost, and the fire had covered more than 2,000 acres. When an early morning breakout threatened homes at the top of Highland Road, a large number of firefighting resources were immediately stationed there to protect structures. At dawn concerned residents watched through binoculars from Highway One on the east side of Tomales Bay as helicopters, expertly flown by pilots who specialize in such demanding, high-risk operations, dipped 3,000-gallon "Bambi buckets" into the bay to support the ground efforts atop the ridge. The effort succeeded.

By 6:00 p.m. Thursday, 45 homes were lost and another 12 damaged. The Park Service estimates that, just two days after the fire began, the flames had scorched 11,720 acres.

Partly because of the massive fire suppression effort, as well as a long-awaited weather change that brought moist fog off the ocean by early Friday morning, the fire was fully contained by Saturday evening at 6:00 p.m. Had the wind kept blowing as strong as it initially was, though, the blaze could have raced through the Seashore: "It's entirely possible this could have gone all the way to Bolinas," Fire Commander Tarp said.

Flare-ups continued throughout the area, though, up to 11 days after the fire started, and it wasn't until October 16th — nearly two weeks after it began — that full control over the fire was declared.

All told, the fire burned 12,354 acres and destroyed 45 homes. But, as Rowan said, it could have been worse.

"When the wind did a right-angle turn and took the fire to the ocean, that saved a lot of houses," he said, noting trucks were stationed along Vallejo, Laurel, and Balboa streets. "We expected to lose a lot more homes up there."

Most importantly, no one was injured in the blaze, Rowan added.

The Mount Vision Fire of October 1995 left an indelible mark on the minds of those who were here for the conflagration. And while we will always remember the smoke, the flames, the red sunsets, and the tears, the fire is behind us.

"The Seashore will recover from this, " explained Stan Rowan. As of this writing in May 1996, charred stumps in the wild lands of the Point Reyes peninsula have given way to soft greenery and brilliantly colored flowers. ■

3 :: DISCUSSION OF STUDY AREA ::
THE INVERNESS RIDGE AREA AFFECTED BY THE VISION FIRE

toyon

■ THE FIRST TASK OF THE PHOENIX TEAM was to physically describe the study area and identify which questions to address. This short chapter is an introductory overview of the Inverness Ridge area that we assessed.

Plant Communities / Fuel Types

Although various gradations of ecological communities occur within the Point Reyes area, a number of more or less distinct communities can be identified. Included among these are salt marsh, dune grass, vernal pools, grassland, riparian (streamside) forest, mixed evergreen forest, Douglas fir forest, hardwood forest, bishop pine forest, and coastal scrub. Four of these plant communities dominated the neighborhood units of the Phoenix Project study area, and each displayed a relatively distinct fire behavior during the 1995 Vision Fire.* These vegetation / fuel types have been redefined here for purposes specific to this report, i.e., to recognize their fire hazard potential, their fairly distinct successional trends following the Vision Fire, and our restoration recommendations for each plant community. The four types we discuss are: Pine with Heavy Undergrowth, Mixed Hardwood with Heavy Undergrowth, Mixed Hardwood with Sparse Undergrowth, and Coastal Scrub.

The bishop pine forest occurs primarily on ridgetops. Hardwood-dominated vegetation types occur on a variety of aspects of lower ridges and slopes. Bay climax forests occur on north aspects in valleys.

All vegetation types have high wildlife value with the exception of bay climax forest (because of the low food availability present in it for animals). A distinct suite of species depends on the coastal scrub; otherwise most local wildlife species use all three vegetation types in varying degrees.

There is a distinct structure to each plant community, comprised of a canopy above and understory below. The understory in all four types is comprised of varying amounts of sword and bracken ferns, huckleberry, coffeeberry, manzanita, ceanothus, coast live oak, tan oak, and bay. bishop pine forest is most commonly associated with an understory of huckleberry, sword fern, coffeeberry, and hardwood reproduction. Hardwoods have the other species, along with poison oak and hazel. The understory of bay climax forest is typified by sword ferns.

It should also be noted that two other plant associations, Douglas fir forest and riparian (streamside) groves, belong to the natural landscape on Inverness Ridge within or near the Vision

* Some of these plant species are adapted to fire: their roots remain viable, and the plant often resprouts from the same root stock or stem after its above-ground vegetation has been consumed by fire. Some common fire-adapted species are live oak, bay, madrone, manzanita, coyote brush, and huckleberry. Other species like bishop pine and Douglas fir must reproduce from seed. Bishop pines actually benefit from fire that opens the cones and releases seed. According to Sugnet and Martin (Chapter 5 references, page 33), the old-growth bishop pines at Point Reyes ate back to an 1887 forest fire. Tree rings counted on burned trees in the upper northwestern slopes of Muddy Hollow confirm this finding. The same study did find that low-intensity fire that burns heavy duff layers is around old-growth bishop pines is just as effective at killing the trees as high-intensity fire. — *Laurel Collins*

Fire zone. We treat Douglas fir forest along with the four dominant vegetation types in Chapter 6. Riparian groves that characterize the lower (unburned) slopes of stream drainages in our study area are dominated by deciduous trees and bay forest, with alder, willow, and California bay laurel the typical tree species.

Pine with Heavy Undergrowth: In our study area this plant community is an over-mature bishop pine forest type. The forest canopy has been in decline and breaking up for a number of years. Whole tree windthrow, as well as trunk and limb failure, are common. Western pine gall disease and beetle damage are epidemic. A second, lower canopy of hardwoods has formed in many areas, and a dense third canopy of brush and hardwood reproduction has formed almost 100% coverage. Some exotic plant species* have invaded here, as well. The forest floor is littered with large quantities of down and dead material with abundant dead needles and leaves. This is Inverness' most fire-hazardous plant community.

Mixed Hardwoods with Heavy Undergrowth: The mixed hardwood forest consists of a canopy of tan oak, coast live oak, and bay, with minor components of bishop pine, Douglas fir, giant chinquapin, alder, and exotics. It has a dense undergrowth of huckleberry, coffeeberry, hardwood reproduction, and sword fern, with minor components of salal, ceanothus, manzanita, hazel, and exotics. This is Inverness' second most hazardous fuel type.

Mixed Hardwood with Sparse Undergrowth: This type has a dense crown cover of tan oak, coast live oak, and bay, with minor components of bishop pine, Douglas fir, giant chinquapin, alder, and exotics. The undergrowth is sparse, typically dominated by sword fern, with minor components of hardwood reproduction, hazel, and other shade-tolerant species. It has a discontinuity (vertical space) between the ground fuels and the crown fuels. This is Inverness' least hazardous fuel type.

Coastal Scrub: This brush type is dominated by coyote bush, coffeeberry, poison oak, blackberry, and toyon, with minor components of scrub oak, ceanothus, sagebrush, currant, and lupine. It is typically over-mature in the Inverness area, with abundant deadwood and ground debris. When wind-driven, fire behavior can be high in this type, but when backing down slope or against the wind, or when there is little wind, this type typically displays low fire intensities and rates of spread.

Fire Behavior

The Vision Fire's intensity was highest within the Pine with Heavy Undergrowth vegetation, where crowning was the most common means of very rapid fire spread. Sustained runs, blizzards of fire brands, spot fires, and area ignitions often confounded suppression efforts. Flame length was often continuous from the ground to high above the 75-foot canopies. Fire intensity was generally moderate in Mixed Hardwoods with Heavy Undergrowth, as was fire spread, and it was low in Hardwood with Sparse Understory. Coastal Scrub exhibited intense fire behavior when wind-driven but otherwise exhibitied low intensities.

* "Invasive exotics" is the term used here to include plant species non-native to the region that are likely to out-compete native plants (and even desired ornamental species) and thus significantly alter the character of the plant and animal community. Invasive exotics in the Inverness Ridge area include acacia, eucalyptus, Monterey pine, thistle(s), broom, pampas grass, *Vinca major* (periwinkle), Algerian ivy, and grasses such as *Zorro fescue*.

Almost invariably the fire was controlled and homes saved where hardwoods dominated the forest cover. Consumption of the vegetation was 90% in all communities except hardwood with sparse undergrowth, which is where the fire was stopped. Within the study area, crown fires only occured in pine with heavy undergrowth and juvenile (relatively young) pine.

Vegetation Responses to the Fire

Throughout the area surveyed, we made several post-fire observations that spanned neighborhood boundaries.

• In the pine forest, pine seedling regeneration was extensive, occurred in clusters, and has been inhibited by heavy grass growth in areas seeded since the fire. • Less than 5% of pre-fire forest overstory will survive. • Approximately 95% of the understory canopy was consumed.• Approximately 95% of understory shrubs will resprout. • Tan oak regeneration by seed was not observed, and stump sprouting is minimal. • Bay reproduction by seed was not observed, and stump sprouting is moderate. • Live oaks because they have insulating bark have largely survived.

In all neighborhood units, the vegetation type and structure will change from one composed of grass, ferns, and short sprouts and tree seedlings in the first year to the same vegetation dominated by shrub sprouts and tree saplings in the third year. In the tenth year juvenile pines and brush will cover the slopes. Pines will increase and eventually dominate a moderate understory.

Neighborhoods

Of the 13 neighborhood units we name and discuss within the study area, all had poor to very poor access, with few turnarounds or similar allowance for heavy equipment. All seven of the burned units were in the high fire intensity zone and had features that predisposed them to extreme fire behavior: steep slopes and drainages; ridgetop exposures; ladder fuels (vertically continuous fuels from ground to tree crowns); aging pine forest; heavy undergrowth of pyrophytic (that is, fire-adapted) plants; and volumes of heavy dead and downed plant material. Before the fire, development in the units ranged from low to dense; areas around structures were sparsely landscaped (but not sparsely vegetated); and (varying between neighborhoods) adjacent wildlands posed a significant threat. Topography varies in the units from almost level to steeply sloped. A considerable amount of logging and tree removal has occurred since the fire, as have debris removal, chipping, mulching, and seeding. Throughout the area, also, we noted numerous abandoned roads, soil disturbance from falling trees, and logging operations. In most units, invasion of exotic weeds has been minimal (Units 1, 2, and 3), but introduction of invasive exotics (particularly Scotch broom) will increase during the rebuilding process after the fire.

Fire Hazard Assessment

We assessed neighborhood units for fire hazard potential based on topographic conditions, the pre-fire fuel type, and the succession of fuel types predicted for each area. For this purpose, we employed the Marin County fire hazard assessment system (explained in Appendix 8), which assigns numeric values to the various relatively static factors of fire behavior around structures, e.g., steepness and direction of slope, and fuel types in the zones surrounding structures. The hazard scale then indicates the amount of defensible space needed for structure survivability. ■

INSERT :: MAPS


chinquapin

■ THE FOLLOWING FIVE-PAGE INSERT includes five maps of the Phoenix study area. The first four are reproduced in color, the fifth in black and white. Each depicts distinct kinds of information about the area, over the the basic topographic relief. Phoenix Team member Tom Gaman used a computerized geographic information system to produce the maps.

Map 1: Inverness Ridge Neighborhoods & Fuel Modification Zones

▮ Burned areas along the Inverness Ridge, neighborhood units as described in this report, and unburned areas where elimination of excessive forest fuels could lessen the impact of future fires.

Map 2: Inverness Ridge Neighborhoods

▮ Areas in the Drakes View Drive neighborhoods where most property damage occurred. Each parcel is identified by its Marin County assessor's tax map identification number.

Map 3: Paradise Estates Neighborhoods & Parcels / Damaged & Lost Dwellings

▮ The perimeter of the fire, parcels sustaining structural damage, topographic lines, upper watershed watercourses, parcel addresses and owner names.

Map 4: Paradise Estates Neighborhoods & Parcels / Geomorphology

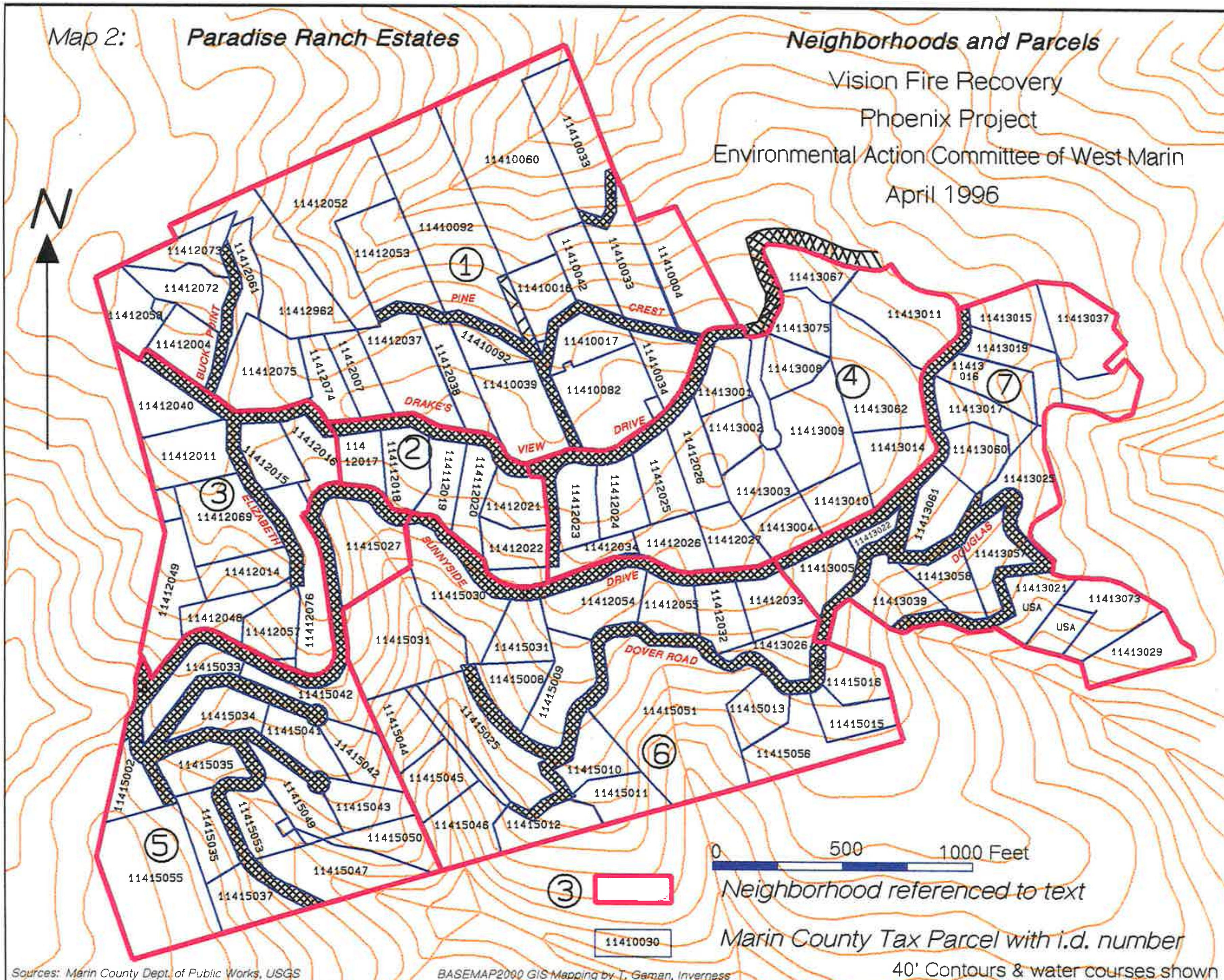
▮ Detailed geomorphic map showing hazard rating and location of colluvial hollows, inactive landslides, and landslides active within the last 25 years. Gullies and road drains (culverts) are also shown.

Map 5: Paradise Estates Watersheds

▮ Watershed boundaries of the Paradise Estates region, depicted for Muddy Hollow, Fish Hatchery, Vallejo, and Redwood creeks.

Map 1: **Inverness Ridge Neighborhoods & Proposed Fuels Modification Zones**

Source: USDI/NPS, USGS; East-West Forestry BASEMAP2000 GIS Mapping by T.Gaman, Inverness


Map 2:
Paradise Ranch Estates
Neighborhoods and Parcels
Vision Fire Recovery
Phoenix Project
Environmental Action Committee of West Marin
April 1996
N
PINE
CREST
DRAKE'S
VIEW
DRIVE
BUCK POINT
ELIZABETH
SUNNYSIDE
DRIVE
DOVER ROAD
DOUGLAS
1
2
3
4
5
6
7
11410060
11410033
11412052
11410092
11412053
11410018
11410042
11410033
11410004
11412073
11412061
11412072
11412058
11412004
11412962
11412075
11412074
11412007
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11415011
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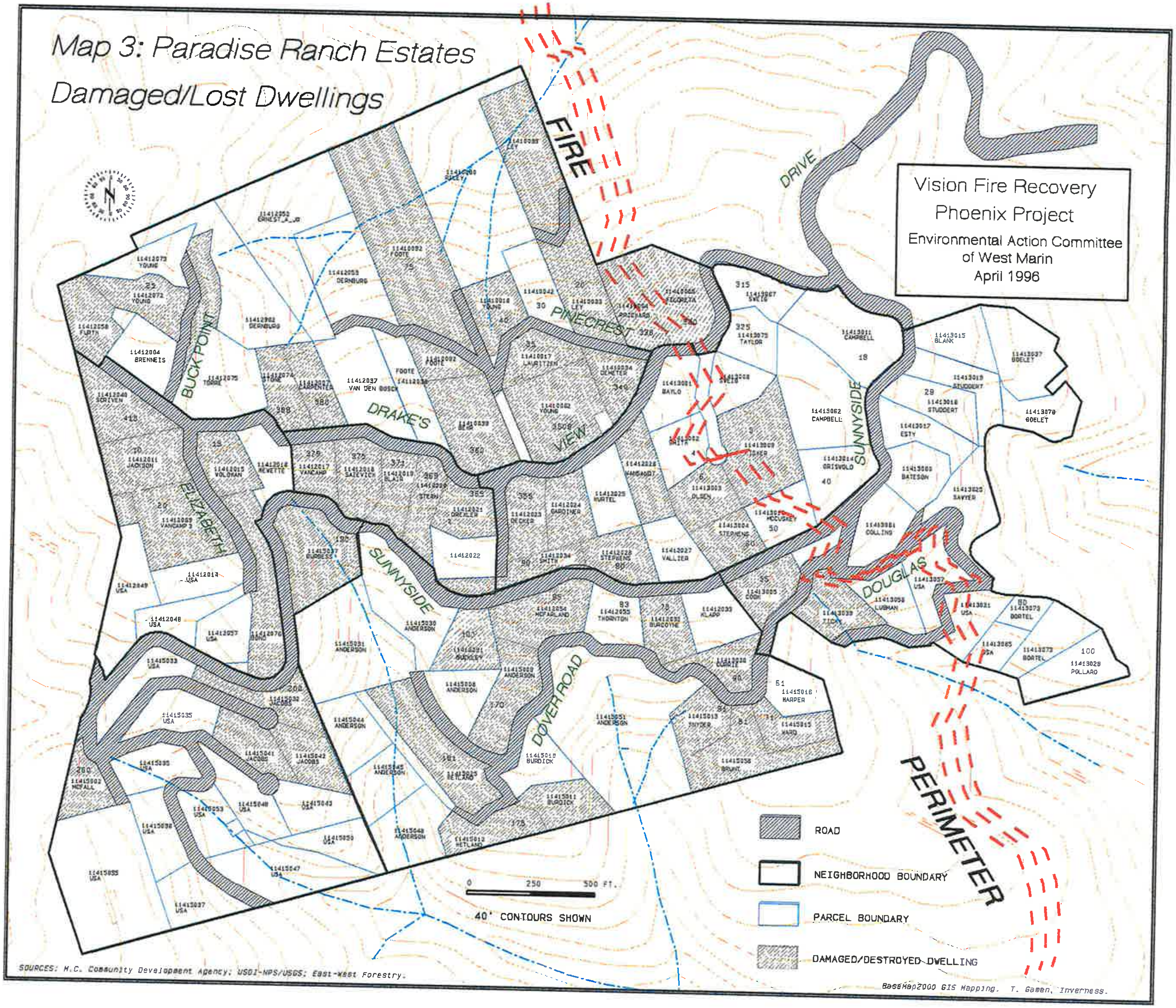
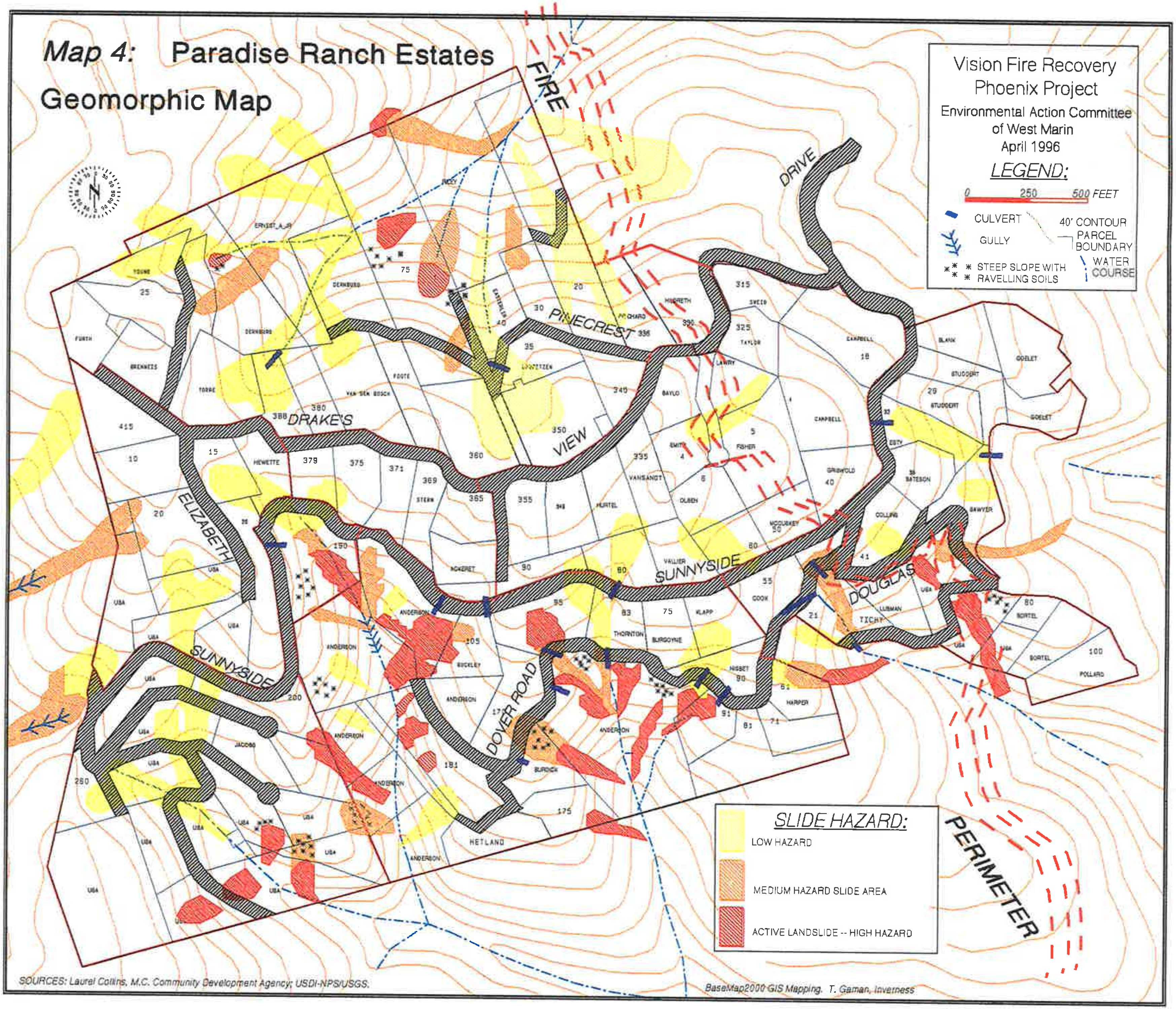
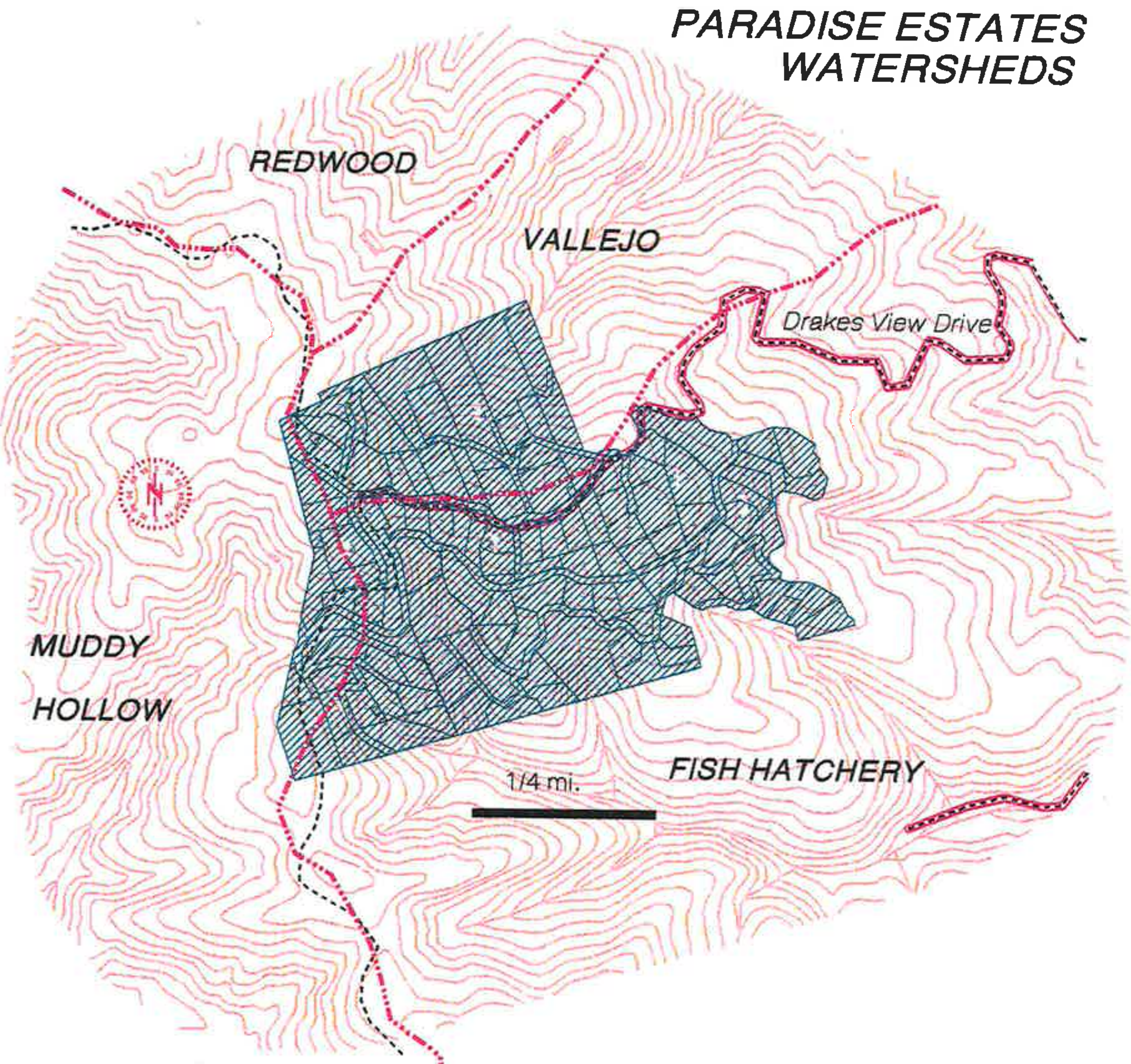
11415050
11415053
11415035
11415047
11415055
11415037
0
500
1000 Feet
Neighborhood referenced to text
11410030
Marin County Tax Parcel with i.d. number
40' Contours & water courses shown
Sources: Marin County Dept. of Public Works, USGS
BASEMAP2000 GIS Mapping by T. Gaman, Inverness



Map 3: Paradise Ranch Estates
Damaged/Lost Dwellings
Vision Fire Recovery
Phoenix Project
Environmental Action Committee
of West Marin
April 1996
FIRE
PERIMETER
DRIVE
PINECREST
DRAKE'S
VIEW
SUNNYSIDE
DOUGLAS
BUCK POINT
ELIZABETH
DOVER ROAD
ROAD
NEIGHBORHOOD BOUNDARY
PARCEL BOUNDARY
DAMAGED/DESTROYED DWELLING
0
250
500 FT.
40' CONTOURS SHOWN
SOURCES: M.C. Community Development Agency; USDI-NPS/USGS; East-West Forestry.
BaseMap2000 GIS Mapping. T. Gamen, Inverness.


Map 4: Paradise Ranch Estates
Geomorphic Map
Vision Fire Recovery
Phoenix Project
Environmental Action Committee
of West Marin
April 1996
LEGEND:
0 250 500 FEET
CULVERT
GULLY
STEEP SLOPE WITH RAVELLING SOILS
40' CONTOUR
PARCEL BOUNDARY
WATER COURSE
SLIDE HAZARD:
LOW HAZARD
MEDIUM HAZARD SLIDE AREA
ACTIVE LANDSLIDE -- HIGH HAZARD
FIRE
PERIMETER
DRIVE
PINECREST
VIEW
DRAKE'S
ELIZABETH
SUNNYSIDE
DOUGLAS
DOVER ROAD
SOURCES: Laurel Collins, M.C. Community Development Agency; USDI-NPS/USGS.
BaseMap2000 GIS Mapping. T. Gaman, Inverness

MAP 5


PARADISE ESTATES
WATERSHEDS
REDWOOD
VALLEJO
Drakes View Drive
MUDDY
HOLLOW
FISH HATCHERY
1/4 mi.

4 :: FIRE HARDENING YOUR HOME AGAINST WILDFIRE

This chapter was contributed to the Phoenix Report by wildland fire management specialist Carol L. Rice.

wax myrtle

■ THE DESIGN AND MATERIALS USED IN CONSTRUCTION do make a difference in the survivability of your home in the event of a wildfire. The chances that a house will survive are determined by the amount of heat it is subjected to and the ignitability and flammability of the structure. The amount of heat (fire intensity) can be reduced by managing the vegetation around the home. Ignitability is determined by design factors (geometry; size of exterior materials), as well as the type of material.

Various studies prove that the survivability of a home in a wildfire is not random, but that decisions made during construction in part help decide the structure's fate. Data from the 1990 Santa Barbara "Paint" Fire indicate the importance of structural and vegetative conditions in structure survival[1]. Although over 20 factors recorded were statistically significant, three were vital in structural survival. The study shows that any kind of roofing other than wood increased the probability of survival from 19% to 70% (a 51% difference). If one added to this flammable vegetation clearance of 30 feet or more, structural survival likelihood rose from 15% to 90% (a 75% difference). Finally, having fire-resistant roofing and vegetation tended to create defensible space so that people could remain present to defend the structure, and the combination of all three increased structural survival likelihood from 4 to 99% (a 95% difference) — i.e., to almost certain survival from almost certain destruction when no precautions were taken vis-à-vis roofs, vegetation clearance, and intervention. Although the data are from only one study, the trend is clear.

In addition, the study found the greater the distance the flammable vegetation was cleared, the greater the structural survival. Also, structures tended to survive in groups, indicating that defensible space involves not just a single structure but multiple structures and the intervening space. Other factors that were important in determining a house's survival in a wildfire included characteristics of exterior sidings, soffit vents, eaves, windows, and decks.

Many agencies, including the National Fire Protection Association, have concluded that fire intensity is the most important factor contributing to house loss. Fire intensity can be reduced by either expanding the area cleared adjacent to the structure (the defensible space) or reducing the heat output of the nearby burning fuels.

Preventing ignition focuses on reducing the amount of heat a structure is subjected to and reducing the ignitability of the structure. Reducing the amount of heat can be accomplished by expanding the defensible space and is addressed in other portions of this report. The remainder of this chapter will focus on preventing a structure from igniting.

In a large-scale wildfire, there are (and will be continue to be) too few firefighters to take defensive action at every structure, so firefighters will try to save a home that can be defended or

1 Ethan I.D. Foote, 1994: MS Thesis, Dept. of Environmental Science, Policy and Management, University of California, Berkeley

where success is likely. Reducing the ignitability of a structure will also increase the chances a firefighter will take defensive action there.

IGNITION CAUSES

■ REDUCING IGNITABILITY REQUIRES DEFENSES against two types of ignition sources, since structures must withstand the radiant heat from the firefront as well as the blizzard of embers that often precede the flaming front. While structures may ignite after the flaming front has passed, in fact this happens only occasionally. If ignition does not occur when the flaming front is passing, there is a much greater chance it will not occur at all.

If one harkens back to experiences in building a fireplace fire, ignition of larger logs needs kindling. Without kindling, a larger log is very difficult to ignite. If the log has a rough bark, or has holes or crevices in it, there is a greater chance it will burn. And so it is with structures. If one removes the kindling (which could be shake siding, nearby bushes, weathered eaves fascias, or lattice under decks), ignition will be delayed and, one hopes, prevented. If one removes crevices (e.g. deep overhanging eaves, porch portals, or many deep corners) and holes (window openings), the same would result.

Many homes are ignited by embers thrown ahead of the fire. These embers coalesce into a large, burning mass. Sometimes they are forcefully blown (crammed) into crevices such as under shakes, in the grooves under ship-lapped boards, or even into unscreened attic vents. Additionally, flat surfaces — such as roofs and decks — catch embers, so they need to be particularly hardened. The USDA Forest Service included the angle of the roofs as a factor to investigate, because the agency thought this an important factor in its study of structural ignition: very steep roofs may confront heat waves more directly (and so increase ignition chances). Very flat roofs, however, act as baskets for embers (as do decks) and are even more likely to ignite. Moderate roof angles may be indicated as the most resistant to ignition.

A fire is simply a way to transfer heat and can be considered a flood of heat. A defensive strategy is to look for weak spots in the dam, plug holes, strengthen weak spots, and shore up resistance.

Embers

Usually it is the coalesced embers in crevices that are the cause of ignition after the fire has passed. Many firefighers have reported valiant and successful efforts to protect homes during the fire's rage to find the home burned after they moved to another location. The embers in the crevices are the likely culprit in such loss of a structure.

In Australia, where fires are generally less intense and their residence time shorter, direction is given to citizens who decide to stay with the house to focus on extinguishing small spot fires and embers in and around the structure after the fire has passed.

Radiant Heat

Radiant heat — those waves of heat associated with dramatic flames — account for a high proportion of ignitions of structures in wildfires. Windows are particularly vulnerable locations in the building exterior. Double-paned windows buy time before breakage occurs. Windows typically crack from the heat, then collapse. Once an opening in the home's exterior is created, ignition is much more likely. Experiments conducted by the USDA Forest Service indicated that windows do crack and collapse at heat amounts less than those that cause ignition elsewhere on the exterior of the structure. For example, in one experiment, exteriors ignited at 50.3 kW/sq.m. whereas all windows — double paned and even tempered glass — broke at only 29 kW/sq.m.

Installing double-paned windows reduces breakage, because the second (inner) pane delays breakage for approximately 20 minutes. In a passing fire front, this delay can also result in ignition prevention. Larger windows break more easily (and sooner) in fires. Additionally, a heat-reflecting film applied to the outward facing surface of inner pane also delays breakage.

Overhangs — from roofs or decks — trap heat and are often sites of ignition.

The position of the structure in regards to topography also influences its survivability. A setback from the edge of the grading places more of the building away from the convective flow of heat up a slope and therefore enhances the structure survivability. Likewise, orientation of the structure matters: if a wall directly blocks the heat flow, it is going to absorb more heat and be more likely to ignite.

The color of the surface is not significant.

Larger structures (particularly two-story structures) produce higher amounts of heat when they ignite and present a greater threat to neighboring structures than smaller homes. When separation between one-story structures is less than 8 meters (26 feet), ignition of the neighboring structure is likely to occur without intervention. When a burning two-story house is located within 12 meters (39 feet) of a neighboring home, ignition of the neighboring home is likely even if there is no fuel (or vegetation) between the two. Structures were usually located well away from one another in the Vision Fire, but placement of structures in narrow or small lots, where it does occur, is a fire safety concern.

USDA Forest Service experiments have also indicated that removing sources of large flames (i.e., large fuel) within 15 meters of a wood-sided structure can significantly reduce the chance of ignition of the exterior (not considering windows) from radiant heat.

AVAILABLE MATERIALS

■ WHILE WOOD HAS MANY WONDERFUL QUALITIES about it as a building material, it has the drawback of being ignitable and flammable.

Several types of materials are potential substitutes for wood. They can be categorized as roof material, exterior siding material, trim, and decks. For roofs, several options now exist that previously did not. In fact, non-combustible roofs successfully mimic shake roofs in appearance. Costs are generally similar to wood roofs. While all non-combustible roofs are superior for fire protection to wood roofs, the ends of tile roofs need to be sealed with "wavy" facia boards to prevent nesting of birds (because nests can increase ignition possibilities). All of the varieties of Class A roof assemblies are acceptable.

Fewer options exist for siding, but these include stone, brick (of any type), adobe, and stucco. The company Hardishake manufactures a non-combustible siding called Hardisiding™; the company even has window assemblies. If wood is selected as siding material, the size of the boards should be larger than six inches wide, with a smooth fit rather than tongue and groove or shiplap.

Coatings

Coatings offer increased protection from fire over non-coated materials. Intumescent paint bubbles when heated, with the bubbles providing an insulating barrier of air. This treatment tends to delay ignition up to 20 minutes (which may be long enough for the fire front to pass). Some coatings, such as Pyroplus™ by Fire and Thermal Protection, Inc., and FR 101™ by New Age Technologies, Inc., chemically react with fire's components to prevent combustion from taking place. While coatings tend to be more expensive than paint, they are less expensive than some alternate building materials. They generally have the same coverage rate as paint and can accept pigments. Rarely are the coatings themselves clear. Pyroplus™ and FR 101™ are the exceptions: they are clear coatings which are appropriate for decks, as well. Deck materials can be made less ignitable by applying a thin coating; while this practice is sometimes used to preventing skidding, it would also decrease its ignition potential.

BUILDING GUIDELINES

■ The following recommendations for building are not necessarily adopted as code, but they address the factors that may decrease the ignitability of a structure. Some of these are already required in the Inverness Ridge burn area but are included in this set of recommendations for the sake of completeness.

All roof assemblies will be Class A roofing. Roof overhangs that are constructed of non-combustible materials need not be protected. Combustible roof overhangs projecting less than 10 inches from the exterior face of the exterior wall may be unprotected. Overhangs extending more than 10 inches should be protected by one of the following: 1) one-hour resistive materials with a non-combustible surface on the underside and exposed edges; 2) "heavy timber" construction; or 3) any other non-combustible material with the approval of the building official.

Exterior siding should consist of "stucco" or any exterior one-hour rated wall assembly with a non-combustible surface, or any other non-combustible material with the approval of the building official. One-inch nominal minimum dimension trim may be applied on walls constructed as noted above. Untreated wood shingles and wood shakes of any kind would not be recommended.

Projections, which include decks, exterior balconies, porches, and exterior stairs, should be of non-combustible materials. Alternately, combustible projections should be protected by one-hour fire-resistive materials, with non-combustible surfaces applied on the underside and all exposed edges, or sprinkled from the underside, or they should be built with heavy timber.

A minimum setback of 10 feet from the structure to the edge of grading should be designed into the siting of the house. This setback should be sloped sufficiently to allow proper drainage. The setback places more of the building away from the convective flow of heat up a slope and therefore enhances the structure survivability.

Garden structures (such as freestanding gazebos, hot tubs, or outbuildings) should meet the same minimum requirements for materials, timber size, and other requirements as pertain to structures.

Built-in fireplaces should not be farther than 15 feet from a water source, or be equipped with a fire extinguisher(s). Barbeques must be surrounded by at least 10 square feet of non-combustible materials and be 10 feet clear of all overhanging structures or trees.

Fences should be constructed of non-combustible material or should use timber size of a minimum of one-inch nominal thickness.

GENERALIZATIONS — ACTIONS TO TAKE

■ PLACE VEGETATION AWAY FROM "WEAK" SPOTS in building exteriors, away from overhangs and windows. Ideally, use non-combustible materials (stucco, stone, slate, gunnite, concrete). Use a design that minimizes crevices, corners, and overhangs. If a combustible material is selected, use large and/or smooth material wherever possible — the smoother the structure, the less ignitable it is. Minimize the size of any pane of windows; use French window designs rather than single large picture windows. Use double-pane windows with a film on the outer surface of the inner pane. Manage vegetation (reduce fuel sources) to minimize radiant heat output immediately adjacent to buildings; the first 30 feet are most important. (See complete discussion of defensible space on page TK in Chapter 6.) Install screens on all openings, as screens help limit ember entry into attic (via vents) and from chimneys.

Fire-safety considerations limit design choices. The appearance of a structure with several wide overhangs, corners, and crevices is vastly different than a smooth structure. There are fewer non-combustible materials than styles of wood. There is added cost to using non-combustible materials.

Tradeoffs exist; it's not a perfect world. If you choose flammable siding, be particularly extreme in removing fuel around the house. If you choose large-size windows, don't leave a tree canopy nearby that might cause the window to break from its combustion.

If you choose a combustible material, make it smoother, of larger dimensions, and with less places for heat to be trapped (overhangs, eaves, vents).

Luckily, energy-saving windows (those double-paned and coated on the inside pane) also provide added fire safety. The coating is a thick, film-type polymer low-e coating (Pella window's standard glazing system, for example), with a heat-reflecting film, such as 3M's "Scotchtint" applied to the outward facing surface of the inner pane (which may also afford protection against injury due to earthquake-caused glass breakage.)

The effect of eliminating structural ignition chances is a great decrease in the chance that a building will be available to fire (and used) as a fuel. A perfectly fire-hardened structure thus acts as an area of no fuel, and thus a fire-break, helping to protect other structures and properties. ■

5 :: WATERSHED AWARENESS FOR RESIDENTS OF INVERNESS RIDGE

:: A PLAN FOR UNDERSTANDING BACKYARD AND WATERSHED RESPONSE TO THE VISION WILDFIRE AND TO EXTREME STORM EVENTS


fremontia

Geomorphologist Laurel M. Collins, a member of the EAC Phoenix Team, authored this chapter of the report.

■ THE OBJECTIVE OF THIS CHAPTER IS TO HELP PROPERTY OWNERS who live within and adjacent to the Vision Wildfire area develop an increased awareness of landslide, erosion, and flood hazard, and an increased ability to assess the type and suitability of erosion control measures that may be needed during the period of reconstruction and vegetative recovery. With an increased awareness of natural processes that shape our backyards and the watersheds within which we reside, we can better predict where erosion and slope stability hazards are likely to occur, recognize and monitor existing hazards, and determine whether technical professional investigation should be sought. This is the judgement, of course, of each land owner, but discussions among neighbors should be encouraged.

The importance of knowing the impacts of one's actions on the landscape becomes self-evident when the natural, functional connection of the hillsides to the drainage network and places downstream is considered. For example, soil loss in the burned uplands means sedimentation and loss of channel capacity downstream. This may cause increased sedimentation in unburned lowland portions of the Inverness community, and in Drakes Estero or Tomales Bay, which can have long-term ecological impacts of concern to the people of Point Reyes.

Much has been publicized by the popular press about the increased hazard of floods and landslides following wildfires. Scant information exists, however, about the response of streams and hillsides to fire in the Mediterranean type climate of Central and Northern California. Following the Vision Fire at Point Reyes, there was speculation that post-fire erosion would be similar to that occurring in granitic bedrock areas of Southern California, where devastating mudflows frequently coincide with the first storms of the winter. Yet due to differences in weather patterns at Point Reyes, such as greater rainfall amounts but lower rainfall intensities, and differences in density and species of vegetation, we should not necessarily expect the soils and streams in the Point Reyes landscape to respond with the same severity of erosion and flooding problems. The landscape response during this past winter (1995-96), when rainfall was above normal, indicates very little erosion has occurred throughout the natural landscape of the entire Vision Fire area, with the exception of the soils on steep hillsides of burned bishop pine forests.

The general study area in this report includes Fish Hatchery, Vallejo, Redwood, and Dream Farm watersheds on the eastern side of Inverness Ridge, and Muddy Hollow drainage on the west side (Map 5, map insert section). The headwater portions of each of these watersheds were effected to some degree by fire. The following general discussion of the physical nature of the study area also applies, in principle, to east-draining First, Second, and Third Valleys. Site-specific mapping of landslide potential was done for the urbanized burned zone at the top of Drakes View Drive called Paradise Ranch Estates.

DEFINITIONS OF COMMONLY USED TERMS

THE TERMS SURFACE EROSION and landsliding have sometimes been loosely interchanged by the popular press. But the two processes have different causes. This point has been poorly understood by people generally not familiar with the subject matter, sometimes leading to confusion about the applicability of certain types of erosion control measures. The following definitions should be reviewed in the context of this report.

WATERSHED is the area of land drained by a given stream or river. Watersheds have parts, such as the top or ridgeline, hillsides, bottom or valley, and the drainage network. The components of the watershed are carved by long-term geomorphic processes, such as erosion and deposition, that over time will continue to modify the shape of the landscape.

SURFACE EROSION is a natural process that is generally caused by water flowing over the land surface. But it can also occur from raindrop impact, blowing winds, and animal burrowing. The type of erosion that is of most concern to people is that which can inflict damage to human life, property, wildlife habitat, or which can reduce soil productivity. Erosion from raindrop impact and water flowing over the soil surface suspends and entrains soil particles and efficiently transports them downslope. The distance transported can be just a few inches, with the particles still remaining on the hillside, or it may be hundreds of feet, far enough to move soil and rock from the ridges into stream channels. Water flowing over the soil surface can take the form of sheet flow, rills or gullies. Sheet flow is a thin veneer of water flowing over the soil surface. Erosion, in this case, is most effective when the soil is barren, for example after grading activities or fire. Rilling begins when surface runoff becomes concentrated. Rills are usually less than a foot deep and can coalesce into a dense network when erosion is severe. Continued downcutting of rills creates gullies, which can range in size to tens of feet deep and wide.

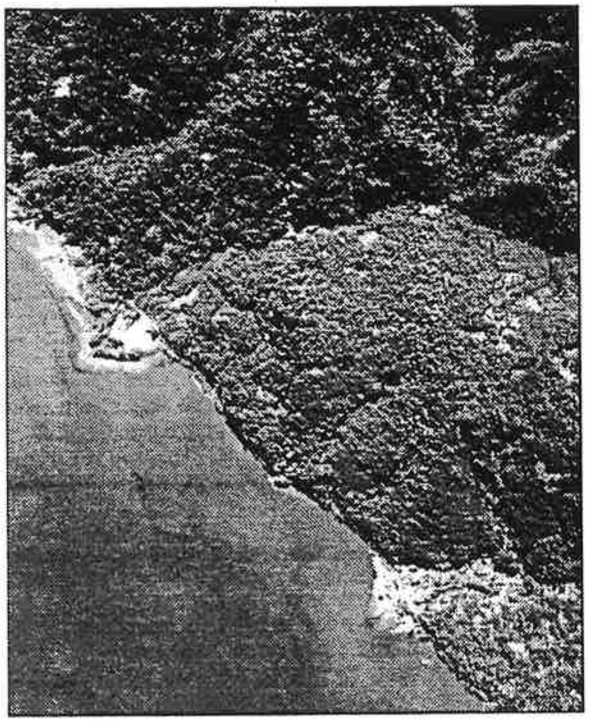
LANDSLIDES are typically initiated by ground water flowing through the subsurface soils that causes a mass of soil and rock to slide downhill. There are many different types of landslides. They vary in their composition, rate of movement, and amount and intensity of rainfall required to initiate their mobilization. The principal type of landslides of concern along the Inverness Ridge are debris flows and debris torrents, as defined below.

ALLUVIUM is sediment that has been transported by stream flow.

ALLUVIAL FAN is a wedge shaped accumulation of alluvium that has been deposited at the base of a canyon or where flood flows become unconfined. Alluvial fans exist at the base of nearly every significant drainage emanating from the eastern side of Inverness Ridge. The apex of the fan represents the location where stream gradient flattens and sediment transport efficiency decreases. The reduction in available energy for sediment transport often creates a loss of channel capacity causing channels to fill, cut new courses and disperse their sediment as the fan builds upward and outward. The segment of a stream that traverses its alluvial fan can alternate through time between scouring its channel or filling it in, depending upon sediment and water supply.

COLLUVIUM is soil and rock that moves downslope by gravitational processes, such as soil creep and ravelling, rather than by water transport. Thick deposits of colluvium often collect in colluvial hollows.

COLLUVIAL HOLLOW is an area on a hillside that typically has thick deposits of colluvium overlaying the bedrock and has deeper soils



Alluvial fans on Tomales Bay below Inverness Ridge

than the adjacent hillsides (Reneau and Dietrich, 1987). The shape of the bedrock below the soil/colluvium mantle is like a tipped, tear drop-like depression that has been carved by former debris flows. Along the Inverness Ridge, some hollows may have deeply weathered granite that has very little strength. The concave contours cause surface and groundwater to converge down the axis of the hollow, below which the channel head usually begins. Steep colluvial hollows are considered potential source areas for future debris flows which can excavate soil, colluvium, and bedrock.

DEBRIS FLOW is a type of fast moving landslide that usually involves sliding of surface soils, colluvium, and entrained woody debris. Their initiation is associated with intense rainfall. The source area for debris flows are typically colluvial hollows located at the heads of the smallest upland stream channels. These slides also occur along steep slopes adjacent to channel courses. They are most likely to occur on slopes greater than 26 degrees but they are also found on slopes as gentle as 20 degrees (Ellen, 1988). Many portions of the upper hillsides on Inverness Ridge have slopes steeper than 26 degrees. If a debris flow enters a stream channel it is called a debris torrent.

DEBRIS TORRENT is a type of flow that occurs in a stream course after the sediment load has been suddenly increased by a large debris flow, several small landslides or by the sudden failure of a large debris jam that has stored a large quantity of sediment. The debris torrent rapidly moves downstream as a slurry of coarse sediment and entrained woody debris.

DEBRIS JAM is an accumulation of woody debris in a stream course that can have large quantities of sediment stored behind it. Eventually jams can break apart by rotting of the wood or by redistribution during flood flow.

FLOODS occur when streamflow exceeds the height of its banks and overflows onto the floodplain. Many of the channels emanating from Inverness Ridge do not have well defined floodplains, so a practical definition of flooding is when streamflow exceeds its banks and causes damage to improvements from water and/or fine sediment.

HYDROPHOBICITY is the tendency of soils to repel water. It can develop during wildfire when vaporized organic compounds are driven into the soil. The organic compounds condense in a layer that is usually within an inch or two of the soil surface. If hydrophobicity is pervasive and rainfall is intense, surface erosion might occur. Peak storm flows will be higher in watersheds that have a large aerial extent of hydrophobic soils because of the limited infiltration capability of the soils.

NICK POINTS are where the stream gradient suddenly steps downward as a falls. These nick points often exist where a shallow channel suddenly becomes deeply entrenched and appears to have a gully head. Nick points can be caused by woody debris, roots, boulders, bedrock steps, or by a sudden lowering in the base level to which a channel is graded. Nick points can migrate headward, eroding alluvium or bedrock, and generating a high supply of sediment as the channel bed increases its upstream gradient.

LANDSCAPE FORMING PROCESSES OF INVERNESS RIDGE

■ CITIZENS WHO WANT TO PREPARE THEMSELVES for extreme storms, fire, earthquakes, and the associated natural hazards must understand their physical setting, including the nature of interactions among vegetation, rainfall, hillsides, and streamflow. The following text discusses these kinds of interactions, which vary in magnitude but continue to influence our lives and landscapes in significant ways. The immediate text discusses landscape processes under the normal vegetated conditions of Inverness Ridge. How these processes are affected by fire is discussed after this basic understanding is achieved.

The Inverness Ridge study area ranges in elevation from sea level to 1336 feet at Point Reyes Hill. The ridge is formed from granitic bedrock that has been tectonically uplifted and moved northward by the San Andreas Fault, the trace of which goes through Tomales Bay. The bedrock has little strength where it has been strongly weathered. In some areas of the Ridge, weathered rock extends 60 feet deep (Galloway, 1977). The bedrock has also been mechanically weakened and fractured by numerous faults that are associated with the San Andreas shear zone. Major seismic events from the fault have triggered large-scale landslides in some portions of Point Reyes in the past and may continue to do so in the future.

Tomales Bay is located east of Inverness Ridge, and Drakes Estero is located to the west. From the ridge top, the minimum distance to the Tomales Bay shoreline is approximately 6,500 feet, as the crow flies. The distance to Drakes Estero is more than three times greater. Due to the shorter and steeper stream gradients on the east side, runoff from the ridge will flow to Tomales Bay more rapidly than it will to Drakes Estero. Such steep, short stream networks on the east side can be considered highly responsive to intense storms, because they are more efficient at transporting water and sediment from top to bottom of the drainage.

Additionally, water and sediment transport is augmented by greater rainfall amounts on the east side compared to the west. Mean annual rainfall is typically about 40 inches at the ridge top, about 36 inches along the Tomales Bay shoreline (within this study area), and only 24 inches at Drakes Estero shoreline (Evens, 1988). The pattern of rainfall amount, combined with steep topography and short run-out distances to the shoreline, suggests that flood and debris torrent potential is greatest along the lower portions of the east-draining watersheds, some of which have undergone residential and commercial development.

Rainfall timing and intensity usually helps determine the type of landscape response to a storm. Flooding may occur after a period of prolonged or intense rainfall, particularly if the soils are already saturated. Whether a channel responds by filling its bed with sediment or scouring the bedrock to a deeper level will depend upon the supply of sediment and the location within the drainage network. The sediment supply will depend upon the response of the hillsides. The hillsides are more likely to produce landslides during middle to late winter, once the soils are saturated.

For the Inverness Ridge area, saturation of unburned soils can be expected after 9 inches of rainfall for the season. Given soil saturation, the danger threshold for debris flow initiation could be reached with the following amounts of rainfall over the given time periods (Ray Wilson, U.S. Geological Survey, personal communication):

3.43 inches in 6 hours,

4.26 inches in 12 hours, and

7.36 inches in 24 hours.

These thresholds are reported for the normal, unburned conditions. Threshold conditions for *burned* soils could be either higher or lower depending upon site-specific conditions of burn intensity, presence and degree of hydrophobicity, granularity and cohesion of soils, root density, vegetation type, and steepness of slope (discussed under Effects of Fire, page #).

As indicated by the numerous landslide scars and deeply dissected canyons throughout both sides of the Inverness Ridge, debris flows have been a dominant geomorphic process for thousands of years. Studies of pollen and stratigraphy in alluvial deposits of western Point Reyes indicate that the climate between 12,000 and 10,000 years before present was cooler and wetter than present. Frequent high-intensity storms caused numerous debris flows during that period (Rypins et al, 1988). Radiocarbon dating of a debris flow scars in First Valley (Reneau, 1990) indicated that abundant debris flows occurred about 10,000 years before present. After studying debris flows distribution in Marin County, Ellen at al (1988) discussed the probability that storm events similar to the January 1982 storm, which produced abundant debris flows, can be expected every 20 to 100 years. Rainstorms capable of generating some debris flows may occur as often as every 5 years.

Such high-intensity rains, needed to generate debris flows, are not needed to initiate other types of landslides, such as slumps and deep-seated earthflows, or slides associated with roads or other man-made landscape changes. Indeed, some deep-seated earthflows can be caused by long-duration gentle rains. This type of slide, however, is not as common on the Inverness Ridge.

The pattern of rainfall can also cause different types of responses in streams, depending upon how much erosion and subsequent sediment is supplied to the channel. Rainfall that creates erosion and landsliding upstream can increase the risk of flooding and sedimentation downstream. With high sediment supply, the streams in the lowlands are more likely to fill their beds, lose channel capacity, and overflow their banks. Conversely, early winter rains that occur before the soils are saturated, and low-intensity but long duration rainfall, may cause streams to scour their beds or become wider by eroding their banks due to low sediment supply. During the last decade, drought and low flow conditions have increased vegetation encroachment, such as willows and alders, onto gravel bars within active stream beds. This has led to localized reductions in channel capacity, which ultimately increases flood frequency. Flood damage to the urban infrastructure tends to be far greater from floods associated with debris torrents, particularly if large woody debris is delivered to the channel by landslides or scoured from stream banks by the debris torrent.

Not all debris torrents at Point Reyes watersheds have flowed to their alluvial fans or met the tides of Tomales Bay. Remaining deposits of some 1982 torrents still exist as accumulations of stored sediment behind log jams or on top of former banks along valley bottoms. These deposits could become entrained in future debris torrents. However, in most of the steep, upland, v-shaped canyons, the 1982 debris torrents effectively scoured their channels. Since then, scant sediment accumulation has occurred in these locations, except for local deposits at the intersections (confluences) of tributaries. In middle and lower segments of the watersheds, such as Fish Hatchery Creek and Dream Farm for example, large accumulations of sediment from the 1982 debris torrents filled the less confined lowland valleys and left deposits in excess of 5 feet high and tens of feet wide.

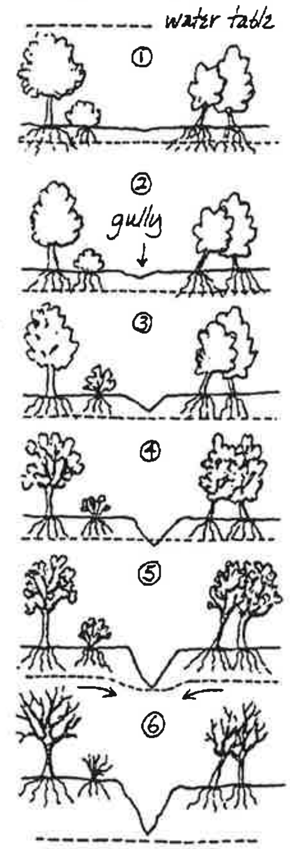
These deposits typically support young alders and willows. Narrow channels have since incised through these deposits, in some cases to bedrock. These entrenched channels now confine the higher flows and may increase the potential for future debris torrents to be transported further down-valley.

URBAN SETTING

■ THE PRINCIPAL URBAN ZONES IN INVERNESS are located on portions of the ridge top, and on eastern hillsides, valley bottoms and alluvial fans. To a small extent, some urbanization has occurred above the extreme headward drainages of Muddy Hollow and Laguna Creeks. The fans of First Valley and Fish Hatchery Creek have had the most intensive urban and commercial development. Structures located in the pathway of debris flows, or along channels and alluvial fans subject to debris torrents, are occasionally at risk whether or not there has been a fire in the watershed. Structures are also at risk when they are located on landslide deposits or immediately upslope of eroding landslide scars, where headward erosion is possible.

Urbanization has had profound effects on the rate of some important geomorphic processes. Impervious surfaces, such as paved roads, compacted dirt roads, and roofs of houses, increase the amount of runoff and cause it to concentrate, especially when it flows from roof drains, inboard ditches along the roads, drainage pipes, and culverts. Such concentrated flow may form gullies, and delivers water to streams more quickly than if infiltration or dispersion had occurred. This leads to accelerated rates of erosion and sedimentation, as well as increased flood frequency. Numerous road drains have been observed to be draining into actively eroding landslides, and it is likely that they caused the slopes to fail.

Roads have also increased the total number of landslides in the watersheds. The coarse or granular nature of the loam soils and the lack of strength in the bedrock in some areas have made road cuts a slope stability problem when too much lateral support is removed from the hillside. Cut banks and fills on many of the abandoned dirt roads are especially prone to failure when little has been done to control surface runoff. The fill slopes of many of these roads have been washed out at stream crossings.



A gully can lower the water table

EFFECTS OF FIRE

Surface erosion

High intensity fires may cause more surface erosion than low intensity fires due to hydrophobicity. During intense fires a water repellent layer can be driven into the subsurface soils, coating the particles with a waxy organic compound that can range from a patchy to more uniform layer. Deterioration of the repellency may take longest in areas subject to high intensity burn, and in areas where animal burrowing and plant growth are slow to recover. The latter actions create flow paths for water to infiltrate through the hydrophobic layer. Intense burns that involve both the understory and the crowns of trees usually consume the leaves and needles, as well as the organic litter of the soil surface. When rain falls and hits the ground, the fine ash and sediment on the surface is washed downslope or worked into the interstices of the soil particles. This causes a slight sealing of the soil surface and further reduces infiltration and increases runoff. When the barren soils do not get covered by leaf and needle drop they remain barren and unprotected throughout the duration of the winter and possibly for a number of years until the vegetation recovers. This scenario may be most pertinent to the high intensity burn areas beneath bishop pine forests. Soil protection will happen more quickly in areas that supported a dense ground cover of grasses or herbaceous species, and in areas where fire intensity was low and leaf drop will continue.

Not all soil types that have extreme hydrophobicity will have severe erosion. Erodibility depends upon slope, drainage area, and soil properties such as particle size, cohesion from clays, and perhaps abundance and viability of small rootlets. Of course erosion rates also depend upon rain intensity and pattern of storms. Under average rainfall conditions, intensely burned soils on the natural hillsides of the Oakland Hills did not exhibit significant erosion unless the soils were disturbed during grading activities (Booker et al.,1993), or by goat grazing for construction of fuel breaks two years after the fire (Collins unpublished data). Such disturbance resulted in rapid and extensive rill formation on steep slopes.

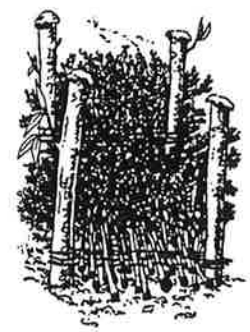
The soils of Inverness Ridge have properties that indicate rilling is likely on some of the more intensely burned sites, particularly on the steep slopes beneath bishop pine forests, where rill networks have already been observed. Only minor rilling has been observed in the other floristic environments, although there is much evidence of sheet flow. More prominent throughout the study area, however, is surface erosion caused by abandoned dirt roads. In these cases rills have formed on the cut banks and road treads, which have then continued across the natural slopes to form gullies that supply sediment directly to streams.

In the middle portions of Fish Hatchery Creek watershed, where vegetation is a mixture of hardwoods and Douglas fir, surface erosion appears to be of much lower potential than in the upper watershed. This is because the fire was mostly low intensity there and did not consume all the organic duff in the soil, or the leaves and needles in the trees. The soils, therefore, do not have well developed hydrophobicity; thus sheet flow is less likely, and there is more litter protecting the soil surface from raindrop impact. Rilling in this area has not been observed to date.

Presently it is not known how long the effect of hydrophobicity will last. The effect of the soil surface sealing by raindrop impact infiltration will be diminished by new plant growth and animal burrowing. The burrows of small rodents such as mountain beaver, gophers, and mice will also be particularly effective in breaking apart any uniform water-repellant layer. It is interesting to note that the long-term (and clearly noncatastrophic) movement of soils downslope may actually be greater by biological activity than by landsliding and surface erosion, the latter of which are more limited in time and space.

Landsliding

Landslide potential following fire is, in part, related to vegetation type (Inverness Ridge supports a variety of plant species associations, as discussed in Chapter 6). Roots of vegetation greatly add to the cohesion and strength of the soil and ability of colluvium to resist sliding. The effects of the Vision Fire will result in a patchiness of dead, stressed, and recovering vegetation. As the roots of different tree and brush species decay, the soil-root fabric will progressively weaken. Plant roots increase slope stability by anchoring the soil to the bedrock, by crossing zones of weakness to more stable soils, by providing interlocking fibers that bind the soil (Zeimer, 1978), by buttressing the soils, and by removing soil moisture. In soils deeper than roughly 25 feet, the vertical anchoring roots may become negligible, but the lateral effects still predominate. Zeimer reports that soil strength has been known to decrease by 50% in some areas of the northwest that have been deforested. The re-establishment of vegetation with strong root networks is key to maintaining slope stability.



brush mat

While the roots of the old forest decay, the roots of new seedlings are too small to significantly increase soil cohesion. Where regeneration depends on germination from seeds, such as the bishop pine forest, the greatest probability of landsliding will occur after dead roots rot and before the new seedlings add significant root strength to the soil. Roots of Douglas fir are known to take about five to seven years to decay after the tree dies. Many Monterey pine trees were observed to break at their roots three years after being burned in the Oakland Hills Fire. Bishop pines may take three to five years to rot. Thus, landslide potential may be at its greatest in three to five years on hillsides covered with dead stands of bishop pine, especially if the water repellant characteristics of the soil have diminished.

In areas of the hillsides that have fire-adapted vegetation with a high proportion of sprouting species — coastal scrub, for example — the mature viable roots continue to maintain some soil strength. The potential for an increased incidence of landsliding in one of these vegetation types is lower than in areas without a high preponderance of sprouting individuals.

After the fire, the lack of both plant interception of rainfall and transpiration of soil water from the leaves of plants would initially cause concern that soils will become saturated sooner in winter and remain saturated longer into spring, thereby extending the time period of landslide risk. Yet, landslide potential in areas that have hydrophobic soils may be lowest during the first years after fire because of reduced infiltration and thus low potential for saturated conditions. Conversely, soils not exhibiting hydrophobicity may have an increased landslide potential during the earlier post-fire years. Root decay rates and abundance of viable roots of the predominant vegetation will be a key factor in any probability analysis for either case.

Stream flow

The most dramatic change associated with streams is the rapidity at which rainfall reaches the channel and flows out of the watershed. For a given magnitude of storm, a burned watershed will have much higher peak flows and lower base flows than a healthy vegetated watershed. The sheet flow that occurs over much of the watershed during intense or prolonged rainfall has caused many of the small headward channels to erode upslope, effectively increasing the length of the drainage network. This may lower the amount of base flow in perennial channels during the summer drought and the location and existence of springs at the heads of channels could be altered.

In the Muddy Hollow headwaters some channels have already removed much of their alluvium and scoured to bedrock. As a result many of the banks are being undercut. This may lead to bank collapse and channel entrenchment. In some areas where the bedrock is highly weathered, the incision has been as much as several feet during December and January.

Many of the channels in the Inverness Ridge have notched profiles. As a result of increased peak flows some of these nick points have been destabilized and are migrating upstream, causing channels to incise. Tributaries will adjust to a changes in base level of their main stream. So, if a channel incises, its tributaries may have nick points that propagate upstream and similarly become entrenched.

Channels in the mid segments of the watersheds seem to be alternating between localized areas of deposition (usually behind woody debris jams), headward migrating nick points, and incision to bedrock. Most of the sediment load appears to be transporting through the system.

In some lower watershed reaches, where channels are not entrenched, increased deposition of sediment on bars and floodplains is expected and has been observed in the Muddy Hollow drainage just upstream of the reservoir pond near Limantour Estero. Entrenched channels have functioned primarily as transport reaches rather than depositional reaches. Visual comparisons of unburned and burned creeks have indicated that the sediment load appears much higher in the watersheds that have had the greatest extent and intensity of fire.

It is worth noting that one of the principal processes that leads to early winter mudflows in granitic terrain of Southern California has not been observed in the Inverness area. In Southern California dry ravelling of soil and rock during and immediately after fire causes channels to fill with loose sediment (Wells, 1981). When rainfall finally occurs, the flows are immediately loaded with the loose materials. After the fire in Point Reyes, numerous channels were field checked for deposits of dry ravel in the stream beds. The only significant occurrences of ravel deposits were associated with large trees that had fallen from steep hillsides along v-shaped canyons, where the root boles pulled the soil from the slope and caused it to ravel into the channel. Where channels were flowing along narrow but flat-bottomed valleys adjacent to steep-sided hillsides, sediment did not get into the channel.

CAUTIONS ABOUT EROSION CONTROL PRACTICES

■ MANY TECHNIQUES AND COMMERCIAL PRODUCTS ARE AVAILABLE for erosion control. The choices include seeding, jute or fiber netting, excelsior with nylon netting, geotextiles, straw mulch, spray-on mulch with seed mixtures, straw bales, check dams, sandbags, and plastic sheeting. Some of these measures may be most timely and effective in the urban zone during the period of reconstruction and landscaping. But it is important to recognize where some of these measures are not useful, where they may cause more sediment disturbance than if they had not been used, and where they may solve one problem but create another. Some examples follow.

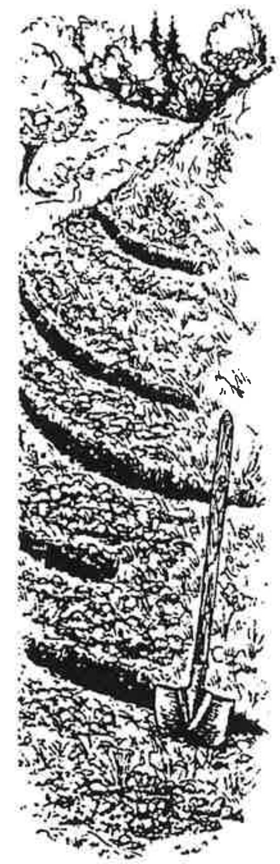
Many surface erosion control measures are designed to increase infiltration and reduce runoff. These kinds of remedies should not be applied to areas that are potential sources of debris flows or other kinds of landslides. In such areas, enhanced infiltration increases the duration of soil saturation, which in turn increases landslide risk.

If a landslide-prone area is covered with an erosion control fabric, it may become difficult to monitor for evidence of increasing hazard, such as cracking ground and shifting soil. Additionally, many fabrics get lifted off the soil by new plant growth. If the netting or mat is not in contact with the soil surface, it is virtually useless because it cannot prevent surface erosion and it may inhibit recovery of the vegetation.

Check dams have often caused more problems than they have solved, particularly if they are not placed according to guidelines indicaded in standard erosion control manuals. They are rarely maintained. They are commonly undercut and lack the strength to survive winter flows. Their failure can cause more erosion than would occur in the absence of unnatural control measures and it can cause cumulative impacts. Some check dams are designed to be only temporary, but they also require regular maintenance. Straw bale dams used extensively for temporary erosion control in the Oakland Hills Tunnel Fire, for example, caused more erosion than if they had not been used (Collins and Johnston, 1995).

Plastic sheeting is often used in great quantities to prevent water from infiltrating into a landslide or to protect from surface erosion. The sheeting, however, creates concentrated runoff along its downhill edge, which often results in the formation of rills and gullies just downslope of the area being protected. Methods of erosion control should not be used if they are likely to transfer a problem from one property to another, or if they are temporary measures applied to chronic problems. The cost of temporary solutions frequently exceeds the cost of good stewardship.

Grass seeding and mulching is often used to prevent surface erosion, but keep in mind that introduction of fast growing species can inhibit the recovery of some native plant species (see pages 37-38). When seed is applied it is most effective at reducing erosion after it has grown to sufficiently cover the soil surface and the roots have become interlocked. Thus little soil protection will occur in early to mid winter unless irrigation is used to achieve sufficient growth before the onset of rains.



Contours

LANDSLIDE HAZARD MAPPING WITHIN THE URBANIZED BURN ZONE

■ Existing and potential landslide hazards and surface erosion features within the urbanized burn zone of Drakes View Drive were mapped in the field during December 1995 and January 1996 (Map 4, map insert section). Culvert locations were also noted. Color, aerial stereo photographs that were taken November 6, 1995, were also used to interpret the landscape.

The base map was computer-generated from a set of digital line craft data from the U.S. Geological Survey at a scale of 1 inch = 1000 feet. During my field work, I found that the base map was not very accurate for the Ridge area. The map was especially inaccurate with regard to slope steepness. The error of the map has not been quantified. Therefore, spatial relationships among landslides and property boundaries should be regarded as approximations.

Map 4 shows the existing geomorphic conditions. Yellow segments represent colluvial hollows and areas of deep soils. These features have gentle to moderate slopes in most cases. Among the features mapped, the yellow areas have a low probability of failure, but higher than the surrounding undesignated slopes due to the concentration of ground water along the centerline of the hollow.

Orange segments represent colluvial hollows or debris flow scars that are usually steeper in slope, presently inactive, and possess a moderate probability of failure. Road drains along Douglas Road may exacerbate these sites. Places where roads cross orange segments could be subject to fill failures.

Red segments show recently active landslide scars and deposits. These may continue to move. Most of these features are related to debris flow, but some are associated with abandoned roads.

Culverts are shown as green dashes across the road network. The arrows point from the culvert outflows. The map shows that some of the culverts are discharging water into active slides.

Black dotted areas are sites that were identified as exceptionally steep with ravelling soils. These sites are subject to high surficial erosion rates and if saturated or undercut could become sites of future landslides. ■

References

Booker, F.A., W.E. Dietrich and L.M.Collins, 1993. Runoff and erosion after the Oakland Firestorm, expectations and observations, in California Geology, 1993, v. 46, p. 157-173.

Collins, L.M. and C.E. Johnston, 1995. Effectiveness of straw bale dams for erosion control in the Oakland Hills following the fire of 1991, in Brushfires in California wildlands: ecology and resource management, edited by J.E. Keeley and T. Scott. International Association of Wildland Fire, Fairfield, Washington, 1995, p. 171-183.

Ellen, S.D., 1988. Descriptions and mechanics of soil slip/debris flows in the storm, in Landslides, Floods, and Marine Effects of the Storm of January 3-5, 1982, in the San Francisco Bay Region, California, U.S. Geological Survey Professional Paper 1434, 1988, p. 63-112.

Ellen, S. D., S. H. Cannon, and S. L. Reneau, 1988. Distribution of debris flows in Marin County in Landslides, Floods, and Marine Effects of the Storm of January 3-5, 1982, in the San Francisco Bay Region, California, U.S. Geological Survey Professional Paper 1988, 1434, p. 113-131.

Evens, J.G., 1988. The Natural History of the Point Reyes Peninsula, published by Point Reyes National Seashore Association, 226 p.

Galloway, A.J., 1977. Geology of the Point Reyes peninsula, Marin County, California, Bulletin, 202 California Division of Mines and Geology, 71 p.

Reneau, S.L., and W. Dietrich, 1987. The importance of hollows in debris flow studies: Examples from Marin County, California, in Costa, J.E., G.F. Weiczorek, eds., Debris flows/avalanches: Process, recognition, and mitigation: Geological Society of America Reviews in Engineering Geology, 1987, v. 7, p. 165-180.

Reneau, S. L., W. E. Dietrich, D. J. Donahue, A. J. Timothy Jull, and M. Rubin, 1990. Late Quaternary history of colluvial deposition and erosion in hollows, central California Coast Ranges in Geological Society of America Bulletin, V. 102, p. 969-982.

Rypins, S., S.L. Reneau, R. Byrne and D.R. Montgomery, 1989. Palynologic and geomorphic evidence for environmental change during the Pleistocene-Holocene transition at Point Reyes peninsula, central coastal California, in Quaternary Research, 1989, v. 32, p. 72-87.

Sugnet, P.W. and R.E. Martin, 1984. Fire history and post-fire dynamics of the Inverness bishop pine ad Point Reyes National Seashore, U.C. Berkeley department of Forestry and Resource Management. Report to Gary Fellers, Point Reyes National Seashore. 86 p.

Wells, W.G., 1981. Some effects of brushfire on erosion processes in coastal southern California, in Erosion and sediment transport in Pacific steeplands: International Association of Hydrologica Sciences Publication no. 132, Christchurch, New Zealand, p. 305-343.

Zeimer, R.R., 1978. Hand-out on root strength given during a presentation by R. Zeimer at California State Capitol Building during 1978, 8 p.

6 :: FINDINGS & RECOMMENDATIONS, SITE-WIDE

This chapter represents collaborative effort on the part of all Phoenix Team members, primarily Ray Moritz, Laurel Collins, and Tom Gaman.

■ TO OFFER GUIDELINES FOR PLANT COMMUNITY RESTORATION and fire hazard management for specific forest or brush types within the Vision Fire burn zone, this section of the Phoenix Report describes each vegetation type, outlines the forest succession that is probable in each, and describes fire hazard management actions appropriate to each. Recommended actions appropriate to each neighborhood are detailed in Chapter 8.

VEGETATION TYPES

■ PLANT COMMUNITIES ARE NOT STATIC: they go through a series of successive changes as they regenerate, compete for dominance, mature, decline, and die. They may replace themselves or succeed to a different mix of species or to an entirely different vegetation type. The development of future plant communities is determined by the ecology of the ecosystem and biology of the species; by natural events like storm, drought, and fire; by browsing pressure from animal species; and by human intervention through seeding, landscaping, invasive exotic plant introduction or eradication, and landscape management. The species composition and vegetation type structure of the various stages of maturation can be manipulated through management. Specific actions depend upon the objectives of the property owners.

Ecological succession is the evolution of communities, or development of the ecosystem. It involves changes in species composition, structure, and plant/animal community processes over time. Succession may be orderly and predictable; it may be periodically disturbed or interrupted by physical agents such as fire and storms or biological agents such as pest and disease epidemics. Over the long term, succession is community controlled. The community modifies the physical environment, making conditions more favorable to a succession of new populations until a stable, self-replacing population (for instance, a climax bay forest) establishes an equilibrium between the biotic and physical elements of the habitat. Such equilibrium may last until another disturbance occurs.

Biodiversity refers to the richness or variety in an ecosystem — not only the number of species but also the number of individuals of each species, the age classes, and the complexity of the mosaic of these various components. It is difficult to generalize about biodiversity relative to succession and disturbance regimes. Generally, species diversity increases through the developmental stages to the mature stages of succession. However, spatially limited disturbance, e.g., fire or storm damage, creates a diversity of age classes, community structure, and successional stages within a region. This variation creates an aesthetic impression that is pleasing to the eye and heightens our enjoyment of the landscape. Some valued plant communities, such as the bishop pine forest, may decline and disappear without disturbance.

In the area of Inverness Ridge affected by the Vision Fire, principally four of the many vegetation types found on the Point Reyes Peninsula co-mingle. Here they are discussed in terms of their characteristics; the behavior and effects of the Vision Fire; and the vegetation response and successional trends that are consequences of the fire.

With the return over time of vegetation to burned areas, fire hazards inevitably rise again. In rating fire hazard, we employ a Marin County scale in which the numerical values 1–9 are assigned to each of five factors (aspect, slope, and fuel type in each of three defensible space zones) then summed. This system is illustrated in Appendix 8. Higher numbers mean higher fire hazard.

Presented here, for reference as you read the descriptions of plant communities, are a table and graph depicting this increase in fire hazard due to natural succession in the plant communities affected by the Vision Fire.

Fuel Type	Prior	1st year	3rd year	10th year	Long Term
Pine with Undergrowth	34	18	23	30	32
Hardwood with Undergrowth	29	15	19	25	29
Hardwood	22	15	17	20	22
Coastal Scrub	28	10	19	23	28

Table 1: Average Succession of Fire Hazard Ratings by Type. Assessments were made during the Phoenix study for burned areas within 100 feet of structural envelopes. This table illustrates that, because the Vision Fire consumed fuel loads, the fire hazard rating in each forest type in the burn area declined dramatically. Over time, however, as the vegetation regrows, hazards will increase (without management) to levels found before the fire.

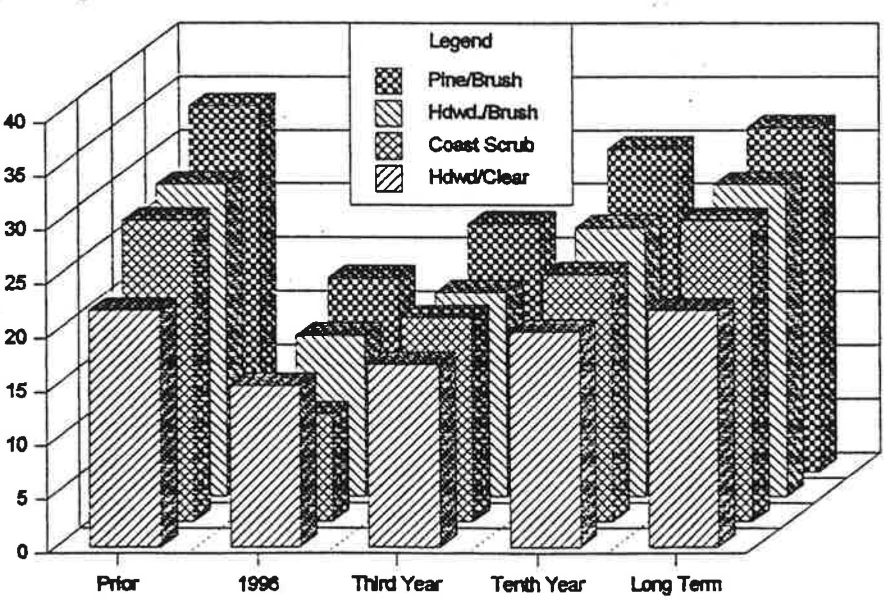


Figure 1: Fuel and Fire Hazard Succession. This 3-D graph provides another view of the relationship between fire hazard (the vertical scale labeled at left) and passing time (the horizontal scale labeled across the bottom). The four plant communities, each given its own shading, are arranged from front to back in order of natural fire hazard, with the lowest, Hardwood Forest, found in the front row. As you move from left to right, notice the drop in fire hazard in the first year following the Vision Fire, and the ultimate rise to pre-fire levels over time. Managed succession can keep fire hazards at lower levels around human habitations.

Bishop Pine Forest with Heavy Undergrowth

PRE-FIRE CHARACTERISTICS: Forest values are very high in this type. It is regarded as having the highest aesthetic value on the Ridge, with high, craggy, sea-blast sculpted canopies that are home to birds of prey, the western grey squirrel, woodpeckers, finches, and other wildlife. As we have learned, though, its beautiful architecture is also its undoing: it is very welcoming to powerful conflagrations. This forest / fuel type has the most severe Marin County Fire Service rating, ninth in a fire severity scale of nine (see Appendix 8 for an explanation of ratings). Bishop pine forest typically occurs along ridge tops and droughty slopes where soils are excessively drained and low in nutrients, and where fire historically killed the overstory and created the conditions for bishop pine regeneration every 30 to 80 years. In the absence of fire, Douglas fir forest is regenerating more successfully than bishop pine and, where the two types meet, firs are encroaching upon the pine forest.

FIRE BEHAVIOR: The Vision fire reached its greatest intensity, very high rates of spread, and produced a blizzard of fire brands in the old bishop pine forest. Crowning fire was most common in this type and reached extreme intensity. The fire was rarely controlled in pine dominated forest and no homes were saved in pine forest where defensible space work had not been done.

FIRE EFFECTS: Usually more than 90% of the forest canopy was killed. At least 90% of forest understory brush and fern canopy was consumed. According to the National Park Service, soils in this forest type experienced extreme heating, consuming most of the duff layer, seed reservoir, and surface soil organic matter. In some areas a hydrophobic (water-repelling) layer was formed a few inches below the soil surface. Since most of the bishop pines have died, the input of organic material by needle drop will be minimal for several years. Surface erosion potential may continue to be high for several years.

VEGETATION RESPONSE: *Forest Cover* — Pine reproduction is extensive but clustered. Tan oak reproduction by seed has not been observed, and stump sprouting is minimal. Bay tree reproduction by seed has not been observed, and stump sprouting is moderate. *Understory Vegetation* — About 95% of the understory plants stump sprout (huckleberry, coffeeberry, some manzanitas, some ceanothus, live oak, tan oak, and bay). Ferns sprout from their rhizomes (roots). Where grasses were seeded, they are growing vigorously (and are depressing regeneration of bishop pine seedlings).

SUCCESSIONAL TRENDS: The pre-fire bishop pine forest was in a state of decline. The canopy had opened through mortality of pines. Underbrush and hardwoods had increased to almost complete coverage and at least ten feet in height. Pine was decreasing its presence and hardwoods were expanding their presence. The successional trend without fire was from pine to hardwood.

POST FIRE FOREST/FUEL SUCCESSION: *Prior Type* — Declining pine forest with heavy undergrowth. *First Year* — Grass, fern, sprout, and tree seedling dominated. Exotics invasion. *Third Year* — Grass, fern, medium shrub sprout, tree sapling dominated. Exotics. *Tenth Year* — Juvenile pine, mature brush dominated. *Long-term* — Pine with shrubby undergrowth. Pine representation will increase as the seedlings mature.

Mixed Hardwood Forest with Heavy Undergrowth

PRE-FIRE CHARACTERISTICS: This forest type is dominated by coast live oak, tan oak, and bay, with scattered Douglas fir, alder, and pine in the forest canopy. The understory is dominated by coffeeberry, huckleberry, blackberry, hardwood reproduction, and sword fern, with minor components of poison oak, ceanothus, hazel, and other shrub species. Mixed hardwood forest is home to large numbers of deer, rodents, and other native wildlife. It typically occurs in valley bottoms, along side slopes, and on ridge tops at lower elevations

FIRE BEHAVIOR: This forest/fuel type is relatively less dangerous than bishop pine forest. On Inverness Ridge it exhibits greater fire resistance than its rating (moderately severe to severe fire danger) over most of Marin County would suggest. The Vision Fire reached only moderate intensities in this forest/fuel type, with moderate rates of spread and moderate resistance to control. Crowning fire was uncommon in this type. Typically more than 90% of the vegetation in this type was crown-killed (that is, crown portions of the plants were killed). Study of the fire zone showed that almost invariably the fire was controlled and homes saved where hardwoods dominated the forest cover.

FIRE EFFECTS: Within the fire zone more than 70% of the forest canopy was killed. At least 90% of the understory brush and fern canopy was consumed. The soils experienced moderate heating, consuming much of the duff layer.

VEGETATION RESPONSE: *Forest Cover* — Tan oak reproduction by seed has not been observed, and stump sprouting is minimal. Bay reproduction by seed has not been observed, and stump sprouting is moderate. Coast live oaks and bays that did not experience intense charring are sprouting new canopies. Tan oaks are less likely to resprout. *Understory Vegetation* — About 95% of the understory plants stump sprout (huckleberry, coffeeberry, some ceanothus, oak, tan oak, and bay) or in the case of ferns rhizome (root) sprout.

SUCCESSIONAL TRENDS: In other parts of Marin County, Douglas fir is invading this forest type and, without intervention, will eventually dominate many mixed hardwood forests. On Inverness Ridge, however, these mixed hardwood forests will likely replace themselves. Douglas fir will increase its presence somewhat in burned hardwood forest where it was present before the fire. Bishop pine will become established in some areas.

POST FIRE FOREST/FUEL SUCCESSION: *Prior Type* — Mature forest with undergrowth. *First Year* — Grass, fern, sprout, and tree seedling dominated. Exotics may invade. *Third Year* — Grass, fern, medium shrub sprout, and tree sapling dominated. Exotics. *Tenth Year* — Juvenile tree, tall resprout, and mature brush dominated. *Long-term* — Hardwood with undergrowth dominated. Douglas fir and (less likely) pine may increase their presence.

Hardwood (including Bay Climax) Forest with Sparse Undergrowth

CHARACTERISTICS: This forest type is dominated by bay, tan oak, and coast live oak, or by pure bay. The understory may have scattered coffeeberry, huckelberry, blackberry, hardwood reproduction, and sword fern, with minor components of hazel and other shrub species. Climax bay forest typically is dominated by sword fern in the understory. Non-bay hardwood forest is home to deer, rodents, and other wildlife. This forest/fuel type is rated as quite fire-resistant, a rating of two on a nine-point severity scale. Fire entering this type typically dies down to a creeping fire with short flame lengths. These forest types typically occur on damp, north-facing side slopes, valley bottoms and at lower elevations.

FIRE BEHAVIOR: The Vision Fire reached low moderate intensities, with low moderate rates of spread in this forest/fuel type. Fire exhibited low moderate resistance to control. Typically, only duff, scattered brush, and down and dead debris were consumed in the fire zone. Crowning fire was rare in this type. Study of the fire zone showed that almost invariably the fire was controlled and homes saved in this type.

FIRE EFFECTS: Within the fire zone more than 70% of the forest canopy was killed (although the bays are basal sprouting). At least 90% of the understory brush and fern canopy (aerial parts of plants) was consumed. The soils experienced low heating, consuming only the surface of the duff layer, scattered brush, and down and dead debris.

VEGETATION RESPONSE: *Forest Cover* — Tan oak reproduction by seed has not been observed, and stump sprouting is minimal. Bay reproduction by seed has not been observed, and stump sprouting is good. Coast live oaks, madrones, and bays that did not experience intense charring are sprouting new canopies. Tan oaks are less likely to resprout. The climax bay forest will resprout with multiple stemmed trees where the mature trees fail to crown sprout. *Understory Vegetation* — The sparse understory plants stump sprout (huckleberry, coffeeberry, oak, tanoak, and immature bay) or, in the case of ferns, rhizome (root) sprout.

SUCCESSIONAL TRENDS: The successional trend in these forest types was self replacement, and on Inverness Ridge they will likely replace themselves.

POST FIRE FOREST/FUEL SUCCESSION: *Prior Type* — Mature trees with sparse undergrowth. *First Year* — Tree resprout, fern, shrub resprout, and seedling dominated. *Third Year* — Fern, medium shrub sprout, and tree sapling dominated. *Tenth Year* — Juvenile tree, tall resprout, fern, and sparse mature brush dominated. *Long-term* — Hardwood with sparse undergrowth dominated.

Coastal Scrub

CHARACTERISTICS: This type is dominated by coyote bush, coffeeberry, poison oak, and blackberry, with minor components of toyon and other species of shrub, herb, and grass. It supports a wide variety of wildlife including deer, gray fox, white-crowned sparrows, wrentits, woodrats, rabbits, moles, shrews, and other rodents. This fuel type is rated as moderately flammable, a rating of five on a nine-point severity scale. Fire entering this type typically has a low to moderate rate of spread with moderate flame lengths. These types typically occur on ridges, side slopes, and valley bottoms exposed to sea blast.

FIRE BEHAVIOR: The Vision Fire reached low moderate to high intensities in this fuel type, with low moderate to extreme rates of spread and low to very high resistance to control. Typically, the only fire-available fuels were fine brush, twigs, standing dead plants, and down and dead debris.

FIRE EFFECTS: Within the fire zone more than 90% of the shrub canopy (i.e., fine brush) was consumed; root systems and root crowns survived. The soils experienced low heating, consuming only the duff layer and down and dead debris.

VEGETATION RESPONSE: About 95% of the coastal scrub plants stump sprout or, in the case of ferns and grasses, rhizome (root) sprout.

SUCCESSIONAL TRENDS: The canopy of this brush had almost complete coverage, and the successional trend was self-replacement.

POST FIRE FOREST/FUEL SUCCESSION: *Prior Type* — Over-mature coastal scrub. *First Year* — Shrub resprout, grass, and seedling dominated. *Third Year* — Medium shrub sprout and grass dominated. *Tenth Year* — Mature brush dominated. *Long-term* — Mature brush with excessive deadwood.

Douglas Fir Forest

In addition to the principal forest types found in the burned area of Inverness Ridge, Douglas fir occurs as a minor but significant element in all the neighborhood units of the study area. The only unit containing developed areas where fir forms substantial stands, along the spines of the main and secondary ridges, is Unit 8 (whose prevalent plant community is Mixed Hardwood with Undergrowth). The fir overstory is generally very open and breaking up (i.e., growing old and falling apart due to windthrow, limb loss, and top loss). A dense secondary canopy of hardwoods and occasional young Douglas fir has formed. Most of the fir stands have a dense undergrowth of huckleberry, coffeberry, blackberry, hardwood, and occasional Douglas fir reproduction.

In the heart of its natural range Douglas fir can live more than 1,000 years (350 years is common) and reach heights of 300 feet, but in the southern reaches of its range, like Marin County, it begins to decline and break up at 100 years old and 100 feet tall.

Our investigation found extensive root rot and abnormally fine, fibrous root growth in trees 115 years old. In addition, development and tree removal have opened the stands, making them more exposed and vulnerable to tree throw by strong winds. Windthrow, as well as top and branch failure, are common in this forest type. We found many trees hazards near homes, roads, and drives.

FIRE BEHAVIOR. The Vision Fire moved into Unit 8 under less extreme fire weather than prevailed during the early, severe stage of the fire. Fire behavior on the Drakes Summit ridge was moderate to low in intensity with relatively low rates of spread.

FIRE EFFECTS: Mature Douglas fir is more fire-tolerant than bishop pine. Its bark is more insulating, so the living tissue under the bark is usually protected from damage by moderately intense fires. Only about 15% of the fir overstory was killed in the Unit 8 sector of the Vision Fire zone. About 50% of the undergrowth crowns (not root stocks) were killed.

SUCCESSIONAL TRENDS: Surprisingly, and opposite to the successional trends in most of Marin County, in most of the developed portions of the study area Douglas fir is declining , and mixed hardwoods are increasing their presence. Douglas fir is reproducing in some disturbed sites such as roadcuts and landslides, sometimes in "doghair thickets." Doghair reproduction will be slow to mature because of excessive competition of available light, water, and nutrients.

POST FIRE FOREST/FUEL SUCCESSION: The reproductive success of fir on disturbed sites may indicate that it will increase its numbers on fire-disturbed sites. We observed no fir reproduction, but this may appear later in the spring. Fir reproduction will have stiff competition from resprouting shrubs, seeded grasses, opportunistic exotics, and hardwood trees. We expect most of the mature fire-exposed firs will survive, but they will continue to decline and will suffer increased windthrow due to further opening of the forest from fire mortality, bulldozer clearing and damage to root systems, and other removal.

Without management we expect the following successional stages: *Prior Type* — Declining fir forest with heavy undergrowth. *First Year* — Remnant overstory with grass, fern, resprout shrubs, tree seedlings, and pioneer exotic plants dominated. *Third Year* — Grass, fern, medium shrub sprouts, tree seedling, and exotics dominated. *Tenth Year* — Mature brush, fern, tree sapling, and exotic shrub dominated, with down and dead fuel loading. *Long-term* — Hardwood dominated with mixed fir and heavy undergrowth, and heavy down and dead fuel loading.

RECOMMENDATIONS: Follow general restoration recommendations (below) and specific measures for pine forest, plus: 1) all mature and over-mature Douglas fir within reach of potential targets of value should be inspected for hazard potential; 2) young doghair fir stands should be thinned to reduce competion, increase survival, and acclerate growth; and 3) old fir stands should be replanted with local stock from thinning or seed to preserve this valued plant community.

STRATEGIES FOR FOREST RESTORATION

■ THE FOLLOWING STRATEGIES FOR FOREST RESTORATION were specifically designed for the plant communities within the area of Inverness Ridge assessed in this study. If left alone, the forests will likely contain more invasive exotic plant species (see below), fewer pines and firs, and plants in stressed and stunted thickets. Managed succession, on the other hand, is an effective strategy for promoting recovery of native plant communities while producing a fire-safe environment (two goals that can be accomplished at the same time).

Management actions chosen will depend upon the goals and objectives of the property owners, and there are several considerations to weigh. The health and composition of plant communities is one; the watershed (slope stability, erosion) is another; and minimizing fire hazard is a third. The focus of this section is restoration of the plant communities in conjunction with fire hazard management.

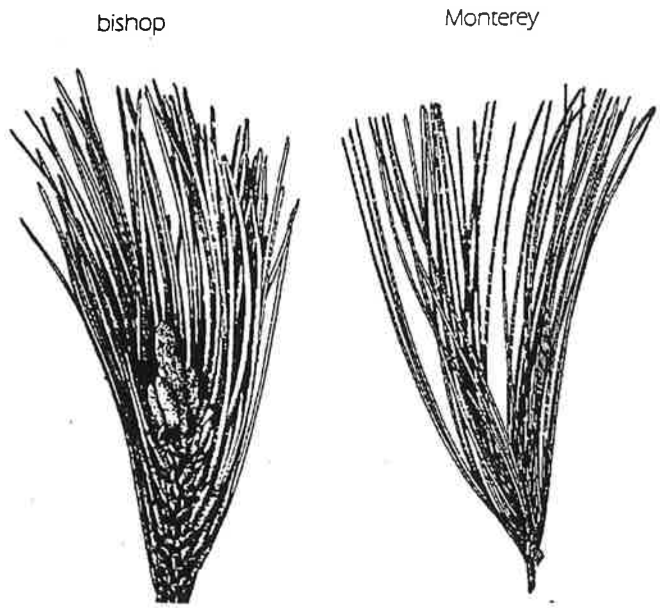
Invasive Exotic Plants

Because of our emphasis on native plant communities, this report often recommends control or removal of non-native plants,* especially species that compete with native plants and produce unwanted fuel loads. We define these "ecological weeds" as *invasive exotics* throughout this report.

The invasion of exotics in the fire zone has been rampant in post-fire Inverness. This is especially true along active and abandoned roads. As part of the post-fire mitigation effort, grasses have been introduced over wide areas where they will compete with native vegetation and obstruct restoration of the native plant communities.

The Phoenix Team has observed that heavily seeded areas have produced thick stands of grass that have inhibited pine and other native plant reproduction from seed. Grass will rob the soil of nutrients and water needed for successful native plant establishment and survival. At the same time we have observed no difference in erosion and soil stability between seeded sites and areas with natural grass recovery. The seeding has created a problem in that it has introduced species not native to the study area. The presence of grass also exacerbates the ignition and rapid spread of

*While certain non-native species are genuinely invasive and, if left unchecked, can damage entire ecosystems (an example is Scotch broom), other non-native or uncommon plants may sprout following the fire's disruption that are desirable in a restored landscape (coast redwood or live oak seedlings would be examples).



Needles in packets of two (bishop) versus usually three (Monterey)

wildfire in the first and subsequent years of community recovery. Grass seeding should be employed more sparingly and cautiously in the future, and excluded from most future post-fire mitigation programs.

When the rebuilding process gets under way, introduction of exotic invasives will become a worse problem. Weed seeds will be carried in on trucks and heavy equipment. Scarification (scraping, grading) of building sites, drives, and roads will provide habitat for invasive pioneer weeds.

The Phoenix Team concludes that we must start our exotics and weed control program now. We recommend the following operations:

1. Mow, weed whip, or pull all introduced grasses immediately and often. Do not allow them to reseed and spread. Do not sow grasses where they will interfere with natural regeneration: they have not proved to be necessary for erosion control. Perennial grasses (such as Zorro fescue) will need to be aggressively weeded out, especially around tree seedlings. Cutting will keep them from reseeding but will not eliminate them.

2. Dig out or precisely target with herbicides all thistle immediately, and patrol your property often. Do not allow thistle plants to form seed heads.

3. Do not introduce invasive exotic ground covers like ivy, honeysuckle, matress vine, ice plant, cape weed, *Hypericum*, *Gazinias*, *Vinca*, *Echium*, *Helichrysum bractiatum* (strawflower) and *H. petioloatum*, srawberry, geranium. Ask your nursery person about the invasiveness of the ground covers you select.

4. Remove brooms, *Cotoneaster*, Himalayan blackberries, *Echium*, and other exotic shrubs.

5. Monterey pines are reproducing agressively in the burn area (also in unburned areas). We recommend discrimination against this agressive species, which is not locally native and has created many arboricultural problems. You may not be able to distinguish Monterey pine seedlings from bishop pine seedlings, and you may have to wait a couple of seasons to differentiate these closely related speciese. Monterey pine has deep green needles in bundles of three (there are some bundles of two on this tree). Bishop pine has yellow-green needles exclusively in bundles of two.

6. We recommend against planting non-local bishop pines in the Inverness hills. They will pollute the local genotype and will not be well adapted to local conditions.

7. We recommend active discrimination against invasive non-indiginous trees like acacia and eucalyptus.

Mulch

The disposal of chipped materials is most efficiently disposed of by broadcasting it back onto the site.* It can then be spread as a mulch. It can be applied thickly (up to six inches) to areas where the property owner wishes to discourage weeds and grass. It should not be applied thickly (more than two inches) where the owner wishes to encourage seed germination and growth. We have observed inhibition of pine reproduction where wood chip mulch is thickly applied.

RESTORATION MANAGEMENT ::

GENERAL STEPS, ALL VEGETATION TYPES

■ This section provides sets of recommendations divided into three time periods: the first two years, years three through ten, and long term (i.e., through the 30th year).

Under each time period, find first a set of actions broadly applicable to each of the four plant communities. Immediately following this section, find recommended actions listed that are particular to certain vegetation types.

Years 1–2

In order to fulfill the goal of creating and maintaining a fire-safe environment, a number of management actions are appropriate during the first and second years. These include thinning and moving seedlings, selecting sprouts (no more than three dominant ones) to retain from each plant, and removing sprouts selected to remove. Through the culture of resprout trees and transplanting of seedlings the owner can design the eventual forest cover to his or her own needs and, where desired, reforest areas where regeneration has failed.

Entire shrubs should be removed to establish a suitable spacing from each other and from overstory trees. In contrast, plant material from areas of dense vegetation can be transplanted to augment vegetative cover. Fertilizing, mulching (including addition of soil amendments), and irrigation can accelerate plants' regrowth. To fight disease and pests, sick plants should be removed. Lastly, volumes of debris will need to be removed: this entails removal of dead stems of shrubs and other smaller dead material, and selectively culling some dead trees. In the first or second year it is important to restore roads, rehabilitate abandoned road beds, and selectively remove dead trees that pose a hazard to roads and structures. These can be control-burned in winter or spring with appropriate permits.

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* The practice of leaving as much carbon (wood) in the forest as possible is becoming widely recognized as a key factor in maintaining the health and vitality of forest ecologies. Leaving logs, duff, chips, and leaves in the forest recycles nutrients, promotes fungal and microbiological activity, and retains moisture in the soil, providing erosion control. Rotting wood acts as a sponge, storing water and promoting mycelium growth. The fungal mycelium, an extensive thread-like structure, aids in water retention by absorbing and storing water in its cells. It also reduces erosion by spreading throughout the forest floor and "knitting" the top soil together. Maintaining soil moisture is fundamentally important to reducing both risk of fire and invasion of chaparral species and other potential fuel load species, e.g., poison oak, scotch broom, coyote brush, and pampas grass. In addition, mycorrhizae are essential to many trees and other plants. In this symbiotic growth involving a fungus and a plant root, the fungus (as well as protecting roots against predators and pathogens) provides nutrients to the root in exchange for sugars provided by the root to the fungus. — *Penny Livingston*

Additionally, many cautions are required during this initial period after the fire. Crown trunk sprouts should be protected from deer and rodents to promote recovery of highly valued trees near structures. Residents should not over-fertilize or spray-irrigate trees and tree sprouts.

Resprout trees can be eliminated or cultivated; because of their well established root systems (particularly bay laurel), they are difficult to kill, tend to persist, and will grow rapidly. The dead stem should be removed as soon as possible and the sprouts should be thinned to the most vigorous, not more than three per stump. Younger trees with smaller diameters sprout more vigorously and ultimately grow mature second-growth trees that are more sound and stable. Single-stem regrowth tends to be better balanced and more structurally stable.

Trees that resprout from trunks, limbs, and branches — such as coast live oak and bay -- may continue to sprout and fill out over the next couple of seasons. They may be cultured to speed recovery. Sprout photosynthesis is important for feeding the tree in the first two years. Trunk sprouts that are not selected to become new branches should be removed after the second spring. In resprouting single-trunked trees (like redwood), a new leading stem should be selected from the multiple sprouts as soon as possible. Other crown restructuring and deadwood removal should occur after the second spring.

In any case, it's important to recognize that resprouting burned trees will look scraggly, like burned trees, for years to come.

Oak and pine seedlings can be transplanted easily for three years.

Shrub seedlings may be pulled in the first spring of growth or otherwise eliminated. Shrub reproduction may be unevenly distributed, and transplanting is an option for desired distribution of shrub coverage. The land owner should favor fire-resistant shrubs over highly flammable plants (see list, Appendix 2). Remove invasive exotics (see footnote on page #) if they become a problem.

Pyrophytic (flammable) shrubs should be removed from under pyrophytic trees or from a perimeter within ten feet of the dripline of such trees. In spacing shrubs, they should be separated from one another a distance of no less than twice the current height. Fire-resistant plants can be used as infill.

Shrub resprouts are managed in the same manner as resprouted trees (see above). The dead stem should be removed as soon as possible, and the sprouts should be thinned to the most vigorous — not more than three per stump. Spacing should be maintained as recommended for shrub seedlings.

Fertilization, mulching, and irrigation will accelerate the growth of any seed- or sprout-regenerated plants. Deep fertilization is best. Surface fertilization may encourage weed invasion.

Woody plants need only nitrogen for accelerated growth, but be careful not to over-fertilize with nitrogen. It can burn your plants and pollute runoff. It is better to siphon-inject moderate amounts of nitrogen into a drip irrigation system than to apply large quantities to the surface.

Mulching can help maintain soil moisture and provide a healthier root environment for plants, as well as reduce erosion. It can restore organic matter and compounds to fire incinerated soils. It aids water and nutrient retention, and it promotes a healthy soil fauna and flora. However, excessive incorporation of poorly composted organic matter into the soil can rob your plants of nitrogen and can slow regrowth. Manure composts should be well composted to avoid root burn, nitrogen loss, and the introduction of weeds and invasive exotics to the landscape. Heavy applications can inhibit plant recovery.

Soil amendments may be beneficial. Soils sterilized by high intensity fire can be reinjected with beneficial insects, bacteria, mycorrhizal fungi, and other soil organisms through transplanting from unburned Inverness Ridge sites or through inoculation with unburned soil. Be careful to collect only from sites where the plants are healthy and vigorous, so as not to transplant disease. Naturally, obtain permission before collecting young plants from a neighbor's property.

Irrigation may also ensure survival and rapid recovery of the plant community but is not necessary on trees and resprout stumps and can cause rot and disease during the summer months. For fern and herb ground covers, spray irrigation is fine. Drip irrigation is preferred for trees, however. During the summer, irrigation around mature oaks can cause root rot and should be avoided. Irrigation of seedlings is fine at any time of year.

Disease and pest control is best done through cultural practices and the least toxic means. Cultural practices include all the restorative actions discussed above that promote plant health and vigor, plus additional practices designed for disease and pest resistance.

The first and most effective action to fight these threats is to remove any pest- or disease-infested plants as soon as possible and avoid bringing infested and non-resistant plants into the landscape. Second, avoid daytime and warm-weather irrigation, particularly surface or spray applications. Plant pathogens are favored by a warm, moist environment. Third, improve air circulation through plant separation and crown thinning. Fourth, apply the least toxic pest control chemicals (such as Bordeaux Mix™ or Safer™). Apply the minimal amount needed to get full coverage. Pesticides are often toxic to non-target organisms; more is not better. In most cases the plants recover from disease on their own, especially if given a favorable environment.

Transplanting from outside the fire zone to sterilized areas within it is another option. Some sites burned with such intensity that little or no natural revegetation will occur for a long time. Transplants, even native plant species, will require more irrigation and general maintenance than plants seeded by nature. A rule of thumb is to water twice a week the first year and less the second year.

Fire-killed tree removal is not necessary for forest restoration. Logging, in fact, may damage otherwise stable soils. Wildlife trees (burned trees) may be valuable assets to the fire zone. The wildlife value of a tree may be enhanced through proper trimming and the mechanical creation of habitat; tree failure potential can often be reduced through thinning and balancing. Raptor (osprey) nesting can be encouraged through the creation of palmate tops for supporting nests. Bark should be stripped from the finger branches and crotch area to reduce the rate of decay. All cuts should be angled to shed water. Leave one or two finger branches longer for perches. Bat habitat can be created by making steep upward cuts through the bark and white wood of the trunks. Cavity nesting for rodents and birds can be enhanced through the mechanical creation of cavities with a chainsaw route tip or chainsaw drill.

Abandoned roads could be restored by putting the fill and side-cast soils up against the cut banks to trap eroding soil and begin the re-contouring of the road cuts. Chipping onto abandoned roads will help break up runoff and restore organic matter. The road tread could be disced to break up compacted surfaces, in order to increase infiltration. Alternately, slash could be packed against the cut banks. As part of restoring abandoned roads, planting is encouraged. We strongly **recommend not reopening abandoned roads if they will not be used and maintained.**

Years 3–10

During the third through tenth years less action is required, but management is still important to maintain a fire-safe environment that is ecologically sound.

Resprout trees — Raise crowns one-third of height, that is, prune the lower third of branches smaller than 3" in diameter. Remove dead and unwanted sprouts.

Shrub seedlings and resprouts — Continue thinning to attain crown-to-crown separation of twice the total height.

Fertilization, mulching, and irrigation may continue to speed growth.

Monitor for disease and pests, and treat as discussed above.

Years 11–30

The 11-30th-year period has a few significant major actions. Residents should thin pines and shrubs to spacing desired when vegetation is mature. Prune lower branches of trees and shrubs to ten feet, or above the grade at slope dripline. Raise crowns one-third of height (at least ten feet above grade at upslope dripline/tree canopy edge).

Resprout trees — Raise crowns one-third of height (at least ten feet above grade at up-slope dripline).

Shrub reproduction — Continue thinning for proper spacing (two times height).

Fertilization, mulching, and irrigation may continue to speed growth.

RESTORATION MANAGEMENT ::
STEPS SPECIFIC TO PARTICULAR VEGETATION TYPES

Years 1-2

PINE FOREST: Pine seedlings may be thinned and adjacent grass removed to reduce competition, increase survival, and accelerate growth. Irrigation will encourage exotics and an eradication program should be initiated.

COASTAL SCRUB: Through the culture of resprout shrubs and seedlings and the transplanting of seedlings, the coastal scrub cover can be designed, in part to revegetate areas where regeneration has failed. Shrub seedlings may be pulled during their first spring. Shrub reproduction may be unevenly distributed, and transplanting is an option for desired distribution of shrub coverage. Fire-resistant shrubs should be favored over highly flammable plants (see list, Appendix 2). Remove exotics. Shrubs should be separated from one another or maintained in groups not exceeding 18 feet in diameter and separated from one another for a distance of no less than two times the current height.

Years 3–10

PINE FOREST: Continue thinning pine seedlings to reduce competition. Seeding or transplanting to sites that fail to reproduce is an option. Raise crowns one-third of height.

COASTAL SCRUB: Seeding or transplanting to sites that fail to reproduce is still an option but more difficult. Continue thinning or clumping shrub seedlings and resprouts, with a maximum diameter of 15 feet and separation of two times the total height.

Years 11–30

PINE FOREST: Thin pines to final mature spacing. Raise crowns one-third of height (at least ten feet above grade at upslope dripline).

COASTAL SCRUB: Shrub reproduction — Continue thinning for proper spacing (two times height).

FIRE HAZARD MANAGEMENT :: SUMMARY

■ WITHIN THE LARGER ACREAGE BURNED BY THE VISION FIRE, a small part of the developed east-facing slope of the Inverness Ridge burned. Homes in the rest of the Inverness Ridge communities, as well as wildlands and watersheds, continue to be at serious risk.

The principles of modern fire ecology dictate that we must be respectful of both the natural environment and the power and peril of uncontrolled conflagrations. It is also now recognized that our passive, overly protective management of the land has had a tremendous impact on natural plant communities and has subverted natural processes, including periodic fire, leading to a decline in biodiversity and to destructive fires of unnatural size and intensity.

Antiquated strategies for fuel management (clearing, firebreaks, and bare mineral soil exposure) typically have conflicted with other aesthetic and environmental values: erosion control and slope stability, wildlife habitat preservation, the maintenance of biodiversity, forest restoration, and maintenance of the natural beauty of the many plant communities in which we live and work.

The Phoenix Team believes that homeowners can have a beautiful natural landscape and manage for fire hazard at the same time. Many of the same operations recommended for forest restoration are also recommended for fire hazard reduction.

Fire hazard management in the "urban/wildland interface" requires management of wildland and landscape vegetation to reduce the intensity and rate of spread of a potential wildfire to a level that can be suppressed with basic firefighting resources — a fire engine and three firefighters.

State law and local ordinances require that roads and drives provide adequate safe access and egress for emergency evacuation and response. They require that landscape vegetation be managed so as not to provide the rapid transmission of fire from the landscape to the structure or visa versa.

State Public Resource Code 4291 and Marin County Code Title 24 do not specify how defensible space around structures should be achieved. They require "clearing away...all flammable vegetation or other combustible growth," but "this subdivision does not apply to single specimens of trees, ornamental shrubbery, or similar plants which are used for ground cover, if they do not form a means of rapidly transmitting fire from the native growth to any building or structure." (PRC 4291(a)).

Creating defensible space around each structure, in fact, is essential for fire hazard management for residents and home-owners. It consists of managing vegetation in an area in order to calm fire behavior, reduce ignition of the structure, and provide space for firefighters to take defensive action. The size of the area needed to calm the fire depends on current vegetation type, topography, development density, and access. As the new (post-Vision Fire) plant community develops through various successional stages from a grass-dominated landscape to mature pine forest, the fuel type or "model" will pass through successional changes and require various types and levels of treatment to provide defensible space.

Study of the Vision Fire zone demonstrated that almost invariably the fire was controlled and homes saved where hardwoods dominated the forest cover. The fire was rarely controlled in pine dominated forest, and no homes were saved in pine forest where defensible space work had not been done.

The fire safety approach adopted here focuses on making fuels unavailable to a potential fire. There are four ways to make fuels unavailable to fire:

1) Favor fire-resistant plants, and discriminate against pyrophytic plants in your defensible space zone (see plant list, Appendix 2).

2) Remove dead or cured plants, and clean up down and dead debris.

3) Disrupt the horizontal and vertical continuity of fuels (plants). Separate shrubs and trees to provide space between plants to discourage the rapid horizontal transmission of fire across the landscape. Raise tree crowns, and clear or trim undergrowth to prevent the vertical transmission of fire into tree crowns. Use only highly fire-resistant plants adjacent to structures (the 0- to 10-foot critical zone; see below).

4) Maintain high fuel moisture through irrigation and deadwood removal.

Wildland areas outside the defensible space zones and roadside treatments may be managed to accelerate forest restoration and renewal in a manner similar to those recommended above but with a view toward reducing available fuels and achieving greater fire resistance.

DEFENSIBLE SPACE :: RECOMMENDATIONS

■ DEFENSIBLE SPACE IS THE AREA AROUND THE BUILDING(S) and other flammable structures on a developed property where you can prevent the rapid spread of high-intensity fire by reducing fuel loads. The area of defensible space needed depends on: general conditions, such as the area's topography, major fuel types, access, and development density; and site conditions, such as slope, aspect (direction of slope), and specific fuel type. Defensible space might vary from a minimum of 30 x 30 x 30 feet upslope, across slope, and downslope from the structural envelope in a low fire hazard zone to a minimum of 50 x 50 x 100 feet in a high fire hazard zone.

Defensible space consists of four fuel modification zones (defined by local Marin County Fire Department ordinance): 1-10 feet, 11-30 feet, 30-50 feet, and 51-100 feet from a structure. For fire hazard mitigation, there are six kinds of vegetation to address within the defensible space surrounding a structure, with some actions common to all four zones.

Actions Necessary in All Fuel Zones:

- Annual maintenance is very important in all zones. When "firescaping" is done properly, however, annual maintenance does not become a big chore.
- Remove deadwood, favor non-pyrophytic plants, and protect from construction the plants to be retained.
- Thin sprouts of trees and shrubs to three per stump, and space clumps of plants to two times their height.
- Thin seedlings to create a spacing of no less than two times the height of the crown.
- Prune lower branches up to ten feet in height, or in shorter plants one-third of the lower branches, until the plants reach 30 feet in height.
- Create spaces between trees so that crowns of each tree are separated by ten feet.

GRASS & HERBS — Mow to no more than six inches high. Mulch or remove cuttings.

BRUSH RESPROUTS & SEEDLINGS — Thin sprouts to no more than three per stump. Remove all deadwood. Thin to spacing of no more than twice the mature height.

TREE RESPROUTS — Thin sprouts to no more than three per stump. Remove deadwood. Thin to no less than ten feet crown-to-crown spacing.

TREE SEEDLINGS — Remove deadwood. Thin to no less than ten feet crown-to-crown spacing.

STANDING TREES — Remove deadwood. Keep only safe wildlife trees. Thin to no less than ten feet crown-to-crown spacing.

DOWN & DEAD TREES & BRUSH — Remove, chip, or multi-cut, and scatter all debris less than six inches diameter in defensible space zones. Maximize soil contact of all lop and scattered leaf material.

Actions Particular to a Fuel Zone

ZONE 1. The zone closest to the home is most crucial for structure survival and access for firefighters. Safe fire suppression access around the structure(s) must be provided, and the landscape must be highly maintained to prevent structural ignition from direct flame impingement. The landscape must also accommodate the design and materials of the structure, especially its fire-vulnerable features: post-supported structures and areas under decks should be free of all plants and debris; flammable plants should be avoided under overhangs and near windows. No flammable plants or trees should be placed against the structure. Branches should be pruned ten feet back from roof, chimney, and deck. Protect plants from construction.

Plants in this zone need to be the most fire-retardant and should not include any pyrophytes (flammable plants) that are high in oils and resins, such as pines and junipers, or any dead plants. While this zone can have specimen trees, its landscaping is best comprised of fire-retardant foundation planting. When irrigation is limited, use more of your available water in this zone than other zones. Plants with high moisture content are less likely to burn.

Avoid fire brand "beds of opportunity," such as debris or wood piles. Landscape construction should be of non-combustible materials. Non-flammable patios, walkways, rock, gravel, and mulch can be used as fuel breaks for this zone. Removal of all dead wood (on structural elements as well as in the garden) is crucial. Dead trees and brush can be cut and chipped, or multicut, and spread on the site as mulch. Alternately this material can be removed or burned in piles.

GRASS, HERBS — Mow to a height no greater than three inches.

BRUSH RESPROUTS & SEEDLINGS — Remove all pyrophytes. Keep highly fire-resistant plants only. No pyrophytic brush against structure.

TREE RESPROUTS — Keep sprouts of fire-resistant trees (thinned to no more than three per stump). Remove all deadwood and pyrophytic trees. Favor highly fire-resistant plants.

TREE SEEDLINGS — Remove all dead plants. Discriminate against pyrophytes. Favor highly fire-resistant plants. Favor hardwoods.

STANDING TREES — Remove all dead trees and pyrophytic trees. Limb up (raise crowns) to no less than ten feet above grade, and reduce crowns to ten feet from chimneys, roofs, decks, etc.

DOWN & DEAD TREES & BRUSH — Do not stack firewood in this zone.

ZONE 2. The zone 11-30 feet from the structure (or 11 feet to the property line) is the crucial working zone for structural defense: it operates as working area for firefighting and for egress for residents and firefighters. Minimal resources should be able to suppress fire in this zone. Provide for safe access and escape.

This is a well maintained, irrigated area of well spaced and trimmed fire-resistant plants. Favor low plants up to 18 inches high, such as fire-resistant ground covers, and separated clusters of well trimmed and deadwooded native or ornamental shrubs. Also, well maintained taller shrubs and trees, limbed up to a minimum of ten feet above grade, are permitted. Dead trees and brush can be cut, chipped, and spread on site as mulch. Alternately, this material can be removed or burned in piles.

GRASS, HERBS — Mow to three inches high.

ALL RESPROUTS & SEEDLINGS — Discriminate against pyrophytes. Create a green belt.

TREE SEEDLINGS — Thin to no less than twice the height of crown-to-crown spacing.

STANDING TREES — Remove all dead trees. Discriminate against pyrophytes.

DOWN & DEAD TREES & BRUSH — Remove, chip, multicut (to less than two inches in diameter and four inches in length), and scatter evenly over the site as mulching material; or pile-burn all debris.

ZONE 3. The area 31-50 feet away from the structure (or 31 feet to the property line) is a belt managed as a fuelbreak downslope, on sidehills, or between the structural envelope and heavy fuels. A single firefighting unit should be able to suppress fire in this zone. Break up horizontal (crown-to-crown) and vertical (ground-to-crown) fuel continuity. Manage vegetation as in Zone 2, with the addition of clusters of native vegetation, which are acceptable when separated by a distance of two times the height of the plants and when each cluster is smaller than 18 feet in circumference. All dead material should be pruned out of these clusters, removed, chipped or multi-cut (to less than two inches in diameter and four inches in length), and scattered evenly over the site as mulching material. Mulching also helps prevent grass and weed encroachment on the treated areas, helps maintain the soil moisture for the desired plants, and minimizes soil erosion. Dead material that is larger than six inches in diameter can remain.

ALL GRASS & CURED WEEDS — Mow or weed whip to a maximum stubble height of six inches. Mulch/remove cuttings.

ALL OTHERS — Exactly as in Actions Necessary in All Fuel Zones.

ZONE 4. The area 51-100 feet from the structure, or to the property line, reinforces defensible space closer to the structure wherever steep slopes, warm southwest aspects, heavy fuels, or poor access justify enhanced fuel management. The intent of vegetation management in this zone is to reduce the total fuel load and resulting heat output from a wildfire. Selectively remove and limb up trees and shrubs to break up the crown-to-crown and ground-to-crown continuity of fuels. Favor fire-resistant plants. Thin and deadwood the remaining trees and shrubs to reduce the total fuel load. Most other actions are the same as for Zone 3, e.g., multi-cutting for mulch and clusters of native brush.

ALL GRASS & CURED WEEDS — Mow or weed whip to a maximum stubble height of six inches. Mulch/remove cuttings.

ALL OTHERS — Exactly as in Exactly as in Actions Necessary in All Fuel Zones.

Actions Particular to Vegetation Type

In a very few instances, some specific actions particular to the plant community are required for defensible space beyond those summarized above.

Pine Forest with Heavy Undergrowth – Burned

IN FUEL MODIFICATION ZONE 4: Current State law and local codes can require only a maximum of 100 feet of defensible space. Depending on fire hazard factors, up to 150 feet of defensible space might be advisable.

Pine Forest with Heavy Undergrowth – Unburned

OVERALL: Grass, herbs - (This fuel type is absent in the mature pine forest.) Annually mow to 3 inches where present, and remove cuttings.

BRUSH IN ZONE 1: Highly fire-resistant, low-growing (18") shrubs are preferred in Zone 1

OTHER ZONES: *Standing trees* — Limb up (raise crowns) as high as possible, no less than ten feet above grade, and thin crowns to reduce total fuel load, as well as reducing crowns to ten feet from chimneys, roofs, decks. *Young trees* — Remove all deadwood; discriminate against pyrophytes; thin to no less than two times the height (at a given time) of crown-to-crown spacing.

Hardwood Forest with Heavy Undergrowth – Unburned

IN EACH FUEL MODIFICATION ZONE: In dense stands of sword ferns, cut down every third sword fern each year to provide a mosaic of fresh growth.

Hardwood Forest with Sparse Undergrowth – Unburned

This forest/fuel type tends to be fire-resistant, even the Bay Forest Climax type. If the trees are limbed up and deadwooded, then the dominant fuel that carries a potential for fire tends to consist of down and dead debris and old and dead sword fern fronds. An intact canopy will reduce light penetration and undergrowth.

IN EACH FUEL MODIFICATION ZONE: In dense stands of sword ferns, cut down every third sword fern each year to provide a mosaic of fresh growth.

ROADS AND DRIVES

■ IN A FIRE, MOST OF THE DEATHS AND INJURIES TO CITIZENS OCCUR ON DRIVES AND ROADS. The ability to evacuate areas safely and fight interface fires is dependent on having roads with adequate width, turning radii, turnouts and turn-arounds, and proper vertical and horizontal clearance.

The Inverness Ridge generally has poor to very poor road access, with long slow climbs up even the main roads; narrow, unpaved, dead-end secondary roads serving multiple dwellings; long shared drives; and long, often unsigned single drives. Most of the roads and drives are narrow (below state standards for safe evacuation and response) with hairpin turns that slow or even halt fire response. The roadside fuel loading is typically very heavy and very flammable.

Fire could easily prevent evacuation and/or emergency response.

Better turn-arounds, back-arounds, or hammerheads should be provided at the ends of the main and secondary roads and ends of drives over 150 feet in length.

Turnouts (weather-surfaced parking spaces a minimum of 30 feet long and 8 feet wide with adequate roadside fuel management) should be located along Drakes View Drive at least every 400 feet. Long drives (150+ feet) should have a turnout near the midpoint. Parking in these spaces should be discouraged.

Local ordinances require fuel management along roads and drives for a minimum of ten feet from road, turnouts, and turn-arounds. They also require a minimum of 15 feet clearance above travel lanes. The Vision Fire clearly demonstrated that these minimum "clearances" are inadequate for safe evacuation and firefighting. Where possible, defensible space and vertical clearance from vehicle use corridors should be increased.

Driveways should have the same minimal vertical and horizontal fuel management. Good firescaping is particularly important where the drive approaches the parking area, garage, or home because this is where families will gather to load their vehicles and evacuate in the event of a wild fire.

Dead or damaged unstable trees along road and drive cutbanks (above) and spoil banks (below) should be removed to avoid uprooting and disturbance or obstruction of the road or drive.

Many property addresses are not clearly posted. This can be a serious problem in both fire and medical emergencies when minutes count. Addresses should be posted at the entrance to all drives and shared drives, and at the intersections of shared and individual drives, with clear directions to the individual homes. Addresses should also be posted at the homes themselves. The address signs should have bright four-inch numbers with at least a 3/8-inch stroke on a contrasting background. ■

7 :: EMERGENCY PREPAREDNESS FOR INVERNESS RIDGE COMMUNITIES :: INCLUDING NEIGHBORHOODS UNBURNED IN THE VISION FIRE

Phoenix Team member and Inverness resident Tom Gaman assembled this chapter based on conclusions of the entire study group. Particular information was contributed by geomorphologist Laurel Collins.

■ As most people acquainted with the Point Reyes peninsula have seen, natural hazards are a part of life on this fragile landscape. Although each resident accepts some environmental risk in living on the Inverness Ridge, there are precautions that can readily be taken to reduce the threats of wildland fire, surface erosion, and "mass wasting" landslides. We are strongly suggesting emergency preparedness in all Inverness neighborhoods. This chapter discusses measures that can be adopted and put in place in advance of the next natural catastrophe.

WILDLAND FOREST AND FUELS MANAGEMENT

■ In our field inspections we noticed that the hottest and most damaging fires invariably occurred in the bishop pine forests of Inverness Ridge. Not only did those forests burn the hottest, the Vision Fire was virtually uncontrollable in those forests. From looking at the fire area on color aerial photography taken in November 1995, it is clear that hardwood forests, particularly bay forest types, were where control of the Vision Fire occurred. Although the understories of these forests burned under the extreme dry conditions, bay forests did not sustain crown fires. This factor created situations where the Vision Fire fire could be effectively contained.

When Inverness is again faced with wildfire, there is a good likelihood that ignition will occur in or about the unburned bishop pine forests, such as those predominating in Neighborhood Units 10 and 12 north and west of Inverness (Map 2. map insert section). The fuel loading in these areas is identical to that which existed on Drakes View Drive a year ago. These neighborhoods were spared in October 1995 by a combination of factors —wind, weather, the location of the actual point of ignition, and fire suppression efforts. We will never have any control over three out of four of these factors, but another one mentioned above, fuel loading, could provide an opportunity for people to consider, plan, and manage our lands to reduce the potential effects of a future fire.

Essentially the community has three choices in anticipating and preparing for future wildfires:

1. No action. A popular choice is to do nothing. The land most threatening to Inverness is in Tomales Bay State Park, one of 312 units within the northern district of the California State Park system. Tomales Bay State Park has no general plan, and without one, no vegetation management is said to be possible.

An argument can even be made that, in the absence of fire, hardwood forests will succeed the bishop pine forests, and that once the heavy pine fuels rot and decay, the renewed hardwood forests will not be as flammable as the existing pine forests. However, this process would take perhaps 50 years, which is a long time without a fire, and the principal tree succeeding pine is tan oak — also a very flammable species.

2. Fuels modification. During our field work we identified several fuel modification corridors and zones that could reduce the threat of uncontrollable fire (Map 1, map insert section). These are areas where vegetative fuels around houses and along road corridors can be reduced (as described elsewhere in this report) to create definsible space. Ladder (ground to crown) fuels are eliminated, dead fuels are removed, excessive fuel loading is reduced, and areas of highest potential for ignition are carefully managed. We have made extensive effort in this report to suggest fire-safe landscape management in the burned areas. It is equally important to manage unburned areas as fire-safe.

3. Controlled and prescribed fire. It is not really a question of "if" the remaining bishop pine forests in Inverness will burn, it is a question of "when." An alternative to wildfire is to prescribe fire and to burn under optimal conditions following a carefully planned prescription. Controlled fire has been utilized at Point Reyes National Seashore, Golden Gate National Recreation Area, Salt Point State Park, the Marin Municipal Water District watershed, and other local areas. On a smaller scale, dead material, branches, and other flammable material can be manually gathered and burned during the winter on rainy days — at times when fire hazard is nil.

RECOMMENDATIONS

■ Our team looked briefly at the outlying wildland areas identified as Neighborhood Units 8-13. These include the Vallejo Canyon, the Tomales Bay State Park Annex (the Inverness Publis Utility District (IPUD) watershed), Dream Farm, Vision Road Corridor, Ottingers Hill (which includes Seahaven), and the lower portion of Drakes View Drive ("Roberts"). They are without exception extreme fire hazard areas on hot spring and autumn days when relative humidity is low. The following specific actions should be taken as soon as possible in order to avert another catastrophic fire, which could occur at any time.

Vegetation Management Plan

1. Interagency Vegetation Management Plan (VMP). An interagency VMP, such as that recently completed for the Marin Municipal Water District and the Marin County Open Space District, should be created for the Inverness Ridge. Creating such a plan would be the first step towards mitigation of the fire hazard in the bishop pine forests of the Point Reyes peninsula. A VMP would incorporate the California Environmental Quality Act (CEQA) legal and administrative structure, allowing for scoping, public participation, and assessment of environmental impacts. The result would be a specific plan enabling landowners to know what needs to be done and then apply to funding sources for assistance. The final product, resulting from a collaborative effort, would defend Inverness against inevitable future fires.

The VMP would recognize both the interconnected nature of land ownership and also the mosaic of fuels management needs along the Inverness Ridge. Obviously, in order to accomplish common goals that cross property boundaries, it is necessary to have agreements and legal documents in place that allow agencies to work in partnership with each other and with private landowners. Cooperative Resource Management Plans (CRMP's) are administrative tools that can provide this structure. Undoubtedly, CRMP's and other types of cooperative agreements would also result from the planning process.

This planning process will take some time. We recommend that an interagency committee be formed now with a goal to create an area-wide VMP and the necessary CRMP's so that the obvious fire hazard in Inverness can be effectively reduced.

Fuels Modification Corridors

Proposed fuels modification corridors are indicated on Map 1 (map insert section). We are suggesting that fuels modification corridors be created 1) along Vision Road; 2) along a portion of Sir Francis Drake Boulevard; and 3) north of Seahaven along the boundary to Tomales Bay State Park. Numbers 2) and 3) here are merged into one shaded area on Map 1. Another valuable fuels modification corridor would be located along the road at the upper end of Perth, west of Inverness, along the boundary with Tomales Bay State Park lands.

The land along Vision Road is mostly private, and the project could be accomplished via an agreement among a number of landowners. We are recommending a "shaded fuel break" of at least 100 feet on either side of Vision Road for its entire distance. In a shaded fuel break live trees can be pruned to eliminate ladder fuels, dead fuels should be removed, and shrubbery should be spaced. Examples of this type of fuel break exist on Mount Tamalpais in the area of West Point Inn and in Inverness along portions of upper Highland Way.

The combination of high use and heavy fuels along Sir Francis Drake Boulevard from Chicken Ranch Beach to Ottinger's Hill make this a likely ignition zone. A shaded fuel break should be established in this area.

Tomales Bay State Park has heavy fuel loads, threatening the village of Inverness and Seahaven. We recommend fuels modification on the Tomales Bay State Park lands. It may be necessary for a number of concerned residents to take political action to achieve this.

Defensible space & winter broadcast burning of slash

Inverness residents should be encouraged to create defensible space. This would be facilitated by the ability to broadcast burn the slash created in conformance with California Department of Forestry (CDF) and air quality regulations. Extensive burning occurs in Mendocino and Sonoma counties. Broadcast burning with a permit is legal in Inverness. On April 1, 1996, during a day when three inches of rain fell on Inverness, two members of the Phoenix Team burned a community slash pile with well over 100 yards of pine and hardwood slash. This potential threat to an Inverness neighborhood was harmlessly reduced to ashes in just a few hours.

We recommend that Marin County Fire and the IPUD facilitate and encourage the issuance of permits for burning slash piles during the winter and spring months when fire hazard is low.

Hardwoods

In all the neighborhoods where structures burned in the Vision Fire, wildland areas outside the defensible space zones and roadside treatments can be managed to accelerate forest restoration and renewal but with a view toward reducing available fuels and achieving greater fire resistance. Forest management efforts around developed housing areas should be directed to encouraging hardwoods, particularly live oak, madrone, and bay forests. Openings should be maintained. Grasses along roadsides should be cut by May each year.

Access

Upper Perth should be maintained in a condition that is accessible, traversible to Highland Way, and is safe for emergency vehicles under extreme fire conditions.

Fire Plan

All Inverness neighborhoods should establish emergency response plans so that when a fire ignites, residents have considered how they are going to respond and how to safely evacuate.

WATERSHED READINESS

■ Regarding the response of watersheds to a wildfire on the scale of the 1995 Vision Fire, many local details cannot be accurately predicted. A general familiarity with the topography, geology, climate, and plant ecology of a watershed can lead to forecasts of hillslope and stream response that can substantially reduce the threat of loss of life and property, reduce downstream sedimentation rates, and help prevent the misapplication of mitigation measures. The Burned Area Emergency Response (BAER) Team (1995) reported that after the Vision Fire there was a public false sense of security in the lower portions of the watersheds that were not burned.

Regardless of fire, debris flows and debris torrents are geologic hazards that will continue to threaten property in the Point Reyes community. Focus should be turned upon preparing a comprehensive geomorphic map of the entire residential community, not just the burned zone. The distribution of debris torrent run-out pathways, landslides, and creeks prone to flooding should be common knowledge to citizens, community groups, and police/fire departments involved in emergency preparedness planning. A system of continuously recording stream and precipitation gages should be placed within the urban watersheds for an early alert system. Such a program should be locally guided. The need to develop such information and monitoring has increased since recent federal cutbacks have caused the U.S. Geological Survey to drop their public landlside alert and warning program.

Recommendations

The following list of basic principles and activities is provided as a starting place for a responsible level of watershed awareness. They apply in all of the Neighborhood Units discussed in Chapter 8 (where elements of the geomorphology particular to each have been detailed), as well as in unburned areas of Inverness Ridge. Chapter 5 of this report consists of a thorough discussion of the factors involved in these concerns.

1) Successful efforts to manage any part of a watershed requires an understanding of the nature of the watershed as a whole. Get to know your land and where your runoff goes.

a) Study a contour map of your watershed to understand the topographic conditions around you. Remember that colluvial hollows and slopes where the contour lines on a topographic map are concave are areas where ground water converges making these areas most prone to saturation.

b) Watershed processes transcend property boundaries. Neighbors share responsibility for their watershed. Communicate with each other and develop emergency preparedness plans to deal with natural hazards in the event of fire, earthquakes, or landslides.

2) If surface erosion is a problem on your property, look upslope or upstream and identify the source of runoff. Deal with permanent solutions to erosion at its source.

3) If you live near an active landslide or an area that has a moderate or high potential for sliding, visually monitor the landscape, looking for new or expanding cracks in the ground, shifts in the soil, or trees that lean downhill. If any of these features are found, contact an expert for a professional analysis of landslide risk. Be alert during intense storms.

4) If you live in an area that is on or near an alluvial fan, a creek, a debris torrent pathway, downslope or upslope of steep colluvial hollows, debris flow scars, or extremely steep slopes, get a rain gauge and heed the warnings of ground failure based upon rainfall intensity (see table, page #).

5) Learn whether or not the vegetation on your property is fire-adapted. If you have experienced a fire, learn what vegetation has died. Remember that the rotting roots of trees on steep slopes pose a substantial decrease in the strength of the soil to resist sliding. Under such conditions, monitor the slope for signs of failure, and consider re-establishing vegetation with an extensive and deep network of roots that will increase soil cohesion. Remember, tall trees with shallow roots that are planted on landslide deposits have a high potential of falling, even in the absence of fire. Consider the proximity of structures in these cases.

6) If you own property that has large dead tree stems on slopes that have high hazard for debris flow onto a road or structure, or into a stream, consider cutting the tree trunks near their base, cut the trunk into small pieces, and remove the large wood from those portions of the slope that have potential for failure. Do not remove or pull out the roots.

7) Maintain road drains. Clear clogged inlets of debris, check for signs of instability, and notify appropriate authorities of problems. Periodically monitor those that drain into unstable slopes during storms if necessary. Clear the inlets of debris that may prevent water from flowing into the culvert, and check for headward erosion at the outflow that could destabilize the road.

a) Road drains and culverts that are poorly constructed or deteriorating, or that do not have dissipation devices, should be corrected.

b) Abandoned dirt roads that are creating surface erosion and landslide problems should be "put to bed" by recontouring, discing, and planting.

8) Along the Inverness Ridge, erosion control efforts should be maximized during urban reconstruction when grading activities will disturb the soil and make it highly prone to surface erosion.

9) Future programs that seek to modify vegetation for fuel reduction purposes should seriously consider the potentially negative impacts on segments of hillside that are prone to debris flow failure.

10) Get professional technical advice when you have concerns. ■

8 :: VISION FIRE NEIGHBORHOODS — ASSESSMENTS & RECOMMENDATIONS


Garrya

Phoenix Team members Ray Moritz and Tom Gaman are the principal authors of this chapter, with additional information and review contributed by Laurel Collins.

■ THIS CHAPTER SURVEYS EACH OF 13 INVERNESS RIDGE NEIGHBORHOODS. Seven of them, along upper Drakes View Drive where dwellings burned, are discussed in some detail. For each of these seven, we offer a detailed description — the location and aspects, the watershed, human impacts (encroachments due to development), the vegetation and fuel type prior to the Vision Fire, critical fire features, the fire's behavior and effects. We then offer some specific recommendations that may mitigate the threats of future wildfires, erosion, or landslides. Succession within the plant communities in most cases results in an avoidable increase in the fire hazard rating of the natural landscape; to help guide residents in making management decisions, these rating progressions are summarized for each neighborhood in the table on the opposite page.

Readers will find additional information pertinent to a given neighborhood by cross-referencing this chapter with previous parts of this report, particularly the sections in Chapter 6 on Vegetation Types, Fire Hazard Management, and Defensible Space. The Prior Vegetation Type listed here for a given neighborhood (e.g., aging bishop pine forest) will tell the reader where to find the appropriate forest restoration actions in Chapter 6.

Readers interested in geomorphology will find a thorough discussion of this subject in Chapter 5. In addition to watershed information in this chapter, precautions recommended for all Inverness neighborhoods (including unburned areas) are listed on pages 52-53 in Chapter 7.

The Phoenix Team also offers recommended actions, in Chapter 7, that could substantially reduce the threats to Inverness Ridge communities from future wildfires.

Neighborhood Units in our study area were assessed for fire hazard potential based on the topographic conditions, pre-fire fuel type, and succession of fuel types predicted for each. For this purpose, we again employed Marin County's system for fire hazard ratings, explained in Appendix 8.

Fire hazard ratings in recovering plant communities will steadily increase over time to levels approaching pre-fire conditions; careful management of areas around homes is essential. The table opposite summarizes the upward trends in fire hazard in each neighborhood as post-fire natural succession progresses through time. (Units 5 and 7 both have two distinct vegetation types, as explained in the caption.) See also the comparable table and accompanying graph on page 32, showing fire hazard in the four principal plant communities discussed in this report.

UNITS	PRIOR	1st year	3rd year	10th year	Long Term
1	33	15	22	27	33
2	35	19	24	32	33
3	35	19	24	32	33
4	32	19	22	28	32
5a	28	10	19	23	28
5b	34	19	22	31	34
6	32	22	24	31	35
7a	32	19	22	28	32
7b	29	15	20	26	29
8	28	20	23	23	28
9	28	15	17	24	28

Table 2: Average Succession of Fire Hazard Ratings by Neighborhood Unit. Assessments were made during the Phoenix study for burned areas within 100 feet of structural envelopes. In neighborhood units in the burn zone, as in the forest/fuel types, fire hazard ratings will increase over time unless vegetation around structures is carefully managed. The ratings shown here correspond with primary forest types found in each neighborhood. Units 5 and 7 are characterized by two distinct plant communities: 5a is coastal scrub; 5b is bishop pine with dense understory; 7a is overmature bishop pine; and 7b is mixed hardwood forest

WATERSHED

■ THE GENERAL RECOMMENDATIONS ON PAGE 52-53 apply to all the burned neighborhoods of the Vision Fire zone. If part of your property was affected by fire, learn which vegetation has died, will die, or will recover. Remember that the decaying roots of trees pose a substantial decrease in the strength of soil to resist sliding. Consider the proximity of dead pines to nearby roads and structures. Choose plants and trees for landscaping that are appropriate for soil moisture conditions of a given site, that have low flammability if planted near structures, that have fast and deep growing roots if planted in an areas where slope stability is of concern, or that forms a low ground cover if surface erosion is a problem. If you own property that has large dead tree stems on slopes that have high hazard for debris flow onto a road, structure or into a stream, consider cutting the tree trunks near their base, cut the trunk into small pieces and remove the large wood from those portions of the slope that have potential for failure. Do not remove or pull out the roots. If abandoned dirt roads are creating surface erosion and landslide problems in the neighborhood, "put them to bed" by recontouring, discing, and planting.

Erosion control guidelines for reconstruction efforts will soon be available to homeowners within the Vision Fire area from the Marin County Department of Public Works (MCDPW). According to Liz Lewis, MCDPW Creek Naturalist:

"Erosion control measures should be completed no later than September 15, 1996. Every effort should be made to minimize the area disturbed. This includes areas to be graded, equipment parking areas, vegetation removal zones, and stock piling areas. By minimizing the extent of disturbed land, erosion potential as well as the cost of its control is minimized.

"All disturbed areas that are not paved or otherwise covered should be stabilized as soon as possible. Depending upon the size of the disturbed area and its location, several choices exist: hand seeding, jute or fiber netting Curlex™, straw mulch, silt fences, straw bales and sand bags, are just a few examples. Diversion of surface runoff through the proper placement of berms and ditches may also be used in tandem with ground protection measures.*

"An erosion control plan should be included in the initial building application package. The decision to implement particular measures should be made after evaluating each site and will depend on the specific characteristics of each site, as well as the timing of construction. For advice on preparing your erosion control plan contact either John Wooley (Associate Civil Engineer) or Liz Lewis at the MCDPW Land Use and Water Resources Section (phone 415-499-6549)."

Unit 1 — Pine Crest

Description

Location & Slope: See Map 2 (map insert section). Located along the north to northeast slope of the watershed immediately north of the Drakes View Drive ridge, this unit is bounded by Pine Crest Road, Drakes View Drive, and Buck Point Road. It also includes the parcels below (to the north of) Pine Crest. Topography ranges from almost level on the parcels along Drakes View Drive to steeply sloping on the parcels above and below Pine Crest and below Buck Point.The general slope is to the northwest. A major north to northeast drainage cuts through the west end of the unit up toward the intersection of Buck Point and Drakes View. A secondary drainage enters at the east end, at the intersection of Drakes View Drive and Pine Crest. This unit has poor to very poor road access because of its location toward the end of Drakes View Drive and the dead-end secondary roads Pine Crest and Buck Point. It was in the high intensity fire zone of the Vision Fire.

Watershed: This unit includes the uppermost ridge and moderate to steep slopes that drain into Units 13 and 9 of the Vallejo Creek watershed.

Human Impacts: This neighborhood has high-moderate development density. Three active roads, a number of active driveways, and several abandoned roads enter the unit. An automotive junkyard was present prior to the fire. Before the fire, the areas around structures were sparsely landscaped. The introduction of exotic vegetation was insignificant. Following the fire, building demolition, logging, debris disposal, chipping, mulching, and seeding activities and the installation of straw-bale sedimentation dams have taken place.

Prior Vegetation Type: The unit was dominated by an opening stand of mature to over-mature bishop pine forest. At the east end there was more nixed evergreen forest (pine, tan oak, coast live oak, bay, and chinquapin), but bishop pine dominated the over-story or forest cover. The canopy was 70 to 80 feet tall, and the canopy cover was inthe 61-100% class.

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained, droughty soils; steep slopes; two major "chimney" drainages; ridge-top exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants; and heavy down and dead debris.

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* For example, see the illustrations on pages 27 and 29, and also their source, Malcolm Margolin's *The Earth Manual: How to Work on Wild Land Without Taming It* (Heyday Books 1975), among other references.

Adjacent wildlands are also a threat. This unit had the highest Marin County Fire Department (MCFD) fuel class rating, nine out of a possible nine points.

Fire Behavior: The Vision Fire entered the unit from the north out of the drainage and from the south over the Drakes View Drive ridge, with extreme fire behavior. More than 90% of the unit burned. Crowning fire engulfed most of the unit and reached extreme intensities and fuel consumption. All but two of the homes were consumed.

RECOMMENDATIONS

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet upslope by 50 feet cross-slope by 100 feet down slope.

Fire Hazard Management: With its poor to very poor road access, the unit is essentially one way in and one way out. Fire moving up across the shoulder of land supporting Drakes View Drive, or up the east chimney drainages, could prevent evacuation and/or emergency response in the entire unit. Fire moving up the main drainage could cut off evacuation from and fire response to Unit 3 as well as the Buck Point parcels of Unit 1. Better turn-arounds, back-arounds, or hammerheads should be provided at the ends of the two secondary access roads; there should be a turnout near the midpoint of each road. Turnouts (weather-surfaced parking spaces with adequate roadside fuel management; a minimum of 30 feet long and 8 feet wide) should be located along Drakes View Drive at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: Numerous colluvial hollows of low to moderate slide hazard exist in this unit (Map 4, map insert section). One particularly steep, north-facing slope in the middle of the unit is particularly prone to ravelling, and there is a large active debris slide scar just below one of the abandoned spurs of Pine Crest Road. Tension cracks above the crown scarp are active. An estimated 1,000 cubic yards of soil could be dislodged above the existing crown scarp. If failure should occur instantaneously during an intense storm event, rather than slowly or sequentially, there is potential hazard to downstream properties along Vallejo Creek and along Sir Francis Drake Boulevard. Continued slope failure could also be triggered by seismic shaking from a moderate earthquake event. Between Buck Point Road and the end of Pine Crest Road, runoff and erosion from abandoned road surfaces have caused some of the straw bale dams to fill with sediment. These roads should be "put to bed" or should have appropriate erosion control measures in place. All general recommendations (page #) apply.

Forest Restoration: This unit needs particular attention to sword fern transplanting. See also general recommendations in Chapter 6 beginning on page 39.

Unit 2 — Drakes View

DESCRIPTION

Location & Slope: This unit is bordered by Upper Sunnyside, Drakes View Drive, Sunnyside, and the center of the major drainage that connects with the intersection of Drakes View Drive and Elizabeth and drops off to the southeast. Varying from almost level to steeply sloped, the unit drops off from Drakes View Drive down to Sunnyside. One major drainage borders the unit boundary at the west end. Road access is poor to very poor because of the location at the end of a long slow climb up the dead-end roads of Drakes View Drive and Sunnyside. This unit was in the high intensity fire zone of the Vision Fire.

Watershed: This is an upper ridge area of Fish Hatchery Creek, which drains into Units 8 and 13.

Human Impacts: This unit has moderate development density, with three active roads and a number of active driveways. No abandoned roads were observed. Before the fire, areas around structures were sparsely landscaped. The introduction of exotic vegetation was insignificant. After the fire a considerable amount of logging and tree removal has occurred in the unit, along with debris disposal, chipping, mulching, and seeding activities.

Prior Vegetation Type: The unit was dominated by an opening stand of mature to over-mature bishop pine forest. At the north end it grades to mixed evergreen forest.

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; steep slopes; a major "chimney" drainage; ridge-top exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants; and heavy down and dead debris. This unit had the highest MCFD fuel class rating, nine out of a possible nine points.

Fire Behavior: The Vision Fire entered the unit from the west along the Drakes View Drive ridge and from the south, with extreme fire behavior. More than 90% of the unit burned. Crowning fire engulfed most of the unit and reached extreme intensities and fuel consumption. All but one of the homes were consumed.

RECOMMENDATIONS

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet upslope by 50 feet cross-slope by 100 feet downslope.

Fire Hazard Management: This unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the narrow, unpaved, dead-end road, Sunnyside. It is essentially one way in and one way out. There is a road leading out through the National Seashore from the end of Sunnyside, but this exit is not available to private vehicles. Fire moving up across the shoulder of land supporting Drakes View Drive or up either lower Drakes View Drive or the south drainage could prevent evacuation and/or emergency response. Better turn-a-rounds, back-a-rounds, or hammerheads should be provided at the ends of the access roads and drives. Turnouts should be located along Drakes View Drive and Sunnyside at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: Slopes in this unit are of relatively gentle gradient. Landslide and erosion hazards are minimal.

Forest Restoration: General recommendations beginning on page 39 apply in Unit 2.

Unit 3 — Ridge Unit.

DESCRIPTION

Location & Slope: This unit is located along the north-south ridge at the top of and perpendicular to Drakes View Drive. It includes the ridgetop parcels at the end of Drakes View Drive, the parcels accessed from Elizabeth Road, and the parcels above Buck Point road. Varying from almost level to steeply sloped, the unit drops off to the northeast and the southwest. At the south end it drops steeply into a saddle in the ridge. The general slope is to the southwest. Two major drainages converge at the unit boundary from the northeast and the southeast. This unit was in the high intensity fire zone of the Vision Fire.

Watershed: This upper ridge area drains into Muddy Hollow Creek (Point Reyes National Seashore) and Fish Hatchery Creek. Below the latter are Neighborhood Units 5, 8, and 13.

Human Impacts: This unit has moderate development density. Three active roads, a number of active driveways, and seven abandoned roads enter the unit. A National Seashore road borders the southwest perimeter of the unit. A North Marin Water District facility including two tanks occurs in the middle of the unit. The areas around structures were sparsely landscaped. The introduction of exotic vegetation was insignificant. After the fire a considerable amount of logging and tree removal has occurred in the unit, along with debris disposal, chipping, mulching, and seeding activities.

Prior Vegetation Type: This unit was dominated by an opening stand of mature to over-mature bishop pine forest, grading at the north end to mixed evergreen forest (pine, tan oak, coast live oak, and bay) with hardwoods dominating the (forest cover).

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; steep slopes; two major "chimney" drainages; ridgetop exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants; and heavy down and dead debris.

Fire Behavior: The Vision Fire entered the unit from the north along the ridge and from the northeast and southeastm with extreme fire behavior. More than 90 % of the unit burned. Crowning fire engulfed most of the unit and reached extreme intensities and fuel consumption. All but one of the homes were consumed.

RECOMMENDATIONS:

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet upslope by 50 feet cross-slope by 100 feet down slope.

Fire Hazard Management: This unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the narrow, unpaved, dead-end roads Elizabeth and Buck Point. It is essentially one way in and one way out. There is a road leading out through the National Seashore from the end of Drakes view Drive, but this exit is not available to private vehicles. Fire moving up across the shoulder of land supporting Drakes View Drive, or up either of the chimney drainages, could prevent evacuation and/or emergency response. Better turn-arounds, back-arounds or hammerheads should be provided at the ends of the three access roads or drives over 150 feet in length and should have a turnout near the midpoint. Turnouts should be located along Drakes View Drive at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: This unit has mostly low to moderate slide hazard (Map 4, map insert section). Substantial amounts of road runoff from abandoned dirt roads have contributed to active gullying below the neighborhood. Abandoned dirt roads that are creating surface erosion problems could be "put to bed" by recontouring, discing, and planting.

Forest Restoration: General ecommendations beginning on page 39 apply in Unit 3.

Unit 4 — Sunshine

DESCRIPTION

Location & Slope: This unit is bounded by Drakes View Drive, Upper Sunnyside, Sunnyside, and Lower Sunnyside (the northeast burn perimeter). It is almost level to moderately sloped and drops off to the northeast at the north end of the unit and to the southeast over most of the unit. This unit was in the extreme intensity fire zone of the Vision Fire except for the three most northeasterly parcels.

Watershed: This upper ridge drains into Neighborhood Units 13 and 8 of Fish Hatchery Creek and an unnamed watershed to the north. Only the burned portion of this watershed was assessed in detail (see Map 4, map insert section).

Human Impacts: This unit has moderate development density, with three active roads and a number of active driveways. Before the fire, areas around structures were sparsely landscaped. The introduction of exotic vegetation, especially blackberries, is a problem. Debris disposal, chipping, mulching, and seeding activities have followed the fire.

Prior Vegetation Type: The unit was dominated by an opening stand of mature to over-mature bishop pine forest, grading at the northeast end to a greater presence of mixed hardwoods (tan oak, coast live oak, bay, and some alder).

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; moderate south-facing slopes; ridge-top exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants; and attached and detached fuels, particularly heavy down and dead debris. It had the highest MCFD fuel class rating, nine out of a possible nine points.

Fire Behavior: The Vision Fire entered the unit from the north along the ridge and from the northeast and southeast, with extreme fire behavior. More than 90% of the unit burned. Crowning fire engulfed most of the unit and reached extreme intensities and fuel consumption. The fire died where hardwoods dominated on the northeast slope, and there a number of homes were saved.

RECOMMENDATIONS

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet upslope by 50 feet cross-slope by 100 feet down slope.

Fire Hazard Management: This unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the winding, narrow access on Sunnyside. It is essentially one way in and one way out. Sunshine Court is a dead-end cul-de-sac penetrating the center of the unit. Drive access is moderate. There is a road leading out through the National Seashore from the end of Drakes View Drive and Sunnyside, but this exit is not available to private vehicles. Fire moving up across the shoulder of land supporting Drakes View Drive or up the ridge could prevent evacuation and/or emergency response. Better turn-arounds, back-arounds, or hammerheads should be provided at the ends of the three access roads. Drives over 150 feet in length should have a turnout near the midpoint. Turnouts should be located along Drakes View Drive and Sunnyside at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: This unit includes relatively gentle slopes of low landslide hazard and minimal surface erosion problems.

Forest Restoration: At the northeast end of the unit hardwoods should be favored over brush and pine. General recommendations beginning on page 39 also apply in Unit 4.

Unit 5 — Saddle

DESCRIPTION

Location & Slope: This unit is bounded by the National Park road extending off the end of Sunnyside and includes the developed portion of the "chimney" drainage rising from the Vallejo watershed up to Lower Sunnyside. It ranges from almost level at the top of the ridge, at the southeast end, to moderately sloped. The west end of the unit is east-facing; the east half is south-facing. This unit was in the extreme intensity fire zone of the Vision Fire.

Watershed: Unit 5 drains into the Fish Hatchery Creek watershed that includes downstream neighborhoods 8 and 13. It includes side slopes just below Neighborhood Unit 3.

Human Impacts: This unit has light development density, with two active roads, one active driveway, and two abandoned roads. Before the fire, areas around structures were sparsely landscaped. The introduction of exotic vegetation (Monterey pine, thistle, and blackberries) was a problem. Timber felling and skidding, debris disposal, chipping, mulching and seeding activities have followed the fire.

Prior Vegetation Type: At the west end this unit was dominated by coastal scrub (5a on the chart on page 55) with scattered pine (Monterey pine was planted around the two homes). To the east, the south-facing slope was dominated by bishop pine with dense undergrowth (5b on the chart).

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; moderate south-facing slopes; ridge-top exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants and attached and detached fuels; and particularly heavy down and dead debris. Most of this unit had the highest MCFD fuel class rating, nine out of a possible nine points. Two chimney drainages enter the unit, one at the east end and one at the west end. Fire could quickly isolate the unit. Steep slopes (40 to 65%) below the homes would accelerate fire and hinder fire suppression.

Fire Behavior: The Vision Fire entered the unit from the west over the ridge. At least one reburn came from the south, with extreme fire behavior. Almost 100% of the unit burned. Crowning fire engulfed most of the unit and reached extreme intensities and fuel consumption. All of the homes in this unit were consumed.

RECOMMENDATIONS:

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet up slope by 50 feet cross slope by 100 feet down slope.

Fire Hazard Management: The unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the winding, narrow access to the west end of Sunnyside. Drive access is very poor. Several drives below Sunnyside traverse an unstable slope back to the east. The unit is essentially one way in and one way out, with a road leading out through the National Seashore from the end of Sunnyside that is not available to private vehicles. Better turn-arounds, back-arounds, or hammerheads should be provided at the end of the three access roads. Drives over 150 feet in length should have a turnout near the midpoint and turn-a-rounds at the terminus. Turnouts should be located along Drakes View Drive and Sunnyside at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: Several active landslides occur on the lower elevation slopes of Unit 5, where abandoned roads are contributing to slope failure along the inner gorge of the creek drainage. They could be "put to bed" by recontouring, discing, and planting. Surface erosion from two dead-end spur roads could be solved by better road design and runoff control, particularly on the lower spur road.

Forest Restoration: General recommendations beginning on page 39 apply in Unit 5.

Unit 6 – Sunnyside

Description

Location & Slope: This unit is bordered above by Sunnyside — west to the major drainage that connects with the intersection of Drakes View Drive and Elizabeth and east to the major drainage off the end of Douglas. It is steeply sloped and drops off from Sunnyside down past Dover. One major drainage borders the unit boundary at the west end, one at the east end, and one in the middle. The unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and down Sunnyside and Dover. It was in the high intensity fire zone of the Vision Fire.

Watershed: This unit has steep side slopes just below Neighborhood Units 2 and 4. It drains into the Fish Hatchery Creek watershed including Neighborhood Units 8 and 13.

Human Impacts: This unit has moderate development density, with three active roads and a number of active driveways. No abandoned roads were observed. Before the fire, areas around structures were sparsely landscaped. The introduction of exotic vegetation was insignificant. After the fire a considerable amount of logging and tree removal has occurred in the unit, along with debris disposal, chipping, mulching, and seeding activities.

Prior Vegetation Type: The unit was dominated by a stand of mature to over-mature bishop pine forest.

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; steep slopes; three major "chimney" drainages; a steep (40 to 90%) mid-slope location; a highly flammable aging forest cover; heavy undergrowth dominated by pyrophytic plants; and heavy down and dead debris. This unit had the highest MCFD fuel class rating, nine out of a possible nine points.

Fire Behavior: The Vision Fire entered the unit from the west with extreme fire behavior. More than 95% of the unit burned. Crowning fire engulfed most of the unit reached extreme intensities and fuel consumption. All of the homes were consumed in the fire.

Recommendations

Defensible Space: In this unit, defensible space should be established around structures to a distance of 100 feet up slope by 100 feet cross slope by 200 feet down slope.

Fire Hazard Management: With poor to very poor road access because of a location at the end of a long slow climb up Drakes View Drive and the narrow, unpaved, dead-end road, Sunnyside, this unit is essentially one way in and one way out. There is a road leading out through the

National Seashore from the end of Sunnyside, but this exit is not available to private vehicles. Fire moving up across the shoulder of land supporting Drakes View Drive, or up either lower Drakes View Drive or the south drainage, could prevent evacuation and/or emergency response. Better turn-arounds, back-arounds, or hammerheads should be provided at the ends of the access roads and drives. Turnouts should be located along Drakes View Drive and Sunnyside at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: This unit has the highest density of active landslides of all the Paradise Estates neighborhoods surveyed. Dover Road traverses slide features that have a range of low to high slide potential. Road runoff is contriubting to destabilization of the road and hillslopes. Deteriorated culverts along Dover Road and Sunnyside Drive should be replaced, and outfalls should have adequate dissipation devices. A watchful eye should be kept for new depressions or tension cracks that may indicate incipient failure.

Forest Restoration: Remove Monterey pine seedlings at the end of Sunnyside. General recommendations beginning on page 39 also apply in Unit 6.

Unit 7 – Douglas

Description

Location & Slope: This unit includes the east end of Sunnyside and Dover and all of Douglas (the northeast burn perimeter). It varies from almost level to moderately to steeply (30-50%) sloped, dropping off to the east at the north end of the unit and to the south at the south end. The unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the winding, narrow access on Sunnyside, Dover, and Douglas. At the west end, the unit was in the extreme intensity fire zone of the Vision Fire; at the east and south ends, it was in the moderate intensity fire zone.

Watershed: This unit has steep side slopes just below Neighborhood Unit 4. It drains into the Fish Hatchery watershed and small unnamed water shed to the north that includes downstream neighborhoods 8 and 13. Only the portion of this unit within the fire zone was mapped in detail for the Phoenix Report.

Human Impacts: This unit has moderate development density, with three active roads and a number of active driveways. The areas around structures were sparsely landscaped. The introduction of exotic vegetation is a problem. Debris disposal, chipping, mulching and seeding activities followed the fire.

Prior Vegetation / Fuel Type: The unit was dominated by an opening stand of mature to over-mature bishop pine forest (7a on the chart on page 55). At the northeast end, the unit grades to a greater presence of hardwoods (7b on the chart).

Critical Fire Features: The unit possessed all the features for extreme fire behavior: excessively drained droughty soils; moderate south-facing slopes; ridge top exposure to prevailing westerlies or dry northeasterly ("Santa Anna") winds; a highly flammable, aging forest cover; heavy undergrowth dominated by pyrophytic plants and attached and detached fuels; and particularly heavy down and dead debris. This unit had the highest MCFD fuel class rating, nine out of a possible nine.

Fire Behavior: The Vision Fire entered the unit from the northwest and west, with low to moderate fire intensity. The fire perimeter was west of Sunnyside, west of the intersection of Dover and Sunnyside, and west of the homes along Dover. Along the fire perimeter, the forest transitioned to hardwood-dominated. All of the homes were saved.

RECOMMENDATIONS

Defensible Space: In this unit, defensible space should be established around structures to a distance of 50 feet upslope by 50 feet cross-slope by 100 feet downslope.

Fire hazard management: The unit has poor to very poor road access because of its location at the end of a long slow climb up Drakes View Drive and the winding, narrow access on Sunnyside, Dover, and Douglas (dead-end roads). It is essentially one way in and one way out. Sunshine Court is a dead end cul-de-sac penetrating the center of the unit. Drive access is moderate. Better turn-arounds, back-arounds, or hammerheads should be provided at the ends of the three access roads or drives over 150 feet in length, which should also have a turnout near the midpoint. Turnouts should be located along Sunnyside, Dover, and Douglas at least every 400 feet. Parking in these spaces should be prohibited.

Geomorphology: This unit was only mapped in detail within the fire zone. It has a zig-zag roadway that traverses between active landslides and across a couple of slides that have a moderate hazard rating (Map 4, Geomorphology).

Forest Restoration: See general recommendations beginning on page 39 for forest types found in Unit 7.

Summary: Neighborhood Units 8-13

Unit 8 – Drakes Summit. We evaluated the burn in the Douglas fir forests in the Vallejo watershed. These areas burned but with less intensity and less tree mortality. No dwellings were lost, because the fire was controllable on the north-facing slope. We expect the area to recover quickly and the fuels to return. Many of the Douglas fir in the neighborhood were observed to have root rot. We recommend that all landowners maintain defensible space and monitor the Douglas fir around their houses for hazard.

Unit 9 – Dream Farm. This neighborhood sustained intense fire in its bishop pine forests on north-facing slopes, but housing was spared because of the intense efforts of firefighters. It is notable that the fire was ultimately controllable in the hardwood forests around the housing area at the top of Highland. Also, a fuels modification corridor exists along the ridge at the top of highland, and so the area presented an opportunity for firefighters to take a final stand against the fire and to save Inverness. The existing fuels modification corridor should be extended along the wood road which now connects to Upper Perth.

Unit 10 – Tomales Bay State Park Annex is comprised of cover of unburned bishop pine forests in various states of decay, and also bay forests. Ladder and dead fuels build-up is as heavy in these forests as anywhere in the western United States. Fuels modification corridors and possible controlled burning under safe conditions are recommended.

Unit 11 – Vision Road Corridor. This is mostly private land along Vision Road. There is an opportunity to secure the cooperation of a number of landowners and to proceed with creation of a fuels modification corridor. State VMP (see page #) and other cost-share funds are available to help to reduce the expense.

Unit 12 – **Ottingers Hill.** The bishop pine forests of the Tomales Bay State Park are rapidly dying out. Heavy fuel loading in the State Park is threatening Seahaven. A fuels modification corridor should be located and developed to protect that Inverness neighborhood from a wind-driven fire coming from the north or from Ottingers Hill. Prescribed fire should be considered as an alternative.

Unit 13 – **Roberts.** The neighborhood on Drakes View Drive immediately below the fire area is less threatened from future fire due to the decreased fuel loads to the north and west. Also, this neighborhood is in a less flammable hardwood forest type. The facts remain that access is very poor and the hillside is steep. A fire originating along Sir Francis Drake Boulevard could threaten this neighborhood. All homeowners should work to develop defensible space.

Watershed summary: The general watershed recommendations on page 52-53 apply to all the outer neighborhoods of the Vision Fire zone (Units 8–13), particularly in light of the disastrous landslides and debris torrents that affected nearly all these Neighborhood Units during the 1982 winter. Residents who did not live in Inverness during 1982 should talk to long-term residents to find out where there were problems in the past. Residents who live along alluvial fans should be particulary aware of debris flow potential upcanyon.

Also see the advice from Marin County Creek Naturalist Liz Lewis on page 55-56.

Since the Phoenix Team did not map the landscape in detail as we did for the Paradise Ranch Estates burn area, we did not make detailed watershed assessments of these neighborhoods. However, we offer an observation regarding neighborhood 13, Roberts, because stream surveying and research are continuing in this portion of Fish Hatchery Creek. Channel capacity is quite limited along some portions of Vallejo Road, particulary along some of the channel segments that have had bank revetment work and and that flow beneath driveways and small bridges. The best solution is to size these structures so that high flows will not be obstructed. Meanwhile, culvert inflows should be kept free of debris that could clog the conveyance, back up water, and cause flooding. ■

Additional information and resources are found in the Appendix Section, which follows.

Appendix 1 :: Planting Trees for Forest Restoration

by ***Nancy Stein****, Landscape Designer & Phoenix Project Coordinator*

■ GIVEN TIME, AND PATIENCE ON THE PART OF PEOPLE, the bishop pine and most other native plants will regenerate. There are situations, however, where property owners may chose to plant trees. Some areas of the fire burned so hot that seed was consumed. Construction damage to the post-burn soils will mean the destruction of more seed and root, and there will be privacy issues that cannot wait 10 to 30 years for the forest to recover. This essay is intended to give some guidelines for choosing the right tree and planting it in the right place. Considerations will include eventual height, distance from structures, fire safety, and drought tolerance. Trees are listed here in order of choice.

NATIVES

LIVE OAK: Probably the best choice is the coast live oak tree (*Quercus agrifolia*). Its name is derived from the Celtic and means "fine tree," and one can hardly find a more beautiful native tree. It grew abundantly in the pre-fire forest and is fairly fast growing if planted as a 15-gallon size young tree. It will tolerate wind and is very adaptable to either streamside water or drought. Perhaps most importantly, it is very fire resistant. It can be "windowed" to create views and to allow light to pass through the foliage. Live oaks hybridize easily; whenever possible, therefore, it is best to use trees that have come from seed grown close to where they are being planted.

REDWOOD: (*Sequoia sempervirens*) Although not native to the Point Reyes peninsula, redwoods are native to Marin — and fast-growing but less pyrophytic than other conifers. Native to slopes and canyons near the sea, they are fog lovers and will adapt well to growing on Inverness Ridge, as long as they are not exposed to direct sea blasts. Plant them on hillsides where springs have surfaced after the fire. They will also be valuable for stablizing drainages and, in the long term, reducing the likelihood of landsliding. Redwoods' thick bark and non-resinous wood make them quite fire-resistant. Three months after the fire, many trees that were severely burned are resprouting along the entire trunk.

DOUGLAS FIR: A native tree, the Douglas fir does not burn as easily as pines because it holds more moisture in its leaves. The structure of the fir also collects more moisture, and this fact makes it very competitive over pines and oaks. At the southern end of Inverness Ridge, firs have crowded out most other trees. Douglas firs are also shallow-rooted, so they are not the best choice for stabilizing landslide-prone areas.

BUCKEYE (*Aesculus*): Buckeyes are deciduous and are renowned for their beautiful flowers and twisted gray bark. They are native to streamsides and may require some water on Inverness Ridge. They do reach considerable size. Although there were probably few on the ridge before the fire, they are native to Point Reyes and would probably adapt to growing on the ridge. Since the buckeye is a deciduous tree, it is not the best choice for visual screening.

BIG LEAF MAPLE (*Acer macrophyllum*): This deciduous tree, native to stream banks, turns yellow in fall.

PYROPHYTES

CONIFERS (spruce, pine): All conifers ignite easily and burn very hot. Old specimens create many embers and flying brands, which makes them a very poor choice for growing near a structure. The Marin County Fire Department recommends that they be planted outside the defensible space zone. It's very important that you consider your neighbors' defensible space zone as well, even if it encroaches on your land. Choose an evergreen tree from the list above if you are planting within the defensible space zone. All conifers should be planted away from structures and roads. In cases where they must be planted or maintained (for example, where a bishop pine survived the fire), keep them trimmed of all dead wood, and eliminate all ladder fuels.

BISHOP PINE (*Pinus muricata*): It is expected that there will be many small sprouts of bishop pine in the Vision burn zone within a few years. If you are encouraging an area to return to bishop pine forest, select out the best specimens as they grow up. Each tree should have space around it so it does not have to compete for light and nutrients. Firs grow faster and are able to absorb more water than pines, so if a pine forest is your aim, be sure to keep the firs somewhat in check. Bishop pines have two leaves in their needle cluster. Since there were Monterey pine on the pre-fire ridge, an effort should be made to distinguish the bishop from the Monterey, and the Montereys removed.

MONTEREY PINE (*Pinus radiata*): **Not recommended.** These pines are much faster growing than the native bishop and are very poorly suited to growing in our area. They do not handle wind well. This translates into an expensive yearly maintenance effort to keep these trees from becoming a hazard. They do, unfortunately, very much resemble bishop pines, and since there were some growing before the fire, there will be seedlings. Montereys have three leaves in their needle clusters. We recommend that they be removed from all areas as soon as they can be identified.

SPRUCE (*Picea*): Although spruces are not native to this area, there were some fully mature specimens at the top of Drakes View Drive. They adapt well to soil and drought conditions. They are pyrophytic and should be treated in the same way as the bishop pine.

ACACIA: **Not recommended.** Very pyrophytic as well as invasive.

ABIES: **Not recommended.** The deer eat this variety of fir.

TAN OAK (*Lithocarpus densiflora*): Tan oaks were also in abundance in the pre-fire ecology of the ridge. The species produces a tannin in its leaves that makes it difficult for other plants to grow underneath it. Tan oaks are more pyrophytic than live oaks.

OTHER TREES

Chinquapin and madrone are valuable natives but hard to find as nursery stock.

GIANT CHINQUAPIN (*Castanopsis chrysophylla*): Identified by it's "chestnut" covered with sharp quills. Grows well with coast redwood.

IRONWOOD (*Lyonothamnus*): Has peeling red bark and bright green, fernlike foliage. Native to Catalina Islands, well adapted to growing on the ridge.

MADRONE (*Arbutus*): Grows well in dry areas with oaks and firs. Twisted red wood, with peeling bark, white flowers, and crimson berries.

BAY: Bay trees for the most part seem to be recovering well from the fire. They are available in nurseries.

LARGE NATIVE SHRUBS

MYRICA (*Myrica californica*): This large native shrub is often confused with bay since its leaf structure is so similar. It can be obtained in shrub shape only and is of slow to moderate growth. Good screening or hedge plant, usually deer tolerant

CEONOTHUS (*Ceonothus thyrsiflorus*): A native-growing wild lilac. Since its life span is about 20 years, it is a good choice for growing between trees that will take many years to reach widths that are adequate for screening. As large trees grow to maturity, Ceonothus naturally goes into decline and dies out.

SILK TASSEL (*Garrya elliptica*): Anative shrub with an interesting flower that reaches about 15 feet. Rather slow growing; may need deer protection

RED ELDERBERRY (*Sambucus callicarpa*): A deciduous shrub, common before the fire, whose red berries appear in May and June. Shallow rooted; easily transplanted.

CONCLUSION

■ FIRES OF THE MAGNITUDE OF THE 1995 VISION FIRE have a powerful effect on the direction of the forest's character. Seed and cone are destroyed, and the sudden change of forest cover creates severe loss of habitat and soil. Placing our homes in the forest ecosystem increases both the likelihood of fire and its intensity. Besides bettering our own chance of survival, there is the opportunity of lessening the impact we have on the land and its creatures by choosing plants for the area immediately around the house that are not flammable and maintaining them in a way that does not transmit fire rapidly.

Where possible, native plants and trees are the best choice for preserving the forest.

However, in a situation where land has been developed, there can be no question that the planting of a "non-native" plant will have much less impact on the forest than many other aspects of humans' presence, particularly with our present lifestyle. Roads create serious and long-lasting effects on all flora and fauna, our cars create pollution, our septic systems deposit unknown pathogens and fertilizers that have long-lasting and far-reaching effects — all of which far outweighs the choice of a few trees on private property. Land where humans live, especially in numbers, is by its definition, disturbed.

Situations where humans and forest interact call for individual solutions based on a careful and considered view of all that exists there, including the human beings. Many of the native plants that are better fire-resistant choices do not exist as nursery stock, particularly in large sizes that will provide screening. Native environments will not suffer from the introduction of a few exotics if they do not have requirements for water that are extremely different than natives'. Plants should not be used that are invasive and not native to the ridge. At the same time, it should be said that natural succession in forests does include some plants, such as the Douglas fir, that do invade and crowd out other trees.

One hundred years ago, the Inverness mesa was a grassland. Since being developed by humans, it has been converted into a healthy and beautiful forest of coast live oak, bay, and redwood along with an occasional specimen exotic. No effort was made to control or discourage what was planted there, and the outcome seems to be mostly native and quite pleasing. Inverness provides us with an example of succession from grassland to forest in which humans have created a diverse forest that both preserves natural processes and protects structures from fire. ■

Appendix 2 :: Fire Resistant Plants for Inverness Park Area

CODE: **boldface** = native species; DR = deer resistant; DT = drought tolerant

Acer macrophyllum, palmatum, or ***circinatum,*** — deciduous trees; shade
Achillea — perennial; DT
Aesculus californica — Buckeye; deciduous flowering tree
Alnus rhombifolia or ***cordata*** — Alder; deciduous tree
Ajuga — groundcover; shade; DR
Anemone — Japanese; shade
Arbutus menzesii, *A. unedo,* — evergreen tree; DT
Armeria — groundcover; DR DT
Azalea — shade
Bougainvilla — vine; DR
Brugmansia — scented shrub; shade; DR
Calla lily — DR DT
Carpenteria — shade.
Cerastium — groundcover; DR
Ceonothus gloriosus and Julia Phelps or Dark Star varieties — shrubs; DR
Cercis occidentalis — deciduous trees; DR DT
Cercocarpus — shrub; DR
Choysia ternata — some shade; DR DT
Cistus — perennial; DR DT
Clematis armandii — vine; some shade; DR
Convolulus — groundcover
Erica (heather) — light shade; DR
Erigeron karvinskianis — shrub (may be invasive); DR DT
Erysimum — shrub; DR DT
Fragaria — groundcover DR DT
Fremontedendron —large shrub; DR DT
Feijoa — shrub; DR DT
Garrya — shrub; DT
Gaultheria (salal) — groundcover; DR DT
Helichrysum petiolatum — shrub, "limelight"shade; DR DT,
Heteromeles (toyon) — shrub; DR DT
Iberis — groundcover;DR
Iris douglasii — perennial; DR
Jasminium polyanthmum (pink jasmine) — DT
Lilium pardilinum — DR
Lithocarpus densiflora — evergreen tree; DR DT
Lupinus — shrub; DR DT
Kniphofia uvaria — perennial; DR DT
Lantana montevidensis — perennial; DR
Lavender — perennial; DR

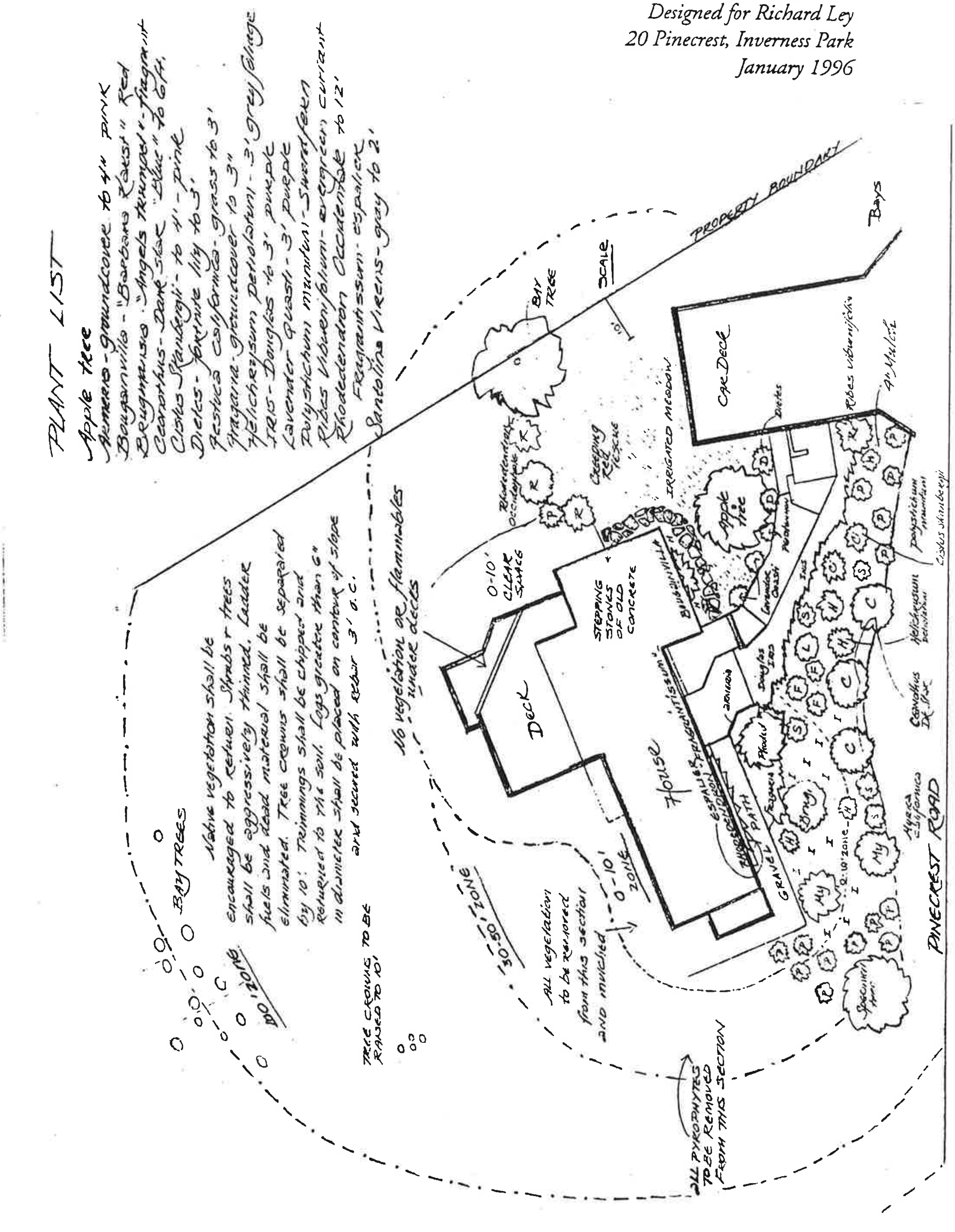
Mahonia aquifolium — Oregon grape; DR DT
Mimulus — perennial
Myrica californica — large shrub; DR DT
Nerium (Oleander) — shrub; DR
Penstemmon — perennial; DR DT
Philadelphus — DR DT
Polystichum — perennial; DR
Pyrocantha — shrub; DR
Quercus agrifolia — evergreen tree; DR DT
Rhamnus californica — shrub; DR
Rhamnus alaternus — hedge; DR
Rhodedendron occidentale — deciduous shrub
Ribes sanguinieum, Ribes viburnifolium — deciduous & evergreen shrub
Romneya — shrub; DR DT
Salvia — perennial; many varieties; DR DT
Santolina chamaecyparissus — perennial; DR DT
Santolina virens — perennial; DR DT
Schinus molle — evergreen tree; DT
Solanum crispum — evergreen vine; DR DT
Solanum jasminoides — evergreen vine; DR DT
Solanum xanti — evergreen shrub; DR DT
Stachys — evergreen perennial; DR DT
Succulents — groundcover; DR
Thymus — groundcover; DR
Trachelospernum — evergreen vine
Vaccinium — evergreen shrub; DR DT
Wisteria — deciduous vine
Zantedeschia (Calla lily) — perennial; DR
Zauschneria californica — perennial; DR DT

We recommend that the following plants be avoided:

Eucalyptus — invasive, pyrophyte
English ivy; invasive
Periwinkle — invasive
Juniper — pyrophyte
Cypress — pyrophye
Monterey pine — pyrophyte

Appendix 3 :: Sample Landscape Design

by Nancy Stein
Designed for Richard Ley
20 Pinecrest, Inverness Park
January 1996



Appendix 4 :: A Natural History of the Mount Vision Fire

***by Jules Evens**, biologist & EAC board member*

■ FIRE HAS BEEN HERE A VERY LONG TIME INDEED. The Miwok, who inhabited this place for at least 3,000 years, set fires periodically to open up the forest and scrub, promote vigorous growth, and attract animals.[2,4] Inverness Ridge has burned a hundred times and will burn a hundred more. The very structure of the bishop pine forest is the result of that fire history, and there is little we can do to forestall its recurrence, try though we will. The perennial advent of fire may be of little comfort to those who lost their homes and precious belongings in a blaze of flames in October 1995, but perhaps the acknowledgment of fire's place in the landscape is integral to our own regeneration of spirit.

Many people who live here have asked: "What has been the impact of this firestorm on the natural environment?" and "What about the animals? Which species were affected and will they ever return?" These questions are as complex as the causes and consequences of the fire itself, and answers and predictions are largely speculative. We can, however, make some sense out of the fate of the plants and animals that were affected, based on our knowledge of their natural history before the burn as well as some subsequent observations.

The fire consumed about 12,400 acres, of which about half was coastal scrub and open woodland, and about a quarter was forest — either Douglas fir, bishop pine, or riparian hardwood. The bulk of the beast was within the Point Reyes National Seashore, and, in total, about 18% of the park was impacted. According to the Burn Area Emergency Rehabilitation (BAER) Plan:* "Due to higher than normal fuel loads, extreme fire behavior, and wind patterns during the incident, about 70% of the vegetative cover was removed" within the burn perimeter. The Douglas fir forest (~1500 acres burned) ranges in age from about 30 to 115 years in age; due to past fire suppression, the younger trees have encroached onto areas previously occupied by coastal scrub and grassland. The bishop pine forest (~1000 acres burned), of uniform age with most trees about 60 years old, had developed as the result of past fires. The riparian corridor encompasses about 500 acres within the burn perimeter, occurring as narrow ribbons of habitat along intermittent and perennial watercourses. The riparian — with its associated swales, ponds, and marshes — was a critical refuge for animals during the heart of the firestorm.

The fire area in the Seashore was assessed according to levels of intensity: 70% burned at low intensity, 20% moderate, and 10% high intensity. Post fire estimates of mortality of vegetation in forested habitats found the highest impacts to bishop pine, with 82-94 % mortality. Douglas fir experienced 28-46% mortality, and only about 5% of the riparian suffered high mortality. The pines grow on shallow soils that are derived from granite and are inherently drier than the shales that underlie the fir forest and much of the coastal scrub. Bishop pine seeds were scattered across the forest floor after the burn, and if these seeds find "bare mineral seedbed relatively free of competing vegetation"1 they should germinate vigorously. The riparian corridor, mostly singed along its outer edge, is expected to recover in the first growing season. The Douglas fir forest will take longer, however, and will depend on variables like rainfall and seed crop production (of surviving firs) over the next few years.

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* Much of the information in this essay was gleaned from the 300-page report prepared by the "BAER Team" within an incredible 72 hours after containment of the fire. The BAER team is employed by the Department of the Interior as a quick response unit to wildfire events. They arrived on the scene as soon as the Vision Fire was declared "out of control" and began assessment, enlisting the aid of personnel from Point Reyes National Seashore, Tomales Bay State Park and the California State Parks, Marin County Department of Public Works, the Natural Resources Conservation Service, Petaluma District, as well as many local residents with particular knowledge of the natural and historic resources within the burn zone. Copies of the BAER Report are available in public library branches, and one resides in the office of Environmental Action Committee of West Marin.

Plants

The BAER Plan identifies several species of threatened and endangered plants within the burn area that may suffer population declines. Several of these species (e.g. north coast bird's beak, Marin knotweed) grow in tidal saltmarsh or swales and are not expected to be impacted severely, if at all. Other species restricted to drier habitats may have been damaged; these include fragrant frittilary, San Francisco owl's clover, Marin manzanita, and Mount Vision ceonothus. The frittilary is "bulberiferous" and therefore protected underground during the burn. The known local population of owl's clover occurs entirely within areas of moderate to high burn intensity within the fire zone. Their seeds should have survived, but the 25 acres where owl's clover occurs will be monitored during the spring of 1996. The manzanita and ceonothus are fire-adapted; although they reproduce via seeds, not by resprouting, they are expected to reestablish themselves.

Animals

Within the heart of the burn, refuge for animals was scarce, with many individuals crowding into the riparian corridors that wend through the canyon bottoms, as well as the few ponds (Muddy Hollow, Glenbrook, Laguna canyons) and their associated wetlands, too damp to burn. Even after the fire, species normally found in coyote brush (like wrentits) were flocking through the alders.

Surprisingly, some animals survived even the high intensity burn areas. Shortly after the fire Gary Fellers and other Park Service naturalists discovered numbers of slender salamanders in their usual haunts. The timing of the fire was serendipitous for salamanders, which were in the right place at the right time. Because the fire occurred before the onset of the winter rains, these amphibians were still aestivating (resting during summer conditions) underground. For some reptiles and amphibians, the fire must have roared over without raising their core temperature more than a degree.

Luckily this fire did not happen during the nesting season when most birds are far more territorial than they are in autumn.[3] The timing of the fire was also fortunate for most neotropical migrants; most of them — warblers, thrushes, grosbeaks, swallows — tend to leave on their migratory track by the end of September, not returning until March or April. Flocking birds that winter here — nuthatches, kinglets, chickadees — probably were able to move out in time.

Rich Stallcup found numerous deer tracks near Drakes Beach at a spot where escaping deer apparently swam across the mouth of Drakes Estero to the safe territory to the north. Survival by individuals of these large mobile species was largely a matter of luck — being in the right place at the right time.

But certainly, many animals lost their lives. The highest mortality was suffered by those with the least mobility; sedentary rodents like mountain beavers, woodrats, and deer mice; birds who are poor fliers like quail, wrens, and towhees. Some carcasses of larger mammals — deer, foxes, bobcats — were found in the ashes, but at least some of these were able to find routes of escape. Less fortunate were burrowing mammals. They tend to burrow not as deeply as salamanders and construct their tunnel systems for ventilation and multiple routes of access and egress. Perhaps most severely impacted was the Point Reyes mountain beaver, a rare and primitive rodent that was fairly common within the burn area. The Point Reyes subspecies is known only to occur in the western Marin County, mostly within the Seashore, and restricted in its distribution to relatively damp loamy soils in close proximity to a perennial water source. The isolated and restricted distribution of this subspecies qualifies it as a candidate for endangered status. Two days after the fire I walked-up a canyon in the heart of the burn, where skeletons of coyote bush limbs, twisted and awry, were silhouetted against the sky. The ground crunched underfoot, the surface of the soil baked to a crisp patina by the oils of incinerated plants of the soft chapparral. I stop at a once ferny hillside next to a creek that used to house a colony of mountain beavers; their ovular burrows are visible beneath the blackened burls of ferns. The beavers must have been asphixiated as the smoke ventilated through their burrow systems. For those who may have survived, there are no fronds left for forage. The fire incinerated about 40% of the habitat of this species and "could lead to its immediate listing as an endangered species."[1]

Surely the heat and smoke proved fatal to many individual animals that did not die directly in the flames. Rangers reported carcasses of animals found in the middle of Limantour Road — woodrats, brush rabbits, and skunks. They likely found the road a fire-free refuge within the inferno, then succumbed to the smoke or the heat. One wonders, also, just what impact the loss of habitat and associated food will have on the breeding success of the survivors, at least in the first year after the fire. Reduced reproductive success is anticipated for those species that forage primarily in the coastal scrub and prairie habitats. If there is no habitat left for a brush rabbit, there will be no prey for the gray fox or the bobcat. Without woodrats, any spotted owls that may have escaped the flames will be without their preferred prey. Without a toyon and huckleberry season, there will be no fruit for thrushes and robins. With few field voles left in once seed wealthy grasslands, the kestrel and kite will have less food to carry to the nest.

Some species may actually benefit from the burn. For example, the Myrtle's silverspot butterfly, a rare local species that breeds on outer Point Reyes, may wander into the burn as its primary foraging plants (thistles, gum plant, buckwheat, and coyote mint) colonize the barren hillsides once covered in coyote brush. The regeneration of plants, already underway, should be accompanied by a superabundance of insects and seeds, if not this spring, then in the near future. The decaying wood of the forest and shrub will also generate its own ecology driven by the gluttony of decomposers. Bark beetles and wood borers will become abundant and thereby provide a bonanza for woodpeckers and other wood-probing species. We should expect healthy populations of flickers and pileated, hairy, and downy woodpeckers. Flycatchers may cash in on a plethora of aerial insects emerging from the pulpy windfall. As always, jays will thrive.

But perhaps the truest prediction we can make is that the effects of the fire will be multifarious. For example, surely large numbers of bats, sequestered under bark or within park buildings, were consumed by the flames. At the same time, the number of snags left standing, and the insects they will generate, provide future habitat for future colonies. The loss of understory thickets will exclude large numbers of wrens and woodrats for a few years, but species that thrive on the plants that colonize disturbed areas — butterflies, goldfinches, and siskins — will likely proliferate. Like all events in nature, there are those who benefit and those who suffer, but over the long view, all niches will be filled.

Anecdotes

Some anecdotes from the fire are worth telling. Here's a brief collection.

▮ Naturalist Rich Stallcup found a covey of quail foraging in Muddy Hollow shortly after the fire. He noticed they were mostly adults, suggesting that juveniles, perhaps, suffered higher mortality. Some of the males had their top knots singed off.

▮ At the top of Inverness Ridge, we walked along the Bayview Trail, through the highest intensity area of the burn. The soil was still smoldering as we collected soil samples for analysis. Standing in the silent forest, I was surprised to hear a sharp "chip." Nearby, within ten feet, a chipmunk balanced on a charry limb, chattering and tail flicking. We guessed he had been attracted by our voices, a sign of life in a silent forest. Where had he survived the firestorm?

▮ Just five days after the fire, the pond at Muddy Hollow hosted about 800 waterfowl, foraging and swimming, apparently oblivious to the devastation of the hillsides surrounding them. Interestingly, after the rains commenced, the waters clouded up with ashy silt and the birds, probably unable to find food in the cloudy water, disappeared. What affect might that silt have on the red-legged frogs and California newts that breed here?

▮ Within the first week, people were reporting green root sprouts around the base of coyote brush, toyon, and elderberry. Within the second week, the first green fronds were reaching out of scorched fern burls.

▮ Mid-March, and five months have passed since the fire. The winter has been generous — rainfall above average. Rich Stallcup and I walk from Limantour down toward Laguna Canyon. Flowers are well into bloom — paintbrush, hairy star tulip, lupine, marsh monkey flower. We find some frittilary on a dry slope, the succulent stem in odd contrast to the parched earth. Three black-tailed deer — a female and two grown does — watch us from the hillside. In the riparian thicket, the alders are in full leaf; we see a pair of

Wilson's warblers in an aerial territorial feud. An orange-crowned warbler sings from deep in the thicket. Other signs of life — racoon tracks, a salamander under a rock, fresh woodpecker borings, an owl feather on the trail. Where the bridge crosses the creek, a pair of red-legged frogs stare at us with golden eyes unblinking. On the hillside above, wildflowers — *Castilleja, Calacortis, Fritillaria* — with names nearly as beautiful as their showy inflorescence, have broken through the charry soil. A hummingbird hovers at a scarlet paintbrush, sipping its nectar with quiet intensity. The sun, breaking through the cloud cover, flashes of his throat in a fiery crimson blaze. ■

References

[1] DOI BAER Team, North Zone. 1995. Mount Vision Fire Incident: Burned Area Emergency Rehabilitation (BAER) Plan.

[2] R.E. Martin. 1984. Fire history and post-fire stand dynamics of the Inverness bishop pine at Point Reyes National Seashore. unpubl. rpt. to the National Park Service.

[3] Stallcup, R. 1995. "Fire in birdland" Observer 105, Fall 1995. Point Reyes Bird Observatory

[4] Thalman, S. B. 1993. The Coast Miwok Indians of the Point Reyes Area. Point Reyes National Seashore Association.

Where fire comes from

by Jules Evens

(ADAPTED FROM DAWN OF THE WORLD: MYTH AND TALES OF THE MIWOK INDIANS OF CALIFORNIA.)

In the early days, the only fire anyone knew about was kept by Starwoman, who lived near an elderberry brake to the East, beyond the Great Valley. She kept her bright treasure in a box she had carved from the burl of a buckeye tree.

In those days it was cold and dreary here near the coast. Coyote decided to remedy that situation, so one day he sent little Hummingbird out to steal the fire from Starwoman. Hummingbird flew in a quick straight line right to the elderberry brake and found Starwoman guarding her fire box. He perched in the branches above her camp waiting for an opportunity to steal an ember. Starwoman, dressed in a bark skirt and bunchgrass blouse, was busy straightening up her camp. As Hummingbird watched her movements, he couldn't help but notice a resemblance between Starwoman and Old Man Coyote — maybe it was the hunched shoulders, or the smirkish smile. Hummingbird wasn't sure and didn't spend much thought on the problem; he had a task to complete. Finally, Hummingbird was rewarded for his attention. Starwoman eventually cracked open the box to check on her fire. Just at that moment, Hummingbird darted down from his perch and stole a spark of fire. He tucked it under his throat and flew directly back home. When he arrived at the coast, Coyote was nowhere to be found, so Hummingbird stashed the fire in the buckeye tree.

The Hoo'-koo-e'-ko, who used to live along these shores, always went to the buckeye tree when they wanted fire. The dried sticks turned easily to ember after a little rubbing. The Hoo'-koo-e'-ko are no longer here — they have followed the East wind, the path of ghosts, out to the Farallones. But fire is here to stay. Even today you can see the blaze on Hummingbird's throat. ■

Appendix 5 :: Suggested Resources

■ THE FOLLOWING IS A PARTIAL LIST OF RESOURCES — telephone numbers of consultants and workers, kinds of materials to use (and, in some cases, where to obtain them) — offered with the intention of helping residents of Inverness Ridge communities in rebuilding and reforesting. We have attempted to provide a comprehensive list, and to include all local resources and providers, but recognize that this directory is incomplete. Our apologies to anyone we may have inadvertently left out.

BUILDING MATERIALS

Hardishake and Hardisiding: Mead Clark, Santa Rosa • (800) 952-8627
Pacific States Plywood, San Rafael • (415) 454-5450
Golden State Lumber, San Rafael • (415) 454-2532

Hardi-shake/HardiPlank: Non-combustible wood-looking assemblies for roofing or siding. Company also has wood-looking window framing assemblies.

REMCO 1077 East Shore Highway, Berkeley, CA 9471 • (510) 528-6130 • Sales Representative: John Capazello (415) 708-4713

Scotchtint Glass by 3M

PryroPlastic: Provides water-proofing and has both an A and B rating depending on the substrate application. Durable, clear fire retardant, not affected by acids or salts. Not UV stable, and will discolor with strong light unless titanium white is used as a paint base or UV stabilizers are added. Listed as non-toxic.

PryrolPlus: Intumescent fire retardant coating for use on wood, as well as corrugated paper, aluminum, certain plastics, and portions of upholstery. Approved by the California Fire Marshal; passed a standard flame spread test. Listed as non-toxic. May allow use of natural-color wood as an exterior.

Fire and Thermal Protection Engineers, Inc. P.O. Box 568, Petersburg, Indiana 47567 • (812) 354-8166 • fax (812) 354-2547

F.R. 101: Clear fire retardant that is applied to wood, carpet, paper, corrugated cardborad, and fabrics (except nylon). Has consistency of water, applied via spray (even a hand-held spray bottle). Provides a Class A fire retardancy, and is approved by the California Fire Marshal. Passed standard flame spread tests. Needs to be covered with a waterproofing agent when used as an exterior treatment. May allow use of natural-color wood as an exterior. Listed as non-toxic.

SOURCE: New Age Technologies, Inc., P.O. Box 1079, Bristol, PA 19007 • (215) 788-3223 • fax (215) 788-3365 • orders (800) 801-7074

SEED: Le Ballister's • (707) 526-6733
Larner Seeds • (415) 868-9407
Harmony Farm Supply • (707) 823-9125
Albright Seed Company • (800) 423-8112
Pacific Coast Seed • (510) 463-1188
Ramsey Seed • (800) 325-4621

RESOURCE PEOPLE — **Landscape Designers & contractors:**

Gray, Karen 663-9449
Gradjansky, Peter 663-8[illegible]69
Heron, Marsha 663-1312
Livingston, Penny 663-9[illegible]39
Stein, Nancy 663-8851

Arborists:

Alexander Treecare 868-0428
Bauer, Matt........... 663-8013
Kent, Tom............ 669-1604
Pacific Slope 868-0380
Whitney, Nick......... 663-1572

Gardeners:

Aranjo, Christina 663-1934
Octobre, Jimmy 663-1662
Paton, Robert 663-8324
Shine, Nancy 669-7442
Storch, Suzanne 663-9338
Sue Taylor 663-5411
Whitney, Elan 663-1572

Maintenance:

Arnold, Brian 663-8306
Aucoin, John 663-1591
Gutierrez, Hector 663-1471
Gutierrez, Ismeal 663-9035
Gutierrez, Sergio ...(707) 778-3721
Padilla, Felipe .....(707) 765-6977

Milling trees into lumber: Since the fire, various local milling operations have appeared. Bishop pine and Douglas fir can be milled on site and there is also some eucalyptus, cypress and other wood available.

Dave Downing 663-1642
Nick Whitney 663-1572
Merle Reueser..... (707) 538-8841
Scott Hunter 662-2472
Mark Miller........... 663-9533

Nurseries:

Cottage Garden Growers, Petaluma .. (707) 778-8025
Darlings, Penngrove............... (707) 664-0350
Flower Power, Point Reyes Station......... 663-8221
Greenpoint, Novato.................... 892-2442
Las Baulines, Bolinas.................... 868-0808
Mostly Natives, Tomales .... (707) 878-2009
Natural Gardener, San Anselmo 456-5060
O'Donnells, Fairfax.................... 453-0372
Sloat, Kentfield 454-0262
Novato............................ 897-2169
Sunnyside, San Anselmo 453-2701
Urban Tree Farm, Fulton........... (707) 544-4446
West End, San Rafael 454-4175
Yardbirds, San Rafael 457-5880

Landscape Supplies (rock, mulch, topsoil, etc.):

American Soil Products 456-1381
Harmony Farm, Graton .... (707) 823-9125
Grab N Grow .... (707) 575-7275
Marin Landscape Material............... 897-1337
Shamrock 456-2552
Rich Readimix........................ 663-1038
Toby's Feed Barn 663-1223
Sprinkler Irrigation Specialists 897-1171
Watersavers Irrigation 454-6581

Building Contractors:

Arndt, Pat 663-1365
Arndt, Robert 663-1181
Arrow (Bill Bailey)....... 669-7573
Carlson, Richard........ 663-9428
Cove Construction
(Bob Cain) 453-0515
Davis, Ben 669-1201
Gadow, Bob 663-1240
Graveson, Tim.......... 669-7235
Hollern, Pat 663-8729
Korhummel, Paul 663-9148
Levis, A.J. 663-8636
Livingston, Marshall 669-1133
Long, Jeff......... (707) 769-0675
Mann, Jeff............. 663-8332
Matthews, Jack 669-1249
Moore, Tony 663-1105
Nelson's Woodworks 663-8192
Plant, Richard 669-1345
PD associates........... 663-1233
Pollard, Doug 663-9231
Ritter, John 669-1632
Rodoni, Dennis......... 663-9223
Smith, Barry 663-8025
Telford, Jeffrey .... (pager) 679-2037
Wallace, Wendy......... 663-1063
White, T.R. 663-1550
Wingate, Seth 663-8216

Appendix 6 :: About the Phoenix Team

■ PRESENTED HERE ARE INTRODUCTIONS TO THE FOUR EXPERTS who made up the Phoenix Team of Environmental Action Committee of West Marin.

Laurel Collins is a consulting geomorphologist. She received her undergraduate degree in 1981 from the Department of Geology and Geophysics at the University of California at Berkeley. She has worked on numerous research projects with the U.S. Department of Justice, U.S. Geological Survey, U.S. Forest Service, California Department of Forestry, Lawrence Berkeley National Laboratory, and U.C. Berkeley. Laurel has also served as District Geologist for the East Bay Regional Parks, during which time she mapped landslides along the urban/wildland interface and developed policy for fuelbreak and landslide management. Some of her local research publications concerning hillside and fluvial processes include the effects of the 1982 storm in the Santa Cruz Mountains and San Lorenzo River; hydrology and geomorphology of tidal marshes in the San Francisco Estuary; managing geological hazards in the Regional Parks; and assessing runoff, erosion, and effectiveness of erosion control after the Oakland Hills Firestorm. As part of the research funded by the Marin Community Foundation through Environmental Action Committee of West Marin, Laurel is presently studying the effect of fire on stream flow and hillside erosion in portions of Inverness and the Point Reyes National Seashore.

Tom Gaman is a California registered forester who lives in Inverness. He holds degrees in forestry from the University of California at Berkeley and Yale University. His business, East-West Forestry Associates, is under contract with the U.S. Forest Service Remote Sensing Lab, monitoring the vegetation, wildlife habitat, and forest fuels accumulation on National Forest lands. In addition, Tom has been involved for 20 years in management and assessment of urban forests and of private lands, developing Geographic Information System databases. He is a member of the California Urban Forests Advisory Council (which advises California Department of Forestry) and is an active volunteer working with local youth and Mexican exchange students through Partners of the Americas.

Ray Moritz is an urban forester and fire ecologist. He studied biological science at the University of Chicago and forestry at the University of Minnesota, where his undergraduate program was in silviculture (forest culture) / ecology. Ray's graduate program was in forest ecology with a specialization in fire ecology. His academic research produced the vegetation management program for 33,000 acres of declining pine and boreal forest where fire exclusion had resulted in the forest's failure to reproduce itself.Ray has lived and worked in West Marin for 16 years, developing extensive expertise in the pine, fir and hardwood forests of the of the Inverness Ridge. He was a consultant on the Marin Municipal Water District / MCOSD "Mount Tamalpais Area Vegetation Management Plan."

Carol Rice is proprietor of Wildland Resource Management, a consulting firm specializing in fire protection in the wildland/urban interface, and Ms. Rice has been involved in this arena for 18 years. Projects in which she has played a major role include baseline studies of the Mount Tamalpais area and a subsequent vegetation and fire management plan; a regional vegetation management plan for the East Bay Hills; a planning guide for San Mateo County's wildland/urban interface; and several fire hazard reduction programs. She conducts varied investigations of fire behavior and effects, is a frequent lecturer on these subjects, and has written over 35 technical reports and publications (including a chapter on fire ecology in the State Fire Marshal's textbook). Ms. Rice holds a bachelor of science in forestry and a master of science in fire science and management, both from the department of forestry and resource management at the University of California at Berkeley. She is a present or past officer of professional organizations including Fire Working Groups for the National Society of American Foresters.

Appendix 7 :: Sample Data Form

■ This is the two-sided form used in the field by members of the Phoenix Team while assessing neighborhood units in the Vision Fire zone of Inverness Ridge.

Neighborhood No: ______

R.U. #'s: ______________________________

Addresses: ______________________________

SITE FEATURES:

1. Aspect: __________ 2. Slope: __________

2. Topographic Features: ______________________________

____

____

3. Burned ❑ Crowning Fire ❑

Intensity: L❑ M❑ H❑ E❑

Fuel Consumption: L❑ M❑ H❑ E❑

VEGETATION FEATURES:

Overstory:

4. Prior Forest Type: ______________________________

5. % Cover:
- ❑ Sparse (0 - 25%)
- ❑ Poor (26 - 40%)
- ❑ Normal (41 - 60%)
- ❑ Good (61 - 100%)

6. Height: ________

7. % Mortality (Crown): ______________________________

8. Regeneration Type: ______________________________

9. Future Successional Trend: ______________________________

____

10. Management recommendations:

____

____

____

____

Understory:

11. Prior Understory Type: ______________________________

12. Prior Cover:
- ❑ Sparse (0 - 25%)
- ❑ Poor (26 - 40%)
- ❑ Normal (41 - 60%)
- ❑ Good (61 - 100%)

13. % Mortality (Crown): ______________________________

14. % Resprout Species: _____, ______________

15. Exotics Problem: ______________________________

16. Existing Treatments:

❑ Seeded ❑ Mulched ❑ Removed

❑ Other: ______________________________

17. Development Density: L❑ M❑ H❑

18. Encroachment: ______________________________

____

____

____

____

19. Management recommendations:

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____

____

20. Fuel Type:

Prior: ________________ Rating: ______
1996: ________________ Rating: ______
03 yrs: ______________ Rating: ______
10 yrs: ______________ Rating: ______
30 yrs: ______________ Rating: ______

21. Access: Road: _________ Drive: ________

22. Fire Flow / Water Availability: ___________

23. Topographic Location: ________________
____

24. Critical Fire Features: ________________
____
____
____

25. Defensible Space:______ X______X______

26. Defensible Space Fire Hazard Mitigation:

1996 ________________________________
____
____
____
____
____
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____
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____

1 to 03 yrs:__________________________
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____
____
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____

4 to 10 yrs: __________________________
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____

27. Road Mitigation (Fire Apparatus Clear Zone): ____________________________

1996:________________________________
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1 to 3 yrs: __________________________
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____

4 to 10 yrs:__________________________
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28. Wildland / Watershed Mitigation:
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Appendix 8 :: Hazard and Fuel Rating Scales

■ THESE ARE THE SCALES USED BY MARIN COUNTY FIRE DEPARTMENT and the Phoenix Team in rating fire hazard in a given forest/fuel type. The type of plant community and steepness of slope are among the factors entered into these assessments. On this page, under Hazard Points, a value of 1-9 is possible in each of five categories (which include three fuel modification zones). The sum of these five values equals the total fire hazard rating assigned, for instance, to forest types and Neighborhood Units in this report. It also indicates how much area around structures is needed for defensible space, as shown under Hazard Scale below. On page 83, the 1-9 point rating system for fuel types used by Marin County Fire Department is explained.

HAZARD MATRIX

Hazard Points	1	2	3	4	5	6	7	8	9
ASPECT	NE	NW	SE	SW					
SLOPE %	"Level"	3 - 10		11 - 20		21 - 30		31 Plus	
FUEL 0 - 30 FT	Domestic garden	Fire-resistant hardwood	Short grass & savanna	Tall grass & savanna	Brush	Short needle conifer	Chaparral	Pyrophytic hardwoods & Pine	Conifer with under-growth
FUEL 31 - 50 FT	Fire-resistant hardwood	Short grass & savanna	Tall grass & savanna	Brush	Short needle conifer	Chaparral	Pyrophytic hardwoods & Pine	Conifer with under-growth	
FUEL 51 - 100 FT	Tall grass & savanna	Brush	Short needle conifer	Chaparral	Pyrophytic hardwoods & Pine	Conifer with under-growth			

Hazard Scale

1 2 3 4 5 6 7 8 | 9 10 11 12 13 14 15 16 | 17 18 19 20 21 22 23 | 24 25 25+

30 X 30 X 30 FT | 30 X 30 X 50 FT | 30 X 50 X 100 FT | 50 X 50 X 100+

FUEL TYPE AND FIRE MODELS

Type	NFDRS[1]	NFFL[2]	Description	Fire Behavior
Domestic Garden **1**	*Not defined*	*Not defined*	Highly maintained and often irrigated. No dry grass Plants have adequate moisture and in good condition Shrubs and trees are separated, thinned and deadwooded Vertical and horizontal fuel continuities interrupted	Low intensity and rate of spread Exposures are easily defended with minimal resources: one engine company. Typically provides 'defensible space'
Fire Resistant Hardwood **2**	R	9	Mainly deciduous hardwoods Includes streamside types Minor component of conifers or pyrophytic hardwoods	Fire mainly in litter layer; slow rates of spread May torch out trees in spots where dead and down material is heavy (branding and spotting)
Short Grass **3**	A	1	Annual grasses and herbs dominate Brush and tree reproduction less than one third of area Quantity and continuity varies greatly from year to year	Rapid spread when cured but low intensity Slow rates of spread when still green Affected greatly by wind and slope
Savanna **3** or **4**	C	2	Open, sparse stands of hardwoods / conifers with grass and herbs as the predominant ground fuels Brush, shrubs and trees cover less than two thirds area Assign to fuel type that carries the fire type 3, or 4	Rate spread affected by wind and slope Behavior reflects the fuel that carries the fire Some torching out of trees (branding and spotting)
Tall Grass **4**	L	3	Grass greater than knee high. Heavier loading than type 3 Shrubs and trees less than one third area	Rapid spread due to wind and slope Highest intensity of grass types Can be very dangerous to suppression crews
Brush **5**	F	5	Brush sparse or less than 4 ft. tall Young closed stands of mixed, hard chaparral included Also less flammable shrubs, "soft chaparral" Less deadwood than type 7, light litter layer	Moderate rate of spread and intensity Grass component may increase rate of spread Strong winds can greatly exacerbate fire behavior and frustrate suppression efforts
Short Needle Conifer **6**	H	6	Closed canopy of high crown, healthy trees May have minor hardwood component Litter is compact: needles, leaves and some twigs	Slow burning surface fires with short flame lengths Occasional torching in heavy fuel concentrations Infrequent crown fires, hard to suppress
Chaparral Brush >4ft **7**	B	4	Dense, tall brush more than 4 ft. tall and typically more than thirty years old California mixed, hard chaparral Secondary crown layer of dead material May have deep litter layer	High to extreme rate of spread in strong winds High to very high intensity May be very difficult to suppress Deep fire front
Pyrophytic Hardwood **8**	O	7	Composed of highly flammable, broadleaf species Foliage is flammable when green and very flammable when water-stressed Understory is heavy brush, reproduction, or litter	Crowning and branding / spotting common; rapid spread Extreme intensity May have extreme flame length Very difficult to suppress
Pine **8**	U	8	Mature closed canopy with compacted litter layer, some small branchwood Grass and shrubs are precluded by dense shade Low branches are shaded out	With moderate fire weather, slow-moderate ground fires easily extinguished Dangerous in high to extreme fire weather Infrequent crown fires (very hard to suppress)
Conifer with Undergrowth **9**	G	10	Conifers and mixed evergreens with heavy brush, young trees or heavy accumulation of dead material Douglas fir type which has invaded and topped brush or other trees Common in old, urban conifer types	Extremely hard to suppress Extreme to explosive intensity in high fire weather Branding / spotting is major component of spread
Urban Complex *(not a specific fuel type)*	*Not defined*	*Not defined*	Flammable structures mixed with heavy flammable forest with dense understories Fuels highly variable and interrupted by linear non-flammable surfaces Structures a major fuel component	Controllable in moderate to high fire weather Extreme behavior in high to extreme fire weather Exhibits extreme rates of spread and intensities Fire may linger at structures and tie-up suppression efforts as the landscape fire progresses

1. NFDR: *National Fire Danger Rating Systems.* 2. NFFL: *National Forest Fire Laboratory*

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